

VOLUME II

Varsity Team Program Features

For Varsity Scout Teams and Venture Patrols



BOY SCOUTS



OF AMERICA®

VARSITY TEAM PROGRAM FEATURES VOLUME II

For Varsity Scout Teams and Venture Patrols

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Cycling
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Fishing

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Soccer
Softball
Survival
Swimming
Tennis
Triathlon
Volleyball
Waterskiing
Whitewater Canoeing

PLANNING THE VARSITY SCOUT PROGRAM

An exciting Varsity Scout program does not just happen. It takes careful planning. The three volumes of *Varsity Scout Program Features* are essential in providing program ideas and in offering basic instruction in 27 different sports and high-adventure activities. Each program feature offers conditioning, training, and basic instruction that will progress the team to a proficient skill level over a three-month period.

The following pages outline the steps in successful program planning. The three volumes of program features and copies of the *Varsity Scout Guidebook* should provide all the tools you will need to plan a successful year for your Varsity Scout team.

A crucial ingredient to program planning is the annual program planning clinic, which is outlined in chapter 15 of the *Varsity Scout Guidebook*. The six steps in this section will also be helpful in effective program planning.

Once the leadership team has selected the program features for the new year, the team must then incorporate all five fields of emphasis into each program feature. Ideas are listed at the beginning of each program feature, and you are limited only by your imagination for other ideas. It is the responsibility of each program manager to make sure his field of emphasis is planned and carried out.

Upon completion of a program feature, team members may be awarded an activity pin to acknowledge their achievement, as well as the Varsity Scout letter or bar.

STEP 1: PREPARATION

Prior to conducting the team's annual program planning clinic, determine the resources available to the team.

- The physical facilities of your chartered organization and community that can be utilized
- The talents of the Varsity Scout parents
- The community resources available to the team such as sports leagues and outdoor facilities

If not already done, you will need to:

- Elect or appoint the team captain.
- Appoint program managers.
- Elect squad leaders.
- Gather calendars for schools, religious organizations, community holidays, and council and district Scouting activities. Do not forget personal dates and holidays.
- Conduct a Varsity Scout Team Resource Survey.
- Set the date and location for the team's annual program planning clinic.

STEP 2: CONDUCT THE TEAM'S ANNUAL PLANNING CLINIC

Chapter 15 of the *Varsity Scout Guidebook* is devoted to the planning the team program. This should be a fun, team-building experience that will set the tone for the new year, and a high expectation of exciting things to come.

STEP 3: SHARE THE PLAN

The team's annual program is presented to the team committee for its approval and support. The team committee chair assigns responsibilities to committee members who are program advisers to provide support to the program managers of the five fields of emphasis. If for some reason the committee cannot provide the needed support for an activity, outside resources should be considered and secured.

After receiving the team committee approval, with any modifications necessary, the team's annual program is published and provided to Scouts, families, and the chartered organization.

It is recommended that a parent's night be held to outline the team's annual program of events.

STEP 4: QUARTERLY PROGRAM DETAILING

- On a quarterly basis, the team leaders meet to detail the upcoming quarter.
- The Coach and captain develop the agenda for this meeting.
- The captain conducts the meeting with assistance from the Coach.
- Specific assignments are given to each program manager.
- A description of activities for the next quarter is entered on an activity worksheet. Program managers note specific assignments involving them. They request specific help from team members and the program adviser.

STEP 5: MONTHLY PROGRAM DETAILING

- The Coach, captain, program managers, and squad leaders meet on a monthly basis to finalize the coming month's meeting.
- The Coach and captain develop the agenda for this meeting.
- Activity worksheets are completed.
- Program managers verify that everything is ready for the month's activity.

STEP 6: WEEKLY CHECKUP

Two or three days prior to the meeting, the Coach or captain should check with each program manager for last-minute assistance.

By following these planning steps, the Varsity Scout program will be well-received by the youth members. Be sure to include all five program fields of emphasis during each quarter. The team committee should devote a portion of the monthly meeting to securing committee member support for the team program and program managers.

Varsity Scout Team Activity Planning Worksheet

Activity: _____ Program manager _____

Team committee member/consultant _____

Place: _____ Date: _____

Team captain's comments: _____

Follow-up: _____

(Filled in by program manager)

Plan the activity. (Meet with your team committee member/consultant; make the plan.)

What needs to be accomplished? _____

Identify needs and resources.

Equipment and facilities needed _____

Determine payment plan for team members. _____

Number of people required _____

Task to Be Done

Assigned To

Follow-up. At additional meetings and through personal contacts, follow up on all assignments until you are sure that everything is ready. If the going gets rough, call on your Coach for help.

Carry out the plan. Just before the activity, double-check all arrangements. Conduct the activity to the best of your ability, using your supervisor as a resource.

Inform others. Give a copy of the plan to the team captain, program manager, team committee member, and Coach.

Varsity Scout Team Meeting Plan Worksheet

Feature _____

Meeting location _____

Date _____ Time _____

Activity	Description	Person Responsible	Time
Warm-up (Preopening) <ul style="list-style-type: none"> • Early arrival activity • Set up meeting room 			
Opening <ul style="list-style-type: none"> • Ceremony or song • Welcome • Announcements 			
Team Business <ul style="list-style-type: none"> • Reports • Assignments • High Adventure/Sports • Service • Personal Development • Special Programs and Events • Squad events • Other reports 			
Skills Instruction <ul style="list-style-type: none"> • Squad meetings • Advancement work • Practice time • Guest specialist/consultant • Contest or game • Special activity 			
Closing <ul style="list-style-type: none"> • Coach's Corner • Quiet song • Closing ceremony 			
Wrap-up <ul style="list-style-type: none"> • Evaluate meeting • Cleanup 			

Annual Varsity Scout Team Planning Chart

Quarter	Program Feature	Advancement	High Adventure/ Sports	Personal Development	Service	Special Programs and Events
1st September October November						
2nd December January February						
3rd March April May						
4th June July August						

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FREESTYLE BIKING

BACKGROUND



Freestyle biking has always been a popular activity for young people. Ride down any street in America and you will see all types of makeshift ramps. Made of boards and bricks, these ramps are used to jump into the air while riding a bike.

The sport began many years ago in Europe and was known as “artistic cycling.” A little more than 20 years ago an American youth revived the sport, somewhat as a fad.

Freestyle biking is defined as gymnastics on bicycles. The rider uses tremendous balance and skill in performing intricate maneuvers on level ground and on ramps.

The Varsity Scout team can use the Freestyle Biking program feature to learn the basics of the sport. This program feature covers the BMX bike, safety equipment, construction of courses and ramps, freestyle tricks, and competitions.

The American Freestyle Association and the American Bicycle Association sponsor and conduct competitions nationally for amateur and professional riders. Some professionals earn in excess of \$100,000 annually.

The Varsity Scout team can enjoy learning the sport and staging events for themselves and other teams interested in freestyle biking.

PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with help from a team committee.

ADVANCEMENT

- Review each Varsity Scout’s advancement status.
- Conduct a Cycling merit badge clinic.
- Monitor the team advancement chart regularly.

HIGH ADVENTURE/SPORTS

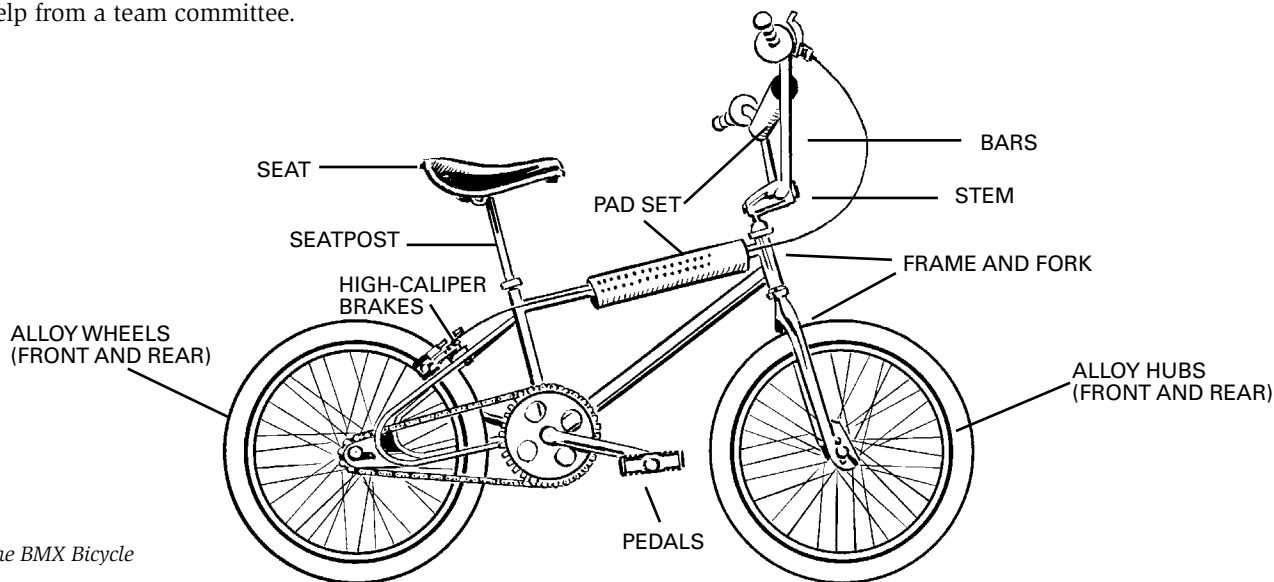
- Program manager outlines or updates the team’s annual special high-adventure event (Philmont, Florida Sea Base, etc.).
- Plan and conduct a freestyle routine.

PERSONAL DEVELOPMENT

- Coordinate a “Drugs: A Deadly Game” presentation for the team.
- Invite a sports medicine expert to present a program on sports-related injuries.
- Videotape practice sessions to provide self-evaluation for riders.
- Invite an expert to demonstrate the proper care and maintenance of a freestyle bike.

SERVICE

- Conduct a bicycle fix-up day for young children in your community.
- Have a cleanup day for your chartered organization.
- Have team members keep a record of Good Turns they do on their own.
- Build a basic wedge ramp or a quarter-pipe ramp.



The BMX Bicycle

SPECIAL PROGRAM AND EVENTS

- Visit a bike shop.
- Conduct a fun bike ride with another team.
- Participate in a local council or district event.

SAFETY EQUIPMENT

Freestyle biking is a fun but potentially dangerous activity. At no time should a rider practice or perform tricks without wearing full safety equipment, which consists of helmet, elbow pads, knee pads, gloves, and high-top shoes. Optional safety gear includes mouth guard, shin guards, leathers (padded pants), and chest and back protectors.

Even when proper safety gear is worn, injuries are still possible. A trick should never be attempted until the basic skills have been mastered. Remember: professional freestylers have spent years perfecting their techniques. They began with simpler tricks and progressed gradually to the spectacular high-flying stunts. *Never attempt a trick for which you are not properly trained and that is beyond your abilities.*



RAMPS

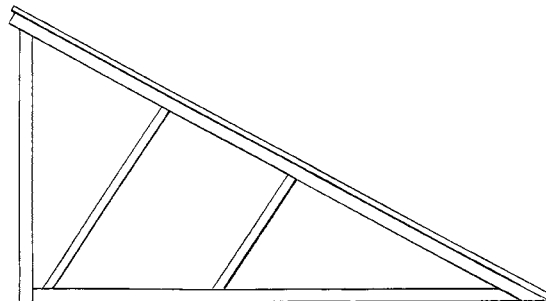
Many Varsity Scout teams will want to construct their own wedge and quarter-pipe ramps. Construction plans have been provided at the end of this program feature, and a few helpful hints are discussed below.

The initial consideration in constructing your own ramp is its location. You should first determine the amount of yard area the ramp will cover, as well as the height of the structure. Review any local ordinances and regulations that might apply and determine whether you will need a building permit. Discuss your plans with your neighbors and obtain their approval. Be considerate to them and remember that they will not want to deal with extended night sessions, trash, loud music, or excessive noise. Find out what they can tolerate.

Here are a few hints:

- To keep your ramp from being unsightly, paint it a pleasing color. Paneling around the sides and back of the ramp may also be attractive.
- To keep ramp noise to a minimum, pack foam rubber, plastic foam, or insulation in the back between the support braces.
- Keep a trash receptacle nearby at all times.
- Establish a time schedule for ramp operation, and avoid using the ramp at night.
- If music is played, keep the volume low.

Because of possible liability, restrict the use of your ramp to team members and their invited guests. Make sure that all ramp use is supervised by adult Scout leaders or your recruited instructors.



Basic wedge ramp

FREESTYLE TRICKS

There are two basic types of freestyle tricks: flatland and ramp. Examples of both types are shown in this section.



DECADE

Ride at a moderate speed with your right foot on the top tube, and do a small front-brake endo. As the back tire touches down, pull the back brake. When the front wheel leaves the ground, jump around the head tube (push off on the seatpost with your right foot). As you come around, land on the top tube. Drop your feet to the pedals and ride out.



MIAMI HOPPER

Ride forward at a moderate speed. Bring your right hand to the seat, grab the front brake with your left hand, and quickly turn the bars 90 degrees. Pull the bike up with the seat and slowly ease it forward until the right grip touches the ground. Balance at this point for as long as you want. Try to keep your weight centered over the bike with the rear tire between your knees. When you are ready to ride out, pull the bike up with the seat and grip. As the bike starts going down, turn the bars straight, grab the other grip, and ride away.



LAWN MOWER

Roll forward at a moderate speed with both feet on the rear pegs (or stays). Do a small front endo. When the rear wheel touches the ground, lock the back brake and release the left grip. Spin the bars 180 degrees to the right. Bring the right foot over the tire and counterbalance with your right foot against the seat.



ONE-HANDER

Begin with a normal air move. As you leave the ramp, lock the back brake. Before you peak, take your hand off of the grip. As you peak, your arm should be fully extended. After you have peaked, move your hand back to the grip as soon as possible. Landing without your hand on the grip could be painful.



STUBBLE DUCK

Locking levers are a must for this trick. Lock the rear lever and do a normal lawnmower move, pulling your right leg over, as with a cancan. Bring the right grip behind your back and grab it with your left hand while pulling the bike around you. As it comes around, put your right foot back on the pedal and find the right grip with your right hand. Turn the bars back around and ride out.



CANCAN LOOKBACK

Ride up the transition fairly fast. You'll want a lot of hang time to pull this one off. The trick is to bring your leg over at the same time you turn the bars. As you do this, snap your bike around with your hips. Grab your rear brake. You should get fully extended at maximum altitude. Now bring your leg over as you turn the bars. This way you twist your body and bike back all in one motion. You should have your foot back to the pedal and your bars turned straight.



FLIPPER

Ride toward the ramp at slow speed, choosing a point at the bottom of the transition. When you get to the point you have chosen, pull the front brakes and go into a front-wheel 360. Pull the back end all the way around. As it finishes the spin, release the front brake. Let the momentum carry you backward into a rollback, and then tap the back brake and do a rear-wheel 180, then ride away.



FOOTPLANT

As you approach the lip, set your pedals with the right one down. Watch the lip as you hit the transition. Plant your foot as close to the top as possible. As the bike shoots off the lip, bring all your weight onto your left foot and lean in toward the ramp. Let the speed carry the bike all the way up. As it comes around, pivot on your left foot and guide the bike down with your arms. Try to lean the bike as close to the lip as you can without hanging either wheel. Bring the bike in straight, and as it touches down, bring your left foot to the pedal.



ABUBACA

Ride up the face of the ramp as if you were going for a pop-out. As you leave the ramp, pop straight out and land on your front tire with the front brakes on. Start hopping on your front wheel. Continue hopping back toward the coping. As you get your front wheel back to the coping, prepare to drop in. Start hopping and go into a rollback down the face of the ramp. You may have to hop to keep your front wheel from hanging up.

STEPS FOR STAGING A COMPETITION

BEFORE THE COMPETITION

1. Hold a meeting to plan recruitment of youth and adult volunteers. Include in your recruitment:
 - a. Gate and admission control—one or two people
 - b. Rider registration—one or two people
 - c. Concession workers (if needed)
 - d. Nurse, EMT, or doctor (Keep in mind that trained medical personnel may charge fees.)
 - e. Announcer/emcee
 - f. Statisticians—one or two
 - g. Judges—five
 - h. Practice monitors—one or two
 - i. Timekeeper—one
 - j. Public address (PA) system operator—one
 - k. Stage supervisor—one
2. Determine the date of the event and whether it will have an outdoor or indoor location. Obtain the proper permits and insurance papers. A few suggestions for possible locations are:
 - a. The closed-off parking lot of the chartered organization
 - b. An outdoor basketball court
 - c. An armory
 - d. An airplane hangar
 - e. The local gymnasium
 - f. An ice rink (drained)
 - g. A warehouse
 - h. A local conference center
 - i. A church hall
3. Secure the necessary materials:
 - a. Sponsor guide
 - b. PA system (megaphone, amplifier, or hot air) with tape player

- c. Cones or rope and stanchions
 - d. Tables
 - e. Calculator, paper clips, pens, paper, etc.
 - f. Quarter-pipe ramp (not recommended on the local level)
 - g. Kick-turn ramp (not recommended on the local level)
 - h. Extension cords
 - i. Registration and tally forms
 - j. Trophies or prizes
 - k. Number cards or score pad and markers
4. Advertise. (See flier example.)

THE BIG DAY

1. Arrive at the site early to set up, decorate the arena with banners, etc.
2. Make sure that all work locations are staffed before opening the doors to riders and spectators.
3. To avoid confusion, have spectators check in through one door or location and riders check in and register through another.
4. Be sure riders know where they may practice outside of the actual performance area. Do not allow unsupervised riding in the performance area.
5. With one or two volunteer monitors, allow up to five riders at a time to practice in the performance area. Give them 3 minutes to practice. Be sure all safety requirements are observed. Suggestion: Have the adult monitors briefly check bikes for safety violations as they are admitted to the practice session.
6. Begin the event on time by ending the practice session and registration about 15 minutes before the start of the competition.
7. Introduce yourself, the judges, the sponsors, and other notables.
8. With everyone in place, announce your first division lineup.
9. The staging supervisor makes sure the participants remain in order so that each rider is ready to go when called. To help identify each rider, type number plates may be used. Numbers corresponding to the rider lineup may be written on the blank surfaces of these plates. Markers and plate surfaces

should be washable for repeated use. These may be purchased by the riders or by the local unit for the riders' use.

10. The rider gives the cued cassette tape to the PA operator.
11. The PA operator begins the music when the rider gives the signal. The timer begins timing when the music starts.
12. It is recommended that no announcing be done during runs. The emcee must take care not to influence the crowd and the judges to particular riders. Try to be consistent for everyone. Be positive!
13. The emcee announces first the 30-second warning, and then the five-second warning. Follow the run with positive comments.
14. The emcee may announce scores but not the average or standing results until the end of the competition. To save time in larger competitions, the emcee may wish not to announce the scores of each rider. Posting scores at the completion of a division will help keep the riders informed. Judges may use scoring number cards or pads and magic markers to pass scores to the statistician, who averages the scores immediately after each rider's routine.
15. The competition continues in this fashion until each class or division is completed. A break may be taken once a complete class or division is finished. (Never break or change judges during a division run.)
16. Additional monitored practice or demonstrations may be conducted during breaks.
17. Announce the winners and award prizes to third-, second-, and first-place winners.
18. Thank the necessary people.
19. Clean up.

LOCAL COMPETITIONS

Small freestyle competitions may be held locally. The competitors will usually consist of riders within the team but not necessarily exclusive to them. These competitions may include such events as a bunny hop contest, a distance-jumping contest, or regular freestyle competitions. This competition should be fun as well as instructive. Points, trophies, and prizes are not mandatory at this level. Ramps are *not* recommended at the local level.

JUDGING POINTERS

LOCAL JUDGING

1. Your selection of judges will depend, of course, on availability. Junior leaders or committee members with some knowledge of the sport should be considered. Advanced riders may also be good judges.
2. The areas for judging, with a brief explanation of each, follow:

Showmanship and Appearance (Judge No. 1).

Judge No. 1 is looking for how much of a showman the rider is and how much energy is put into the routine. The overall look should be clean and professional, but this does not mean that a rider has to buy expensive uniforms.

Execution and Technique (Judge No. 2).

This judge is watching to see whether all of the tricks attempted are completed. This judge may also count how many times a foot slips off the bike. It is recommended that a rider perform only the tricks he knows best during his routine to score high in this category.

Degree of Difficulty (Judge No. 3). This judge will score how difficult the tricks are that the rider is doing compared to those of the rest of the class. He will judge each class according to its own skill level (e.g., novices on novice tricks, experts on expert tricks, etc.). Again, it is recommended that the rider does not attempt tricks that are too hard because he will receive a low score in execution if the tricks are not completed.

Variety and Flow (Judge No. 4). This judge is looking for a variety of different tricks, ranging from balance tricks to rolling and new tricks. Doing the same tricks over and over may result in a low score from this judge.

Overall Impression (Judge No. 5). This judge is looking at the performance or routine, considering all factors involved. He is seeing how you compare against the rest of your class.

3. For local competitions only, it is recommended that each judge be responsible for only one area. This makes it easier for beginner judges to focus on a single skill. The second category (execution and technique) and third category (degree of difficulty) should be judged by the most knowledgeable persons in these areas. This also allows specific and instructive feedback for the riders.

4. When suggestion No. 3 is used, judge No. 1 (showmanship and appearance) is not to score less than a 75, as pointed out in the rule book. This gives less weight to this area of judging.

ADDITIONAL SUGGESTIONS

1. Choose judges who can concentrate for long periods.
2. Judges should talk as little as possible during routines.
3. Judges may find notetaking a help as long as it doesn't interfere with watching.
4. If needed, make changes on the panel only after a division is completed. Changing a judge during a division's run changes judgment perspective.
5. Hold a meeting with the judges before the contest to set ground rules (i.e., who judges what, standards of comparison, your reference of judgment, etc.).
6. Whenever possible, avoid having relatives judge their own family members.

PLEASE READ CAREFULLY

The rules and/or regulations set forth herein are designed to provide for the orderly conduct of freestyle events and to establish minimum acceptable requirements for such events. These rules shall govern the condition of all Varsity Scout freestyle biking events. Participating in these events, all participants in Varsity Scout competitions are deemed to have complied with these rules. No express or implied warranty of safety shall result from the publication of or compliance with these rules and/or regulations. They are intended as a guide for the conduct of the sport.

CLASS/DIVISION TIME LIMITS

Flatland

13 and younger	Open	1 minute
14 to 15	Novice	1 minute 30 seconds
16 and older	Novice	1 minute 30 seconds
14 to 15	Intermediate	2 minutes
16 to 18	Intermediate	2 minutes
19 and older	Intermediate	2 minutes
13 and younger	Expert	2 minutes 30 seconds
14 to 15	Expert	2 minutes 30 seconds
16 to 18	Expert	2 minutes 30 seconds
19 and older	Expert	2 minutes 30 seconds
Professional		4 minutes

Ramp

14 to 15	Intermediate	1 minute 30 seconds
16 to 18	Intermediate	1 minute 30 seconds
19 and older	Intermediate	1 minute 30 seconds
13 and younger	Expert	1 minute 30 seconds
14 to 15	Expert	2 minutes
16 to 18	Expert	2 minutes
19 and older	Expert	2 minutes
Professional		3 minutes

SUPPORT FOR COMPETITION

SUPPORT FROM YOUR SUPPLIERS

You may be able to obtain support for your competition from bike shops. Also, many bicycle manufacturers will donate prizes for special events. When contacting a supplier with a donation request, it is important to keep the following in mind:

- Call as far in advance of the special event as possible, allowing a minimum of three months.
- In most cases, the sales representative is not the best contact person for a donation request; speak with the company's public relations director or sales manager.
- Be sure to explain your affiliation with the Boy Scouts of America; this may provide the necessary "hook" to attract interest.
- Follow up all phone conversations with a letter; enclose Varsity Scout literature and, if possible, videos of your program.

SUPPORT FROM THE COMMUNITY

With the nonprofit status of Scouting, it is often possible to interest local businesses and organizations in providing various forms of support. This support might include:

- Public service announcements (PSAs) on local radio and TV stations
- Feature stories in local newspapers
- Donations of refreshments for meetings or special events
- Transportation assistance for field trips
- Announcements in corporate publications
- Monetary donations

RESOURCES

Information about freestyle biking can be obtained through brochures from local and national organizations, and books and videos.

BOOKS AND VIDEOS

101 Freestyle Tricks. Daisy/Hi-Torque Publishing Co., 1987 (available from Plus Products).

101 Freestyle Tricks, Part II: Psycho Version. Daisy/Hi-Torque Publishing Co., 1988 (available from Plus Products).

Additional books and videos are available from:

Plus Products
P.O. Box 9501
Mission Hills, CA 91345-9501
Telephone 818-365-6831

MAGAZINES

BMXer
American Bicycle Association
P.O. Box 718
Chandler, AZ 85244

Freestylin'
Wizard Publications Inc.
Torrance, CA 09505

Props Video
Props Visual Ltd.
12638 Willow Lane
Genoa, IL 60135

OTHER RESOURCES

Bicycle shops, libraries, bookstores, video stores, and local clubs

ACKNOWLEDGMENT

The Boy Scouts of America is grateful to Daisy/Hi-Torque Publishing Co., for their assistance in the preparation of this program feature and for the use of their sequential freestyle biking photographs.

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FRONTIERSMAN

BACKGROUND



For about 20 years—1820 to 1840—a group of men with a reckless spirit and sometimes savage approach to living took their place in American history. Known as mountain men, they were clad in buckskin with coonskin caps. Carrying muzzle-loading long rifles, perhaps tomahawks, and no more than one or two days' rations, they headed west to blaze trails in land never seen before by other early Americans. Their adventures have fascinated and influenced writers and storytellers ever since.

The Frontiersman program feature encourages today's Varsity Scout to reach into history and relive those adventures. This program feature introduces the Varsity Scout to the history of the frontier way of life, as well as how to make clothing, knives, and axes. Other sections discuss the use of muzzle-loading firearms.

PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with help from a Varsity Scout team committee member.

ADVANCEMENT

- Review each Varsity Scout's advancement status.
- Conduct a Wilderness Survival merit badge clinic.
- Monitor the team advancement chart regularly.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team's annual special high-adventure event (Philmont, Florida Sea Base, etc.).
- Conduct a frontiersman activity.

PERSONAL DEVELOPMENT

- Have the team attend a religious service as a group.
- Visit a historical society to learn about the influence mountain men had on your community.
- Have team members conduct a genealogy search to identify mountain men in their family trees.

SERVICE

- Contact a local historical society and carry out a service project for them.

- Assist an instructor in carrying out a Hunter's Safety Course. Ask the instructor to include muzzle-loaders in the presentation.

SPECIAL PROGRAMS AND EVENTS

- Invite a consultant to conduct a clinic on making knives and tomahawks for throwing competitions.
- Conduct a knife throwing, tomahawk throwing, or archery tournament using only items made by Varsity Scout team members.
- Contact and arrange for a qualified instructor to conduct a clinic on muzzle-loading firearms.

THE FRONTIERSMAN OF YESTERYEAR

It's hard to imagine life in North America 200 years ago. The people of the United States were basically confined to the eastern seaboard. Civilization ended at the river town of St. Louis, Missouri. The land and people beyond St. Louis were completely unknown to all but a privileged few. Who were these privileged few? The mountain men and voyageurs.

In the early 19th century, hardy trappers known as mountain men lived a semisavage existence in the far western United States. Their adventures in the wilderness have fascinated scholars and students ever since. These men, driven by a reckless spirit and a desire for profit from trapping the elusive North American beaver, invaded every valley, plain, and mountain range in the West. They played a heroic role in extending the frontier to the Pacific Coast by exploring the fertile valleys of the uncharted West and spreading the word to eager farmers in the East.

The movement to this wilderness was the result of a fashion change in Europe that made beaver hats the rage of high society. The American West was an untapped reservoir of this furbearing animal. Practically every stream in the mountainous far West was the beaver's home. In searching for the "brown gold," the trappers explored and mapped an extraordinary part of our country. Their campfires became towns; their paths became highways.

The mountain men's days of glory spanned only about 20 years, from 1820 to 1840. But when they vanished to take up other occupations and settle down, they had indelibly etched into their minds every brook and ridge of the far West. Many mountain men who outlived their fur-trading days continued to play significant roles in the westward movement.

Individuals like Moses “Black” Harris and Thomas Fitzpatrick became scouts for pioneer wagon trains traversing lands that they themselves had discovered. Many more served as interpreters and guides for the United States Army. Still others (Jim Bridger, Louis Vasquez, and the Bent brothers) established trading posts at strategic points along the westward route so travelers to California and Oregon could replenish their supplies and receive expert advice.

Trappers’ diaries, journals, and memoirs are another service the mountain men rendered to history. Their literature provided late pioneers with exciting glimpses of their wilderness experiences, which today are considered half fact and half legend.

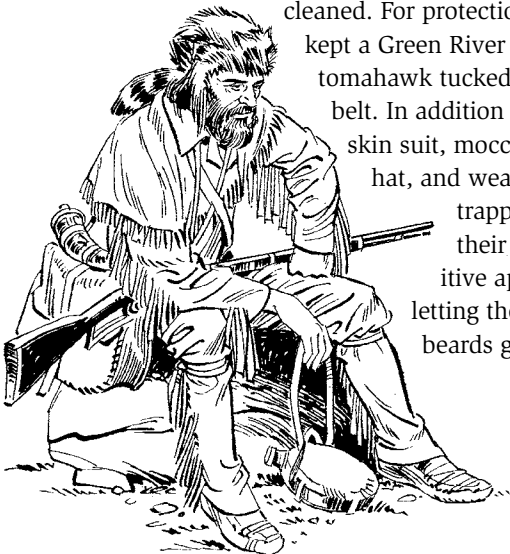
The adventures of these mountain men are unique in our history. Since they were the first to travel west, they faced unknown dangers and situations. Adapting to the hostile environment, they learned to exist and even thrive in their surroundings. In fact, compared to their more civilized Eastern counterparts, the mountain men lived a vastly more primitive existence, evident in a study of their lifestyles.

APPEARANCE AND ATTITUDE

Every aspect of the mountain man’s existence was an adaptation to his wilderness surroundings. The trappers discarded most of their earlier customs, attitudes, manners, institutions, and ways of life. They adopted their new character traits from their wilderness friend and adversary, the American Indian.

The frontier influence was evident in the clothing of the mountain man. Made of buckskin with long fringe and covered with porcupine quills and beads, the frontier suit of the mountain man would usually last three or four years, even though it was never washed or

cleaned. For protection, trappers kept a Green River knife and a tomahawk tucked into a leather belt. In addition to the buckskin suit, moccasins, felt hat, and weaponry, the trappers added to their already primitive appearance by letting their hair and beards grow long.



If his appearance resembled the Indian, the mountain man’s attitude also reflected the influence of his surroundings. Since death lurked behind every tree or beyond every river bend, survival became all-important. While struggling to survive, many came to disregard all human life—their own, their friends, and their enemies.

LANGUAGE AND SPEECH

The language and speech of the mountain man also showed the influence of the unusual environment. Common language included words from Spanish, French, English, several Indian tongues, and, of course, the profane. A modern observer would need a translator. For example, a man was a “hoss” or “child.” Scalping was “tickling a fleece” or “liftin’ his ha’r.” When a comrade died, he had “gone under” or was “rubbed out”; a doomed man was a “gone beaver.” “Bacca” and “Taos light’nin” were pleasures guaranteed to give trappers “quite a glow.” Phrases like “Thar goes hoss and beaver” (bad luck or “oh, well”) and “Keep your topknot” are legacies of a colorful and vivid frontier vocabulary.

DIET

Mountain men used their quaint language most often when they sat around blazing fires at night, spinning tales and enjoying food. Their diet also mirrored their surroundings. Meat, especially buffalo meat, was their main staple. Vegetables and bread were missing from their diets for years at a time.

Since buffalo was their favorite food, they usually devoured the *entire* animal. In fact, eating the long intestines, called *boudins*, became a game. One trapper would begin swallowing the long, stretched-out, greasy intestines from one end, while another trapper began at the other end. First one and then the other would stop swallowing to shout “feed fair,” a shout of enjoyment. Blood from the buffalo, said to taste like warm milk, was also savored.

This favored animal, however, was often hard to come by in the mountains. Like the Indian, the trappers alternated between feast and famine, gorging themselves when food was available and eating less appealing creatures during “starvin’ times.” To survive, snakes, crickets, frogs, insects, horses, dogs, and even moccasins were eaten.

THE FRONTIER VOCABULARY

<i>Bacca</i>	Tobacco
<i>Booshway</i>	Brigade leader
<i>Bring to medicine</i>	Get beaver to take bait
<i>Cache</i>	To hide or conceal
<i>Can't shine in this crowd</i>	Not important or worthy
<i>Companyeros</i>	Friends; from Spanish <i>compañeros</i>
<i>Doomed beaver</i>	Death is imminent
<i>EE</i>	You
<i>Feed fair</i>	Shout of enjoyment at fetes
<i>Fofarrow</i>	Decoration, anything unnecessary
<i>Go under</i>	Die
<i>Greenhorn</i>	Newcomer
<i>Guvner</i>	Leader
<i>Heap</i>	Very much, a lot
<i>Hurraw</i>	Hey
<i>Hyar's damp powder and no fire to dry it</i>	Poor situation
<i>It won't shine</i>	It's no good
<i>Keep your nose open</i>	Stay alert
<i>Keep your topknot</i>	Don't get scalped
<i>Lave</i>	Get up!; from French <i>lever</i>
<i>Long knives</i>	American trappers
<i>Meatbag</i>	Stomach
<i>Old bullthrower</i>	Hawken's rifle
<i>Old Ephraim</i>	Male grizzly
<i>On the prairie</i>	Get something free
<i>Painter meat</i>	Panther, considered a delicacy
<i>Plew</i>	Prime beaver skin; from French <i>plus</i>
<i>Possibles sack</i>	Sack for carrying equipment
<i>Put afoot</i>	Lose a horse
<i>Raisin' ha'r</i>	Scalping
<i>Rubbed out</i>	Killed
<i>She-rip</i>	Female grizzly (more dangerous than the male)
<i>Sirree</i>	Exclamation
<i>Skeared</i>	Scared, afraid
<i>Spree</i>	Great time
<i>Thar goes hoss and beaver</i>	Bad luck, "Oh, well"
<i>Thar</i>	There
<i>That's the way the stick oats</i>	Hard luck, fate
<i>This hoss, child</i>	Yourself
<i>Varmit</i>	Dangerous animal
<i>War</i>	Was

ENEMIES

Running out of food was only one of the dangers they faced in the wilderness. Indians, of course, were always present. Mountain men also had to watch out for the most feared adversary of all—the ferocious grizzly bear, who took the lives of many trappers. Nature added misfortunes, too. Gangrene from carelessly attended wounds, infected rattlesnake bites, poisoned liquor, and venereal disease killed many of these rugged frontiersmen. Even with all the dangers of the wilderness, the mountain men found unique forms of entertainment.



RENDEZVOUS

The rendezvous, held in the first weeks of summer from 1825 to 1840, was the Rocky Mountain version of a medieval fair. It was held in a “hole” (a grassy valley somewhere in the mountains), where bands of trappers met the supply caravans from St. Louis to exchange the year’s catch of pews (beaver furs) for supplies.

William Henry Ashley, one of the fur trade’s prime movers, devised the rendezvous as a method for getting Indians and fur trappers together to sell their pelts. During the first few days of the gathering, pews were traded for money at high mountain rates. The trappers could then buy their supplies of gunpowder, flint, suet, coffee, and other necessities.

When their business was concluded, the fun-starved trappers let loose for a “rip-roaring” week or two of fun and games. There was ample alcohol at astronomical prices, and the mountain men swallowed the often-lethal fluid in large quantities during the two weeks. They staged foot races, horse races, shooting and tomahawk throwing contests, and wrestling matches, and fought sure-death duels at 20 paces. They gambled recklessly at all sorts of games, occasionally losing their trapping equipment, horses, Hawken’s rifles, and even their food in the process.

FIREARMS

Regardless of how the mountain man spent his time—setting traps, cooking, sleeping, or talking among friends—his rifle was always within arm’s reach. When riding his horse, he usually carried it across his saddle so that it could be brought into action at a moment’s notice.

The most common rifles used by frontiersmen were .50- to .55-caliber black powder percussion models. Each weighed 10 or 11 pounds and had a 36- to 42-inch barrel. One rifle had enough firepower to stop a 1,000-pound buffalo at 250 yards.

Because his rifle was a single-shot weapon, the mountain man had to be a superb marksman. He rarely got a second chance if he missed. It was not unusual for the average mountain man to be able to put his shot into a 2-inch mark at 100 yards. The mountain man’s practice routine included snuffing candles at 30 yards, driving nails with the lead ball fired from several yards, and cutting a bullet in half by hitting the sharpened blade of an ax.

For backup, the mountain man also carried a couple of single-shot pistols and black powder shotguns for small game. Later, with the development of percussion caps, multishot revolvers were used.

Additional information and shooting instruction on muzzle-loading rifles and shotguns can be found in the *Rifle Shooting* and *Shotgun Shooting* merit badge pamphlets, and in the Shooting Sports program feature.

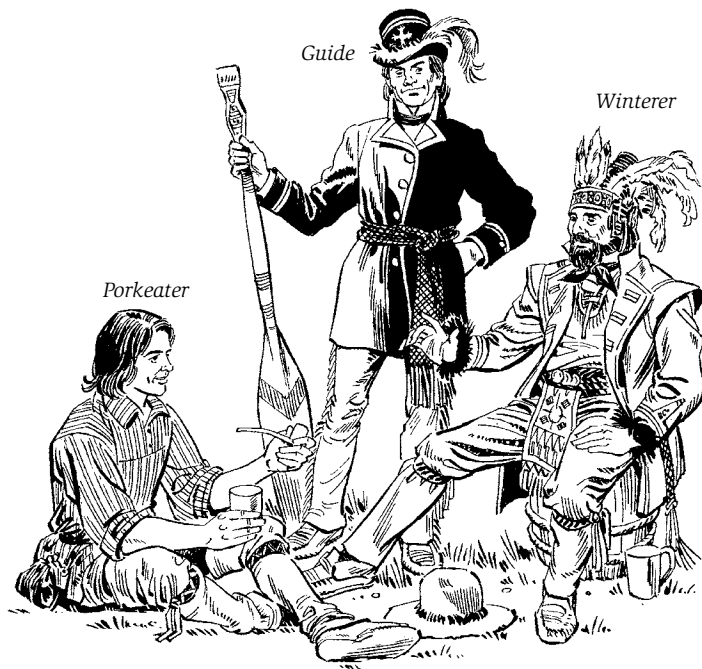
VOYAGEURS

The voyageurs were the French Canadian canoe men of the North American fur trade. They were known for the songs they sang as they paddled birchbark canoes over the rivers and lakes of the continent from Montreal to the Pacific Ocean in the 17th, 18th, and early 19th centuries. Their songs were adapted to accompany the motion of paddles dipped in unison, and they contributed to the morale of the paddlers. But these canoe men did not seem to need a reason to sing; they sang on just about every occasion.

APPEARANCE AND ATTITUDE

Traditional French songs, virtually unchanged over the years, were a favorite of this group. They sang of simple things and events. They were fond of songs about wind and weather, spring, love, nightingales, rosebuds, cavaliers, gallant captains, and especially, fair ladies. Many of the songs had melancholy themes, but most of them could be, and were, sung robustly.

They were fun-loving people. They loved to talk, enjoyed color and finery, participated in races and displays of prowess, and took pride in being voyageurs. They wore picturesque clothing including leggings, deer moccasins, and plumes. Their dress consisted of red caps, bright hooded cloaks (usually blue), and braided sashes from which they hung beaded pouches packed with clay pipes, tobacco, and other possessions highly valued on long journeys.



WAY OF LIFE

Emphasis on the glamour of voyageur life should not obscure the fact that it was rough and hard. Normally, the voyageur worked a 14-hour day, or longer, depending on the weather. When paddling, he was allowed a brief rest, called a “pipe,” every few miles. It took stamina and muscle to paddle all day long on lakes and rivers. It took courage to run foaming rapids where one mistake could mean disaster. It required nerve and skill in appraising the weather to cut across bays in Lake Superior where storms could tear a canoe to bits. It took strong backs and steady legs to carry at a trotting pace one or more 90-pound packs of goods or furs over portages, even though there were poses, or places of rest, on longer journeys.

Canoeing, with its loading, paddling, unloading, and portaging, was only part of the job of the voyageurs. They also had to be skilled in making and repairing canoes, building forts in the wilderness, and handling dog teams for winter travel. They were called upon to do any kind of physical work involved in the acquiring, handling, and transporting of furs.

The area in which the fur trade operated was gradually enlarged until it reached the Pacific and the Arctic in the 1800s. Eventually, the trade expanded to the west and north, and transcontinental canoe routes were developed. This meant more work for the voyageur. It increased the volume of trade goods to be transported inland for bartering with the Indians, the number of posts to be built across the land, and the amount of furs carried to market. While the voyageur had nothing to

do with the complex business of financing, marketing furs, and procuring trade goods, these types of decisions were always based upon his work.

CLASS SYSTEM

There were two classes of voyageurs: the *mangeurs de lard*, or porkeaters, and the *hivernants*, or winterers. The first name is derived from food, the second from the voyageur life at distant posts. The porkeaters worked the waters between Montreal and the great fur post at Grand Portage on the north shore of Lake Superior. Their food consisted of dried peas or pounded, leached corn boiled in pork fat.

The winterers were voyageurs who worked the waters to the west, beyond the mountains between Grand Portage and Rainy Lake where the waters divide, running east to the Atlantic, north to the Arctic, and south to the Gulf of Mexico. The winterers were the higher caste or class of voyageurs. When a winterer crossed these mountains for the first time, a special ceremony was performed. He was sprinkled with water and made to swear certain pledges (one of which was never to kiss the wife of another voyageur without her consent). After the ceremony, he was entitled to wear a plume in his hat, a privilege porkeaters were denied.

There were other differences between the two groups. At Grand Portage, the winterers received rations of meat, bread, and wine. They were permitted to sleep in tents, while the porkeaters slept under their overturned canoes. Both groups, however, were genuine voyageurs and skilled paddlers, and both enjoyed the traditional French songs.

INDIAN CONTRIBUTIONS

The contribution of the Indians to the voyageur techniques and to western Canadian and American history is immeasurable. It was they who trapped the furbearing animals and exchanged their skins for the traders' goods.

Pemmican, easily preserved food ideal for long journeys, was another contribution by the Indians. Pemmican was made from pounded and dried buffalo meat, mixed with grease and often seasoned with berries. It could be eaten dry or mixed with water to make soup. Packed in buffalo-skin bags, it kept well and was readily portable. So important was this long-lasting Indian food that its manufacture was a big business in itself. Pemmican was made at fur posts in the buffalo country and distributed in 90-pound packs to the many trading posts that dotted the wilderness.

Above all, the Indian way of life produced the canoe, which the voyageurs adopted as a primary means of transportation. The Algonquian birchbark canoe was an ancient Indian invention. Assembled without a single

nail from birchbark, roots, cedar boards, and gum, it was a marvel of grace, perfectly suited to voyaging by lake or stream. It also had a capacity for carrying heavy loads.

Two principal sizes of canoes were used in the fur trade: large Montreal canoes on the broad rivers and lake expanses on the eastern end of the route, between Montreal and Lake Superior, and smaller North canoes for the routes beyond Lake Superior. The Montreal canoe was 35 to 40 feet in length, with paddling places for 12 or 14 men, and a carrying capacity of 5,000 pounds or more. The North canoe was shorter than the Montreal canoe by some 10 feet, but it could hold a crew of 8 men and a baggage load of 2,000 to 3,000 pounds.

RENDEZVOUS

Montreal was the employment center of the fur trade. Each spring, representatives of the large companies or the independent traders gathered to hire as many voyageurs as needed. The men signed contracts for one or more years of service at so many “livres” per year (ordinarily 400 for a porkeater, and more for the key posts of bowmen and steersmen). They were given certain individual supplies, including tobacco and a blanket.

The canoes were carefully loaded with trade goods to be bartered for the Indians’ furs. These goods, sent out from England, included knives and guns, shot, powder, hatchets, kettles, beads, tobacco, ribbons, mirrors, blankets, and even hats. There were also kegs of whiskey and rum, which many traders mixed with water before distributing. The canoes also carried sails, which the voyageurs used when weather conditions permitted, ropes to haul the vessels along the edges of perilous waters to save portaging, sponges for quick use against leaks, bark and other materials for mending and patching, and the personal possessions of the voyageurs, bourgeois, and clerks.

Voyageurs paddled from dawn to nightfall, carrying the big canoes and the 90-pound packs over portages, and sleeping on the ground with a blanket for cover. They suffered hungry mosquitoes, the burning glare of a hot sun on cloudless days, soaking rains, and soggy, mud-laden clothes after wading through marshes up to their waists. The short, sturdy voyageurs endured all these hardships and more, singing their way across lakes, enjoying brief rests to smoke and eat, and sleeping soundly at night whether the winds were cold or hot.

The climax of the trip west from Montreal was the arrival at Grand Portage in late June or early July. This busy, 18th-century trading post on Lake Superior, with a stockade enclosing 16 buildings, was a great summer bazaar. At Grand Portage, voyageurs and traders from east and west gathered together.

It was a rendezvous to which the traders from the Northwest brought their harvests of furs. From Montreal came the goods to be used in another season of barter. Here the canoes were loaded with packs of furs for the return journey to Montreal, while the men from the interior assembled their supplies for another year of trading in the West. The company’s partners, or managers, were also there to consider problems of policy. The place was crowded with clerks, interpreters, porkeaters, winterers or Nor’westers, and Indians—men, women, and children.

A MODERN RENDEZVOUS

The days of the rendezvous are long past. The adventure and tradition of that frontier holiday, however, can be re-created for your ultimate adventure. There you will have the opportunity to display your pioneer clothes, crafts, and shooting skills, and study the ways and lifestyles of the original mountain men.

CAMPSITE

First, select a wilderness site where you can set up a rifle range and have ample space for various types of competition. If you make canoes, you will also need a lake. Use your pioneering skills to make primitive shelters or a tepee for shelter.

MEALS

Mountain men had to search for game and local plants for food. That may not be possible for you, but you should try to bring foods similar to those in their diet. Prepare them in the same primitive manner, over fires and using Dutch ovens.

CONTESTS AND GAMES

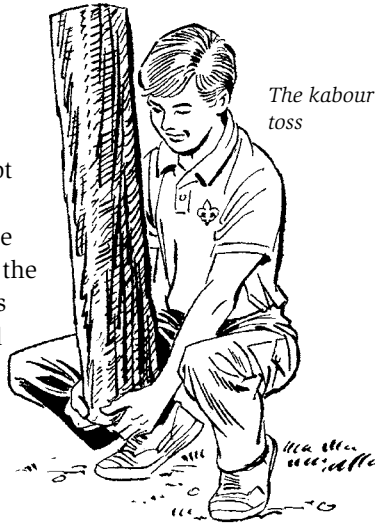
Traditionally, mountain men enjoyed contests and demonstrations of feats of skill at the spring rendezvous. Typical contests might include flint and steel fire making, rope climbing, log sawing, and bow and drill fire making. A few contests and games are described below.

ROPE CLIMB

For this event, you can use a knotted rope hung from a tree, hung over a barricade, or tied around a rock on a hill. Recognition can be given either for completion of the climb or for the fastest climb.

KABOUR TOSS

The traditional kabour was a 12-foot log, 1 foot in diameter. This is a competitive event to see who can throw the log the longest distance. Scores based on distances will be marked on each individual's score card. A scaled-down log should be used.



The kabour toss

LOG SAWING

Pair off into teams. Use a two-person saw and a log at least 12 inches in diameter. Be sure the log rests on braces several feet off the ground. You will need a stopwatch.

FOOT RACES

A variety of foot races can be run. Your team can organize races from 100 yards to several miles. The early frontiersman had to be in good physical condition to avoid bears (short sprints) and Indians (running many miles over varied terrain). You may want to combine a short sprint and a longer run.

WRESTLING MATCHES

Schedule wrestling matches at your rendezvous. You can choose Indian arm wrestling or college-style wrestling.

ARCHERY

For archery competitions, both target and field archery are authentic frontier activities.

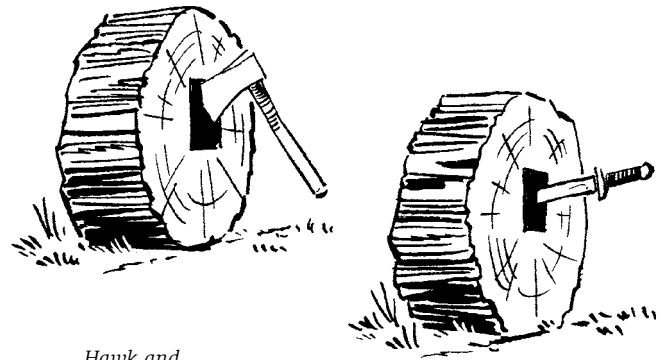
MARKSMANSHIP COMPETITIONS

The frontiersmen used many props to prove their shooting ability. Extinguishing the flame of a candle was a popular method. Wedging the head of an ax into a lead rifle ball and halving the lead ball by shooting the head of the ax was another. They also drove nails into boards by shooting the heads of the nails with their shots.

Your Varsity Scout team, however, should use a standard target. Be sure that everyone in the competition has been trained to use muzzle-loading firearms and that you use standard Boy Scouts of America rifle-range procedures.

KNIFE AND HAWK THROWING

In this event, the winner has the highest number of sticks in the target from three throws from each: knives and hawks. Any tie-breaking throw-off will be held after everyone has had a first chance to throw in the competition.



Hawk and knife throwing targets

KNIFE AND HAWK THROWING RULES

1. All knives and hawks are dangerous. Respect them as lethal weapons that can kill or cause bodily injuries.
2. All knives and tomahawks must be cleared by the range officer before use.
3. Always point the weapons downrange.
4. Never throw them unless you are cleared to do so.
5. Never try to retrieve them until clearance has been given by the range officer.
6. Keep your attention on what you are doing. Listen to instructions.
7. Be sure of your target and the backdrop area.
8. Use safe and sturdy logs as targets.
9. Keep the entire throwing area clear of people and obstacles.
10. Never throw a hawk or knife at a live tree.
11. Do not throw a hawk or knife in camp. Throw only in the designated range.

HOW-TO TIPS

- The correct throwing distance from you to the target is dependent on the length of your arms and legs, and knife or tomahawk handle.
- The end-to-end length of the hawk handle should be the same as the end-to-end length of the knife.
- The overall length of the hawk and knife should equal the length of your forearm as measured from the knuckles of your clenched fist to the tip of your elbow.

- Your knife should weigh approximately 1 ounce for every inch of overall length.
- Your hawk and knife should be of equal weight.
- The balance point, determined by laying the knife flat-side down on your index finger or on the edge of a ruler, should be within half an inch of its center.
- Making your own knives and hawks can be a great team project, including making the patterns.

OTHER COMPETITIONS

You can also add craft, costume, primitive shelter, canoe, tall-tale spinning, and Dutch oven cooking competitions. The team members should decide which activities will be scheduled. If families of your team are invited, you may schedule events for the adults and younger siblings also. Be sure they have been instructed in the activities rules and techniques before the actual competition.

CAMPFIRE

A frontier bonfire was a joyous experience filled with song, food, and tall tales. If any team members play acoustic instruments (fiddle, guitar, harmonica, spoons), have them lead songs from that era. Make up fantastic stories about your trapping and wilderness adventures. And of course, prepare your finest wilderness feast!

PREPARING FOR YOUR RENDEZVOUS

To re-create the sights, sounds, and activities of those days long ago requires a lot of preparation. Practically every aspect of frontier life—articles of clothing, tools, eating utensils, possible sacks, etc.—will need to be made by hand. Team members should visit craft stores, libraries, and black powder clubs during their research to make every aspect of a modern rendezvous as authentic as possible.

Instructions for making many of the items you might want for your ultimate adventure are in the pages that follow.

HUNTING

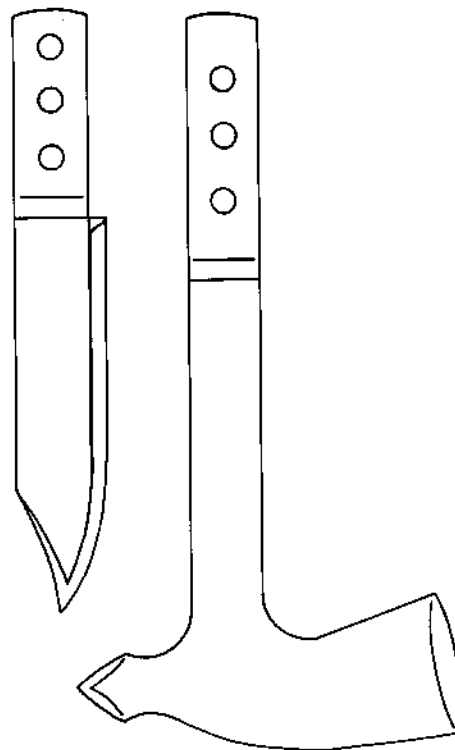
AXES AND HAWKS

The iron ax, one of the earliest items offered in trade, was an immediate attraction to the Indian. Trade axes were imported in great numbers and a variety of sizes. These were shipped to the wintering posts in wooden crates. Handles were fashioned and installed by the buyers.

Axes and hatchets were ordinarily imported to New France. Most of these must have actually come from France, although the makers and exact locations are usually unknown.

KNIVES

Knives had a special importance to the Indian, and, in fact, to anyone living on the frontier where a handy cutting tool was needed. Some were worn in sheaths on the belt for immediate use. Other knives available from the traders were clasp or foldirs knives and those used for butchering and carving. Perhaps the greatest utility for the knife was for skinning and cutting meat.

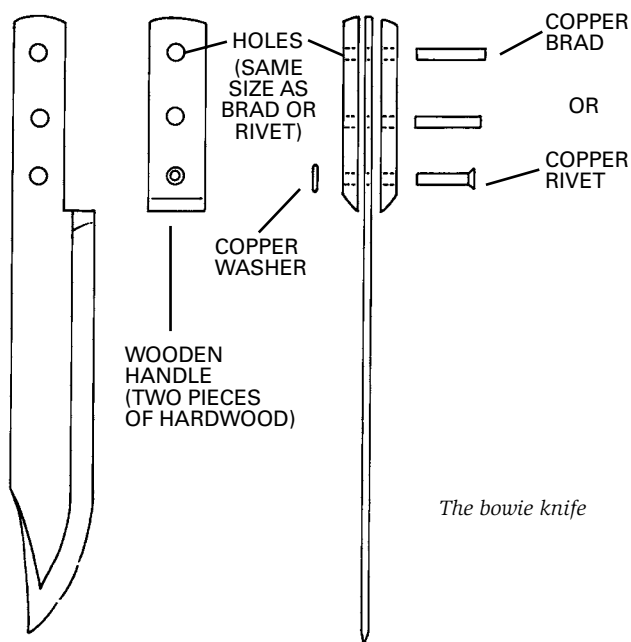


Hawk and knife patterns. Make out of quarter-inch plate steel. Length of handle from head to bottom is 13¼ inches.

BOWIE KNIFE

Blank blades may be cut from a crosscut saw blade with a cold chisel or cut with a torch from a piece of truck leaf spring. The spring may be purchased or scrounged from an automobile wrecking yard. Any heavy sheet metal will work. The handle may be of any hardwood. Maple is a good choice.

Fasten the handle to the knife with copper rivets or brads made of heavy copper wire. Wooden handles on throwing knives tend to split off. Strips of heavy leather may be used when making a throwing bowie or “buck-skinners’ toothpick.” Tempering is not overly important. In fact, a blade of high temper will break easier.



The bowie knife

MOSES STICK

The moses stick is used as a hiking staff, a shelter upright, a dead rest for taking long shots with the smoke pole (rifle), or a rest for binoculars. You can lean on it going down or push with it going up.

LEATHER-COVERED GRIP OR FANCY CARVING

AS TALL AS THE USER



The moses stick

SCRIMSHAW

ENGRAVING A POWDER HORN

Powder horns have been around for centuries. Long before they were introduced to America from Europe, men used cow horns to store and transport gunpowder. They are natural containers because they are light, durable and nonflammable. They will not break if dropped, will not rot, and if sealed properly, are waterproof. In time, men sought to decorate their powder horns by engraving words or pictures on them—scrimshaw.

The art of scrimshaw originally applied to the engraving of nautical subjects and scenes on ivory, horn, whales' teeth and animal tusks. It became popular sometime around the American Revolution. Today we refer to the engraving on powder horns as scrimshaw.

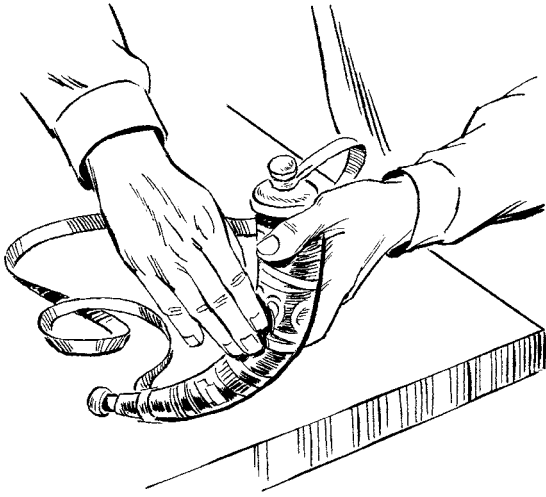
Although there were professional engravers of powder horns in the 18th century, probably the majority of horns were scrimshawed by those who used them. Soldiers, hunters, trappers, and others scratched or cut names, dates or records of events, and scenes into their horns.

Certain subjects were more popular and were used consistently. They included maps, forts, facades of towns, animals (both real and mythical), birds, ships, soldiers, Indians, trees, flowers, and vines. Rhymes were popular. The name of the owner was frequently followed by the words "HIS HORN," and sometimes a date. To accentuate the scrimshaw, shoe black, grease, gunpowder, or soot was rubbed into the lines.

As you scrimshaw your own horn, take all of these things into consideration. If you want to build a horn that looks like the horns carried in the 18th and 19th centuries, study original horns, either in museums or in books and periodicals.

HOW TO SCRIMSHAW

1. Select a scrimshaw-grade horn: It should have good curve and twist, a white body, and the proper size for your use.
2. Prepare the surface. Start by scraping the horn with a sharp blade, piece of glass, file, or all three.
3. Sand the surface using No. 220 sandpaper.
4. Go over it with 4.0 steel wool.
5. Hold it up against a strong light to inspect the surface for cracks, grooves, and rough spots. Sand these and rub out with steel wool.
6. Sketch the picture or legend into the surface with a soft lead pencil. Pictures can be traced onto the horn with the aid of carbon paper.
7. Scratch or cut the design into the surface using a sharp knife point or needle.
8. Using your fingers or a soft cloth, rub black india ink, available at stationery stores, over and into the design.
9. Wipe off the excess and go over it lightly with 4.0 steel wool. The permanent design now stands out.



Scrimshawing a powder horn.

TANNING

A better understanding of tanning will be gained if you first tan small skins such as rabbit or squirrel. Check with a local taxidermist to see if you can get hides or skins. **Do not kill any animal to secure the skin.**

1. Trim off any irregular edges and fleshy tissue.
2. Mix 1 gallon of water with about 4 ounces of lime. Place the skin in the mixture for about one day. Stir it occasionally. Check to see if the hair has loosened. If not, soak it until it does.
3. Place the skin on a flat surface and scrape off with a dull knife any remaining flesh and hair.
4. Rinse the skin thoroughly.
5. Mix the tanning solution. Use one of these solutions.

Solution A. Mix a strong saltwater solution. Rub the solution into the skin each day for about 2 weeks. Hang the skin up to dry between applications.

Solution B. Mix ½ pound ammonia alum or potash alum with 1 quart of water in one container. Mix 2 ounces of salt and 1 ounce crystallized sodium carbonate with 1 pint of water in another container. (These supplies will probably be available at a drug-store.) Slowly pour and mix the two solutions together. Soak the skin in the solution four to five days.
6. After the tanning is finished, wash the skin thoroughly.
7. Tack the skin on a frame. Stretch it as you do.
8. While the skin is still moist, apply a light coat of Neetsfoot™ oil to both sides. After the skin has dried, another coat can be applied if the skin is stiff.

9. The final step is to stake the leather. To stake it, pull it back and forth over the edge of a table. The staking will soften the leather.

CLOTHING

MAKING SKINS

Many buckskinners look around for a good frock coat pattern. If you look at early prints and illustrations, you will see many trappers wearing this style of coat.

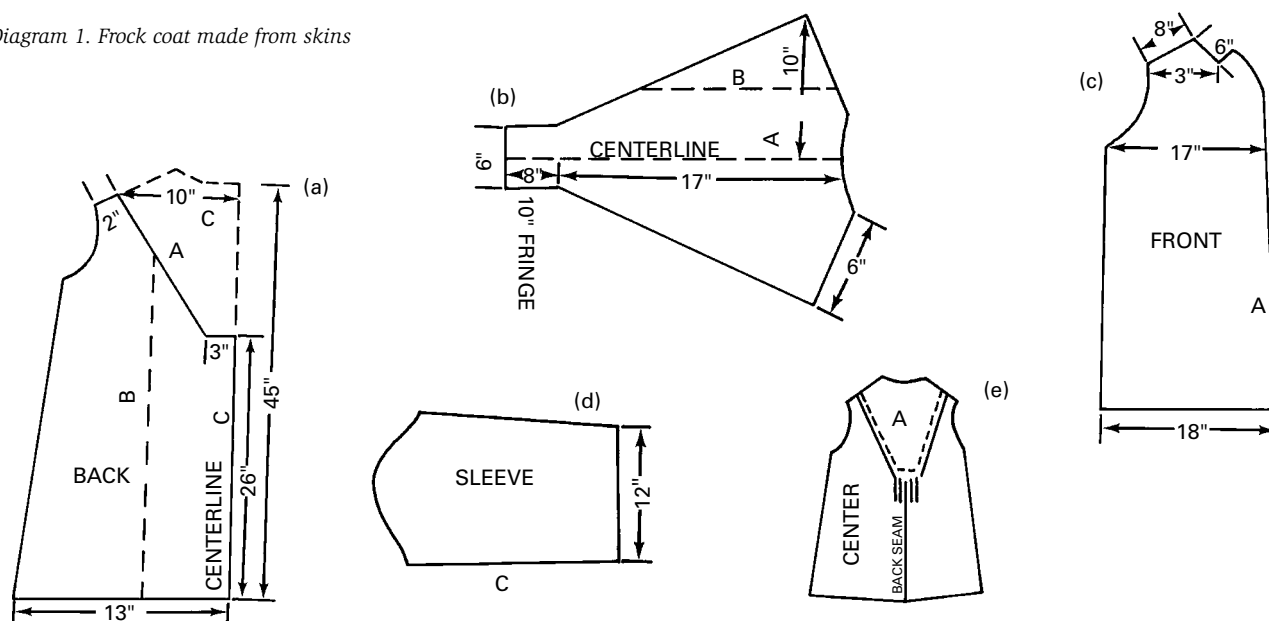
This pattern is taken from an original coat worn by Pierre Choteau of a famous St. Louis fur trader family. The measurements given are for a person around 6 feet tall and 150 to 170 pounds (about size 42).

1. To start, take newspapers or any paper large enough and begin drawing a design like diagram 1a. This will be one side of the back. Complete the drawing and cut off the section enclosed in the dotted line. Cut along line A. To cut the armpit, buy or use a shirt pattern that fits. If you need help, ask someone who sews regularly.
2. Point A to point B should be measured from the vertebrae on your neck to the center of your knee.
3. Next, draw the back yoke (diagram 1b). For measurement C, measure the center of your back to an inch or so below the top of your shoulder. Then subtract 2 inches or so.
4. For the front, make your armpit cut according to the shirt pattern. See diagram 1c.
5. The sleeve comes next. Use the sleeve from your shirt pattern. Make sure it is long enough. It should be about 12 inches wide at the cuff.

When your paper pattern is finished, cut out a complete coat from muslin or an old sheet. Pin it together and make adjustments. Line A on the front should slant from the top outward about 2 inches to the bottom. Most adjustments can be made by widening the front. If you are much smaller or much bigger, width adjustments can be made by splitting line B of the back and yoke and narrowing or widening. When you get a good fit, cut your leather, making sure that you have the two opposite sides of the same side leather.

Now you're ready to sew. First, sew the back along centerline C. Then sew the yoke (diagram 1b), laying it on top of the back diagram 1e. Use a saddler's stitch. Sew about ¼ inch in from line A and use a ½-inch overlap. Next, sew the back to the two front halves along line D. A baseball stitch comes in handy here.

Diagram 1. Frock coat made from skins



Cut a piece for your shoulder fringe and then sew your sleeve and the fringe to the body. Start at seam D and sew down one side and then the other. Turn the coat inside out, fitting the fringe between the outer sides of the sleeve. The fringe should not be visible. Sew the sleeves and the sides. Cut a long strip of leather about 3 or 4 inches wide and sew this on as your collar. Cut fringe and decorate. If desired, two or three leather ties or buttons can be added.

The leather recommended for such a frock coat is elkhide, bucktanned cowhide, or cream horsehide. They all work equally well.

PLAINS-STYLE, HARD-SOLE MOCCASINS

To make this western-style moccasin, you will need

- Two pieces of leather for the uppers
- Two pieces of heavy leather for the soles
- Thread

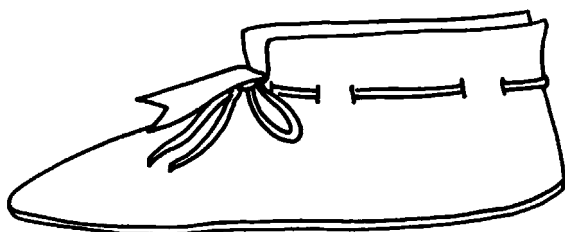


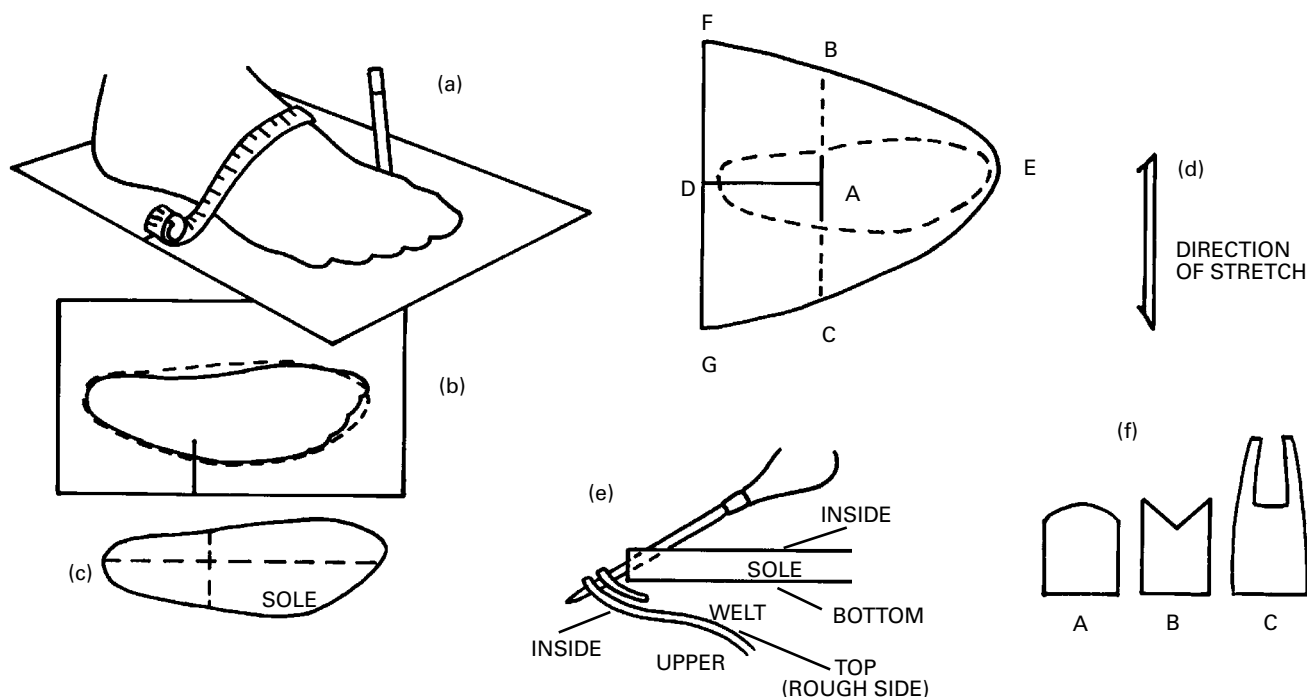
Diagram 2. The plains-style, hard-sole moccasin

- A needle
- Instructions

MAKING A PATTERN

1. On a stiff piece of paper, draw around your stocking foot. Mark your instep and measure it. Write it down on the pattern. See diagram 3a. If your feet are different, then draw and measure both your left and your right foot.
2. Draw sole patterns using the foot drawing for size. Be accurate. Push the big toe over just enough to tighten it up against the second toe. Draw the line $\frac{1}{8}$ inch above the tip of the big toe and around the other toes just enough to allow movement. See diagram 3b.
3. Draw a line down the center of the sole pattern. See diagram 3c.
4. Take another piece of heavy paper and fold it down the middle. Lay it flat. Lay the sole pattern on the paper so that the center line and the crease line up. Trace the sole pattern lightly on the paper.
5. Mark the instep. Draw a horizontal line across the fold at the instep approximately $\frac{1}{4}$ inch less on each side than the width of the sole print at that point. This horizontal line will be your instep opening where you sew the tongue. To be sure it is in the right place look at diagram 2. The distance from A to E (toe to tongue) should be somewhat longer ($\frac{1}{2}$ to 1 inch depending on the size) than the distance from A to D. The width of your foot at the instep is the width of B to C (pattern width). D to F and D to G are each $\frac{3}{4}$ inch longer than A to B and A to C, respectively. Mark a line from A to D and draw your pattern. Double-check it for accuracy and then cut it out. It should look like diagram 3d.

Diagram 3. Making the plains-style, hard-sole moccasin



CUTTING THE LEATHER

1. Trace the sole pattern onto the sole leather. Be sure and get a right and a left pattern. Use a sharp knife to cut out the patterns.
2. Lay the upper pattern on the leather. Be sure the stretch is across the arch. Cut a right and a left version.
3. Cut four strips $\frac{1}{2}$ inch wide or so by the length of the moccasins for welting.
4. Cut out two tongues. See diagram 3f. Tongue A or B will best reflect the frontier style.

SEWING THE MOCCASIN

The best stitch to use all the way through is the over-cast or whip stitch. *Make sure your stitches are tight.*

1. First, lay the pieces of the moccasin as shown in diagram 3e. The moccasin is sewn inside out. The upper is laid on the edge the same way. The sole is laid with the inner (rough) side up. Start sewing at the toe; first one side and then the other, to the center of the heel. Be sure you are sewing straight and evenly.
2. Now trim the heel so that the two sides just meet. Sew up the back. Use a welt here, too, if you wish.

3. To finish the moccasin, sew in the tongue. Repeat for the second moccasin.

Before beading, consider the time period you wish to represent by studying original moccasins or pictures.

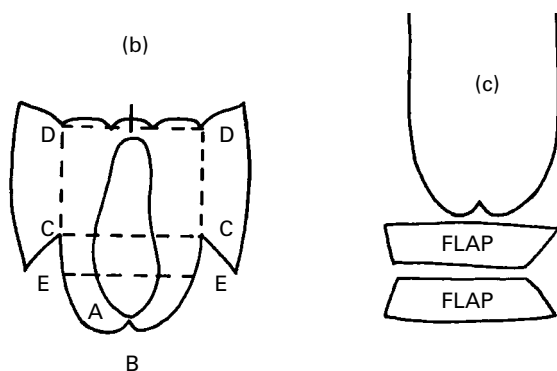
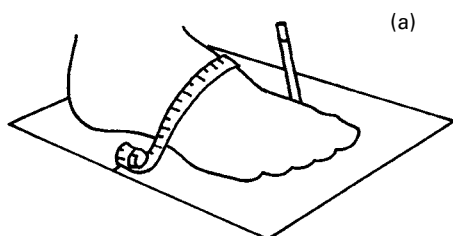
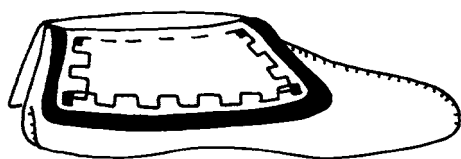
WOODLAND MOCCASINS

The longhunter of the eastern frontier generally wore the woodland moccasin made of buckskin. For the modern longhunter with tender feet, a thicker hide such as cowhide might be a better choice.

MAKING A PATTERN

1. Trace your stocking foot on a piece of heavy paper. Mark the instep with a line. Measure at this point over the arch and mark the measurement on the paper. C is your arch line. Distance from C to C should be the distance over your arch plus the width of your foot at that point. Distance from A to B is about 1 inch. The distance from D to D is the same as from C to C. E to E is the distance around the ball of the foot. See diagram 4a.
2. When you have these points marked, sketch the outline of the moccasin and cut out your pattern. The flaps will usually have to be cut separately from the bottom of the moccasin. See diagrams 4b and 4c.

Diagram 4. Making the woodland moccasin



MAKE A PROTOTYPE

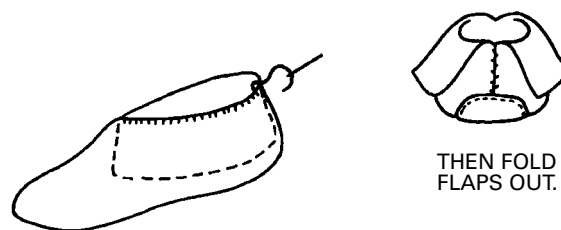
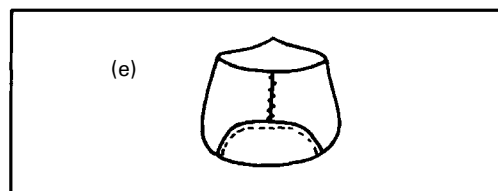
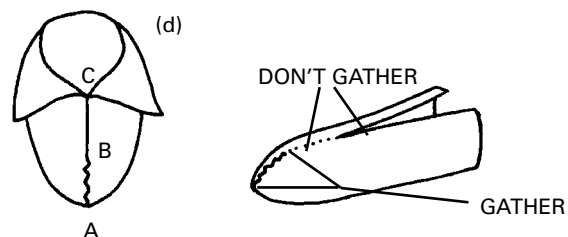
Before cutting your leather, make a cloth moccasin and try it on. This way you can check the fit and correct the pattern before cutting up the hide. Remember though, cloth will not stretch like the leather so it won't fit as well.

CUTTING THE LEATHER

When you are sure your pattern is correct, you can cut out your leather. Be sure you follow these instructions and make a cloth moccasin first as a prototype. Cut out a right and a left moccasin. Be sure the stretch is *across* the arch. Then, cut out the flaps (unless you were able to cut the moccasin in one piece).

SEWING THE MOCCASIN

1. Sew the moccasin inside out. Start at the V of the notch (A) and sew the moccasin using a whip stitch. Gather the seam around the curve of the toe (diagram 4d). Sew the remainder evenly and without pucker. Sew all the way up the vamp (toe area) to where point C meets point C. Pull the stitches *tight*.



SEW FLAPS INSIDE MOCCASIN.

2. Turn the moccasin right-side out. Work the toe over a broom handle and then work your foot into the moccasin. Pull and stretch until it fits.
3. Mark and trim the heel to fit and sew up the back. Then trim the heel tab so you have only about 1½ inches at the center. Fold it up over the back and sew it in place all around the edge. See diagram 4e, below.
4. Trim the flaps to fit and sew them in place. See diagram 4f.
5. Repeat for the second moccasin.

BLANKETS

Before the arrival of the European, the northern Indian relied heavily on animal furs and hides for clothing. The women were experts in tanning skins and could make them thick or thin, hard or soft, as they wished. However, when European goods became available, woolen blankets soon replaced the fur and leather clothing. The Indian quickly saw the advantage of the lighter woolen cloth, for, even when wet, it provided more protection from the elements. The woolen blankets were used for making capotes, coats, pants, gloves, bed covers, and as covering for the Indians who often preferred blankets to coats. The white or "common" blankets were popular with the Indians as they provided the best winter camouflage.

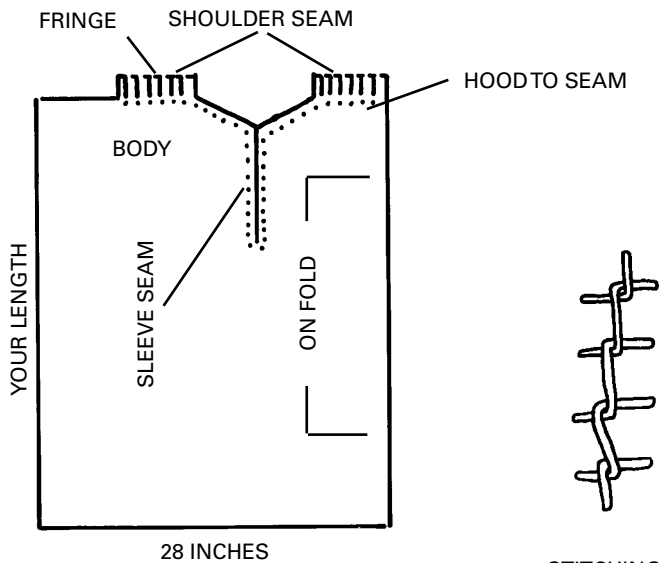
MAKING A CAPOTE

The Hudson Bay Company was founded to establish a fur trade with the Indians. Among one of the prized items was the Hudson Bay 4-pint trade blanket. When the Indian obtained one of these blankets, it was then cut and sewn into a hooded coat, a capote (kuh-POH-tee) that could keep the chill off in low winter temperatures.

This coat, used by both Indians and mountain men, is an all-weather warm coat good for heavy usage. Typically, it was made from a Hudson Bay blanket, but any good quality wool blanket will do. Note: Before you begin this project, you may want to consult a good seamstress for helpful suggestions.

First, make a pattern from some wrapping paper. Measure your arm length from the top of your shoulder to the wrist, adding an extra inch. Measure the length of the coat body from the back of your neck to whatever length you desire; preferably a little past the kneecap. Most Hudson Bay blankets are 72 x 90 inches, so keep that in mind when laying out your pattern. See diagram 5 for remaining measurements. (Helpful hint: You may want to use an old coat as a pattern. Remove the threading from the seams and take the coat apart completely.)

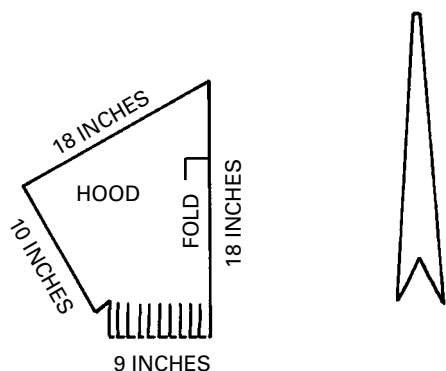
Remember that the body of the capote is made from one piece of cloth. When you think you have all the pieces you need, lay them all on heavy wrapping paper



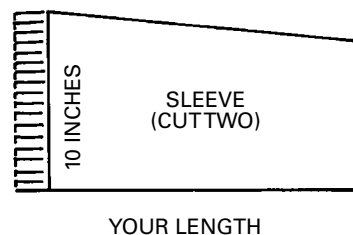
STITCHING



Diagram 5. The capote



TWO TASSELS
20 INCHES LONG



and trace around each piece. Mark the items “left arm,” “right arm,” etc. Cut out each piece with scissors.

Construct the capote by putting all the pieces together with pins or tape. Follow diagram 5 closely. When you have satisfied yourself with a decent fit, you are ready to cut out the actual pattern.

When laying the pattern onto the blanket, make certain that the colorful stripes are all going in the right direction. Also, lay the paper pattern onto a lightweight, inexpensive fabric, and cut out the pieces. This fabric can be sewn together like a lining and later used as such, and you’ll probably end up getting a better fit. When hand sewing, follow the sketch and use red wool yarn for sewing pieces together and for the edging.

The last piece is simple. Cut a belt to circle your waist with enough left to hang over. It should be about 3 inches in width. You now have a nice warm Lone Hawk capote.

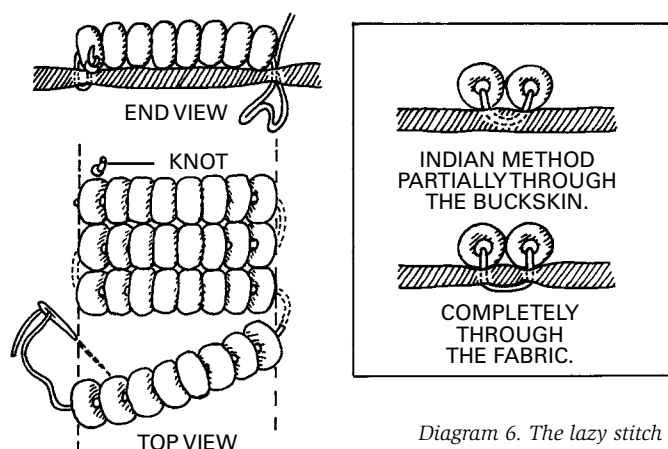


Diagram 6. The lazy stitch

BEADS

Good beads can be bought through many of the reputable dealers who advertise in the black powder publications. Usually they are sold by the hank, a string of beads numbering approximately 220 to 240 beads.

TOOLS AND MATERIALS

- **Beads.** Size 10 or 11 for starting out.
- **Needles.** Beading needles, No. 10 for size 10 beads and No. 12 for smaller beads. Purchase regular length needles, not the long loom version.
- **Thread.** Use beading thread, generally made of nylon. Do not use regular cotton thread, which will break through normal wear. Sizes vary from A to F. The size needed for size 10 beads is F; size A is the finest. Many like to use artificial sinew, split into fine threads. It’s very durable and looks like sinew in your beadwork. It works easily with size 10 or 11 beads.

- **Small pair of needle-nose pliers.** You will need these to break unwanted beads after they have been sewn on.
- **Scissors or knife.** Use to cut thread.
- **Material.** Buckskin, lightweight canvas or duck, or any fairly heavy fabric.

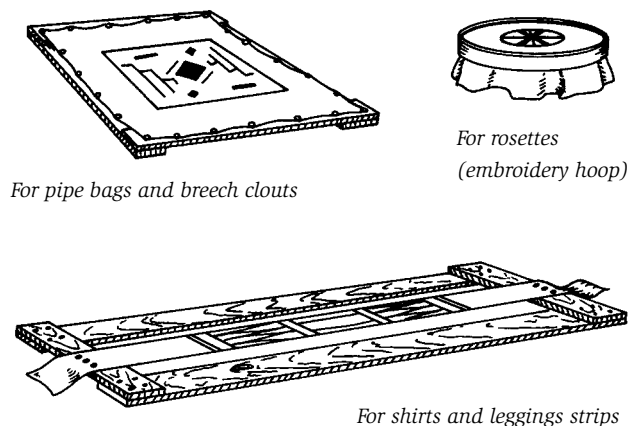
LAZY STITCH AND APPLIQUE METHODS

Two beading methods were used most by the mountain men and voyageurs. Most of their geometric designs used the lazy stitch, while the floral designs were made with the appliqué method. Loom beading is rarely seen.

LET’S BEGIN

The lazy stitch is shown in diagram 6. The thread is knotted and is brought up through the fabric. It is then strung with the correct number of beads. The needle is pushed straight down alongside the last bead, then brought up again a sufficient distance away to be in line for the next row. Ultimately, it should form neat rows of beads.

For your first design, try a simple block and/or triangle pattern without lots of fine lines, a pattern common during the western fur trade. First, mark your design on the material in some fashion. Whether you draw directly on the fabric or draw the design first on a sheet of paper is up to you, although sketching your design first is recommended. Graph paper works well for drawing your design, and fabric carbon serves as a good transfer sheet. It can be obtained at any fabric store. Regular carbon paper is not recommended because it is messy and makes a wide line. Your drawn lines should be fine to help when you start beading.



For pipe bags and breech clouts

For rosettes
(embroidery hoop)

For shirts and leggings strips

Diagram 7. Tacking your work onto a frame will help keep the material from being stretched out of shape.

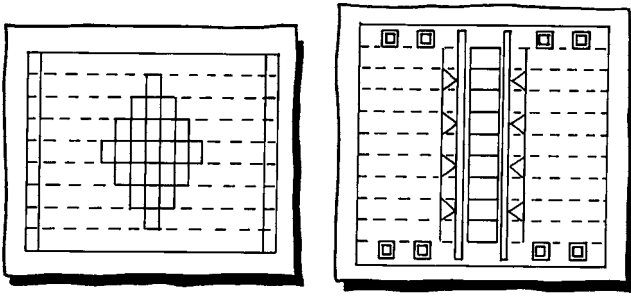


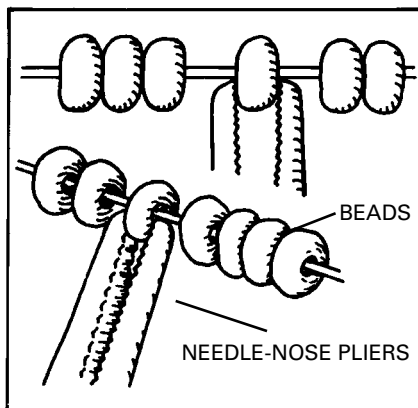
Diagram 8. Mark your design with your pattern.

Before you actually start beading, the fabric should be tacked to some sort of frame. This is especially important when large areas are to be covered. Hat bands, leggings, and shirt strips can be beaded easier if the fabric is kept taut. A frame can be made of thin crate lumber or something similar nailed at the corners. Your work can be thumbtacked to it (diagram 7). An embroidery hoop works well for small items and rosettes. In the case of leather, don't stretch it too tight. When taken off the frame, it will probably return to its original size and may distort your beadwork.

When laying out rows for your design, a width of six to eight beads is easiest to handle. Measure the width of your rows and mark this on your design (diagram 8). This will help keep your rows straight. An even width makes a neater job.

When you come to the end of the thread, there

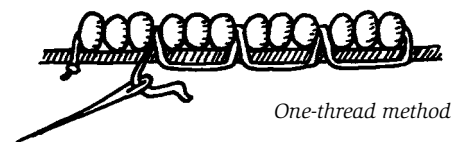
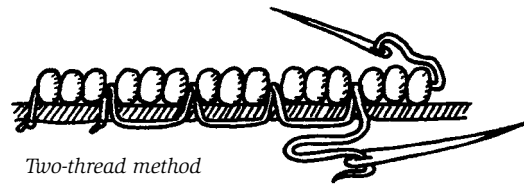
The correct way to break a bead



are two ways to secure it. If you are not going all the way through the leather with the thread, then run the thread back through the last one or two rows of beads. Otherwise, run the needle in a zigzag a couple of times under the thread, and then knot. Cut it off or bring it out the back of the material.

If you need to take out a bead at any point after a row has been sewn down, you can do so with the needle-nose pliers as illustrated without breaking the thread. Caution: Wear eye protectors as you break the bead to protect your eyes from flying particles of glass.

Appliqué beadwork can be used in geometric designs but is used primarily for floral work. In this method, a string of beads is appliquéd to the fabric. By the method described, you can bead curved lines or fill in large areas. Some people prefer to use two threads and some use only one as shown below. Experiment to see which method works better for you.

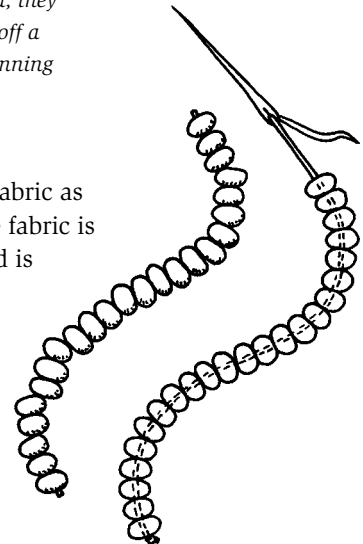


Appliqué beadwork

When curves are a little ragged, they can be smoothed out by tying off a separate thread at one end, running through all of the beads.

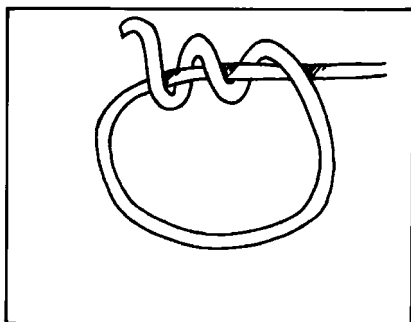
The design is put on the fabric as described previously and the fabric is tacked to a frame. The thread is knotted and fastened, and the beads are strung on the thread and sewn down. Depending on the curve of a particular run, you may sew only one or two beads at a time. On straighter runs, you may sew four or five beads; it is not advised to sew more than that as a run begins to sag under its own weight.

When doing curves such as a vine, the smoothness of the curve can often be helped after beading by using a separate thread. Tie it off at one end of the curve and run the thread through the whole string of beads. Pull it tight and knot it. This will help smooth out the curve.



If you choose to knot your thread on the front side of your work, do it in an area that will be covered by beading. If you are using artificial sinew, tie the knot as shown, cutting the sinew about ¼ inch from the knot. Light the end of the sinew with a match and let it burn down almost to the knot. This melts and forms a knot in the sinew that will prevent the end of the sinew from slipping through the tied knot.

BEADING ROSETTES



Pull tight and tie off the knot as shown; pull tight, and repeat.

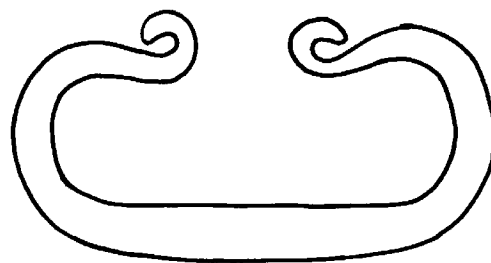
You might wish to bead a rosette to go on your fur hat. If so, you will need a base on which to bead. An old felt hat brim works fine for this. First, draw your design. Then, attach the felt to a frame. Begin in the center, with one bead tied down. Thread four to eight beads for the first row using whichever color has been selected. Sew down every second or third bead. Each row should be sewn as closely to the other row as possible without forcing it. Repeat this procedure until the rosette is completed. When each circle of beads has been completed, your thread should be pulled through the first one or two beads to pull the ends together without leaving a gap. The rosette should be perfectly flat when finished. If it is loose or irregular it means that beads might not have been carefully picked to fit in. When finished beading, cut a leather backing the same size as your rosette and sew it to the back. This will cover the exposed threads and will strengthen the rosette.

Good beadwork takes practice and patience. But with a little of both, anyone can do nice beadwork.

COOKING

FLINT AND STEEL KIT

To make a flint and steel kit, first make the striker by using an old file. Forge (heat and bend with hammer) the material to get it to the desired shape. Heat it until it is red-hot in the center. Cool the material by immersing it in water. Use an old tin box of any kind to pack it in.



Heat until red-hot in the center.

TINDER

To make tinder, first you'll need cloth you can burn. Sheet material is a good choice. It should be 100 percent cotton and not a blend with synthetic fibers. Cut the cloth into small patches about 2 inches square. Place the pieces in a small, airtight metal can with a small nail hole in the top. (You're right, it is no longer airtight with the hole in it.) It must be tight enough so that the cloth does not burn. Throw the can into the fire. A faint wisp of smoke coming from the nail hole indicates that the cloth is charring. The cloth should be dark brown to black when it is charred.

JERKY

Jerky is another name for any kind of dried meat. Today, your best choice is beef. Make sure you select the very leanest beef possible, with no fat and no marbling. The best cuts for jerky are top round or flank steak.

The early Indians simply dried the meat in the sun. Pioneers added salt and pepper and often smoked it as well.

The following recipes all involve marinating the meat. First, cut the meat into strips about ¾" × 1½" × 8" and trim off all fat. Marinate or soak the meat for approximately 12 hours (not less than eight or more than 24). Dry it in an oven set at the lowest heat possible (less than 150°). In a gas oven, the pilot light (on high) is usually adequate. Leave the oven door open about 4 inches to let moisture out and keep the heat from building up.

Place a large cookie sheet or tin foil on the rack below the rack on which you have laid the meat. This catches drippings from the marinade and helps keep the oven clean. Dry the meat until it is very stiff and black on the outside but not all the way through. It will dry much more later in the paper sack you store it in. If you care to store it any length of time, put it in an airtight container.

RECIPE 1

(Up to 5 pounds of beef)
1 quart water
1 cup cider vinegar (brown)
½ cup salt
2 tablespoons pepper

RECIPE 2

(Up to 2 pounds of beef)
2 ounces soy sauce
1 tablespoon lemon juice
1 tablespoon salt
½ tablespoon pepper
Garlic salt to taste

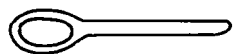
For added flavor, rub liquid smoke on each side of the meat halfway through the drying time. If you like it hot, add more pepper. Just shake it on while the meat is still moist.

SPOONS, SPURTLES, AND BOWLS

To make your own spoons, spurtles, and bowls, pine is recommended. This wood is easy to work and is reasonably durable, although it will dent if handled carelessly. Poplar wood is also a good choice. Straight-grained fir is tough and durable but a bit splintery. Maple and birch have good strength. Close-grained woods, such as pine, maple, and boxwood can be left unfinished or given a coating of cooking oil. Rub the oil in with your hands. Wipe off any excess with a clean, soft, lint-free cloth. Repeat the oiling once a day for a week, once a week for a month, once a month for a year, and once a year thereafter.



SPOON

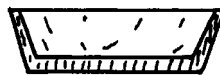


SPURTLE

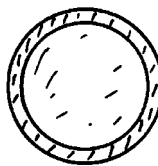


THINNEST SECTION
IS $\frac{3}{8}$ INCH.

Spoons and spurtles



CUTAWAY VIEW



TOP VIEW

Bowls

DIPPER GOURD

As its name implies, the dipper gourd is shaped like a dipper. It can easily be made into a dipper by removing somewhat less than half of the upper part of the gourd body. Save the piece removed and later convert it into a large cooking spoon by reducing it to the desired size and adding a handle carved from a nonresinous, nonaromatic wood such as maple or basswood.

ACKNOWLEDGMENTS

We wish to extend our sincerest appreciation to Dennis Greenwood of the Great Salt Lake Council for his assistance and resources in the preparation of this program feature.

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MECHANICS

BACKGROUND



Unlike many forms of recreation, auto mechanics can be both a hobby and a meaningful career. An interest in cars and a basic understanding of how they work also provide an individual with general knowledge about mechanical devices. As a person's knowledge increases, more and more difficult tasks can be attempted. Once an individual has mastered the fundamental skills, more complicated repairs can be undertaken with confidence and, of course, with a higher degree of accuracy and success.

Understanding the basics is critical. The first step in developing this understanding is learning to identify the major parts of an automobile (or light truck). To begin this task, become familiar with the exterior parts by cleaning the vehicle, from bumper to bumper. From there, open the hood—with the engine shut off—and study the different internal parts.

Common sense will reveal the placement and function of many surface engine parts. The air cleaner, for example, is readily visible on all cars. It is installed in such a way that it filters air before the incoming air enters the carburetor or fuel injector. The wires that lead from the spark plugs to the distributor identify parts of the ignition system on the engine. If the vehicle is a 4-cylinder, there will be four wires; if it is a 6-cylinder, there will be six wires; and if it is a V-8, there will be eight wires.

At the front of the engine compartment is the large radiator, through which air passes to cool the engine coolant. Large hoses from the radiator attach to the engine block and carry coolant used to cool the engine block. There are also hoses of a smaller diameter that circulate hot water through the heater in the passenger compartment for comfort in cold weather. The fan, usually directly behind the radiator, rotates when the engine is running to draw air through the radiator. **(Caution: A rotating fan will cut off fingers or an entire hand! The engine must NOT be on when you explore the underhood parts.)** On some cars a smaller fan will also be found at the front of the radiator to force air through it. These fans are electrically operated and if the engine is hot they will continue to operate automatically after the engine is shut off. **Keep hands and fingers away from the fan if it is operating.**

In all projects, you must “walk before you run,” and an understanding of all of the fundamentals is necessary before advancing into repairs. Above all else—**safety first!**

PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with help from a team committee member.

ADVANCEMENT

- Review each Varsity Scout's advancement status.
- Conduct a Traffic Safety merit badge clinic.
- Monitor the team advancement chart regularly.

HIGH ADVENTURE/SPORTS

- Program manager outlines or update the team's annual special high-adventure event (Philmont, Florida Sea Base, etc.)

PERSONAL DEVELOPMENT

- Invite a law enforcement officer to explain how to obtain a driver's license.
- Arrange a visit to observe traffic court.
- Visit an automobile insurance agency.

SERVICE

- Adopt part of a highway or public road for litter cleanup.
- Operate a “safety break” station over a holiday weekend.
- With the car owner's permission, clean windshields on vehicles in a local shopping center (obtain permission from property management in advance) or elsewhere in your community.

SPECIAL PROGRAMS AND EVENTS

- Attend a motorized speed event.
- Tour a vehicle assembly plant or parts manufacturing plant.
- Conduct a safe-driving “rodeo.”

BASIC OPERATING PRINCIPLES

Let's discuss and define a few basic operating principles. You'll want to refer to the illustrations as well as the glossary of terms found at the end of this program feature as you review.

INTERNAL COMBUSTION PROCESS/ 4-CYCLE ENGINE

The internal combustion process consists of four cycles: (1) the repeating cycle of filling a cylinder with a fuel and air mixture as the piston moves down (cycle 1), (2) compressing the mixture with the piston as it moves up (cycle 2), (3) igniting the compressed fuel with the spark plug and forcing the piston back down (cycle 3, the power cycle), and (4) using the piston to force the burned fuel residue (exhaust) out of the cylinder (cycle 4).

VALVE TRAIN OPERATION

Intake valves are momentarily opened to allow the fuel and air mixture to enter the combustion chamber. Exhaust valves stay closed until the combustion process is complete; they then open to allow the burned fuel (exhaust) to escape.

Valves are opened and closed by the rotating egg-shaped “lobes” on the camshaft. The action is usually accomplished in one of three ways.

- The valve is in direct contact with the camshaft lobe via a follower (lifter).
- One end of a rocker arm is in direct contact with the lobe and valve stem.
- A pushrod is used from a lifter to a rocker arm.

A stiff spring attached to the valve stem closes the valve.

POWER TRANSMISSION (INCLUDING DRIVE TRAIN)

Pistons are connected to a crankshaft by a connecting rod. As the piston is forced down by the combustion process (the power cycle), it turns the crankshaft. The crankshaft rotations are guided by either a set of gears in a manual transmission or a fluid, turbine coupling in an automatic transmission. After being sent through the transmission, power travels by a drive shaft through a differential to either the front or rear wheels, depending on the car design. The differential enables the driven wheels to rotate at slightly different speeds as the car goes around sharp turns.

IGNITION SYSTEM

The spark plug and its power source ignite the fuel and air mixture at precisely the correct time. This takes place just as the fuel is compressed by the piston (cycle 2, above).

FUEL SYSTEM

The fuel system consists of

- The fuel pump that forces gasoline from the tank up to the engine
- The in-line fuel filter that cleans the gasoline
- The carburetor or fuel injector and manifold that distribute the fuel to each cylinder for combustion

See diagrams on pages 51 and 52.

EMISSION CONTROL SYSTEM

Because exhaust is a waste product and a known health hazard, it has to be controlled and limited to protect public health and the environment. Emission control systems process and recirculate the pollutants to make the exhaust cleaner and less harmful when it leaves the tail pipe. Air pumps, oxygen sensors, exhaust gas recirculation (EGR) valves, positive crankcase ventilation (PCV) valves, and catalytic converters are some of the devices that allow automobiles to pollute less.

ENGINE MANAGEMENT SYSTEMS

Found mostly in cars built since 1980, these electronic minicomputers monitor the engine temperature, air temperature, barometric pressure, manifold pressure (vacuum), engine speed, vehicle speed, the throttle position, and fuel and air mixture to continuously “tune” the engine so that it runs at maximum efficiency. Engine management systems provide a continuous “tune-up” as the car is being driven, and they help the car burn less fuel, emit fewer pollutants, and produce more horsepower.

COOLING SYSTEM

Because internal combustion engines use flame to produce power, temperatures have to be controlled so the engine doesn’t become too hot. The cooling system circulates a mixture of water and chemicals through the engine cooling passages, called *jackets*, to keep the temperature from becoming too hot and warping the engine block and heads, which would probably result in damage to other components. An even temperature also helps the engine run more efficiently.

Cooling systems consist of a radiator, radiator hoses, a water pump for circulation, and a thermostat to keep the water at a constant temperature. Some cars use only air cooling, a system that uses a large fan driven by the engine to keep the engine cool.

EXHAUST SYSTEM

This system channels the burnt fuel residue from the engine through the catalytic converter, then to the muffler to keep the exhaust quiet, and finally out to the rear of the car. Exhaust manifolds are mounted beside the engine block to catch the exhaust as it escapes the cylinder, and the exhaust pipes carry the hot gases below the car through the converter and muffler to the tail pipe outlet(s) at the rear.

BRAKING

In most cases, today's cars use front disk brakes and rear drum brakes; friction pads are forced into contact with the surface of the disk or drum to stop the car. Disk brakes use brake "pads" attached to a caliper that squeezes the disk, and drum brakes use a brake "shoe" that presses against the inside of the rotating drum to slow and stop the car. In either case, the pads and shoes are forced against a friction surface with hydraulic pressure that is created when the driver steps on the brake pedal.

Brake fluid is housed in a master cylinder and sent to each wheel through small lines. Each wheel has its own small reservoir (wheel cylinder) of brake fluid that expands when the brake pedal is pressed to activate the disk- or drum-brake mechanism. On most late-model cars, the brake fluid is passed through the system with the aid of a vacuum power-assisted unit; these are referred to as power brakes. See diagrams on pages 55–57.

STEERING AND SUSPENSION SYSTEMS

These are the components that act with the wheels and tires to control the handling, turning, and ride of the car. Today's cars use either a rack-and-pinion steering system or a recirculating ball system. In either case, the front wheels are connected to the steering gear by long rods that move the wheels according to the position of the steering wheel. Some of the major steering components include the steering box, idler arm, and tie-rods and tie-rod ends.

Suspension systems vary widely from car to car, but most use either coil springs, torsion bars, or flat layers of leaf springs to hold the car up and away from the tires. The suspension system allows the wheels to react to bumps in the road by moving up and down over uneven surfaces. This keeps the car evenly "suspended" above the road. Shock absorbers, MacPherson struts, control arms, A-arms, trailing links, and bushings are some of the common pieces that make up the suspension system. See diagrams on pages 58–60.

ELECTRICAL SYSTEM

Cars need a steady supply of electricity to power the ignition system and accessories such as the lights, horn, radio, and ventilation-system fan. This electricity is created by an alternator that is driven by an elasticized (rubber) belt attached to the crankshaft with a pulley. The alternator also continuously charges the storage battery so that there is enough energy in reserve to crank the engine when the car is started.

Electrical systems use a wiring harness that serves as a "map" of electrical wiring, which carries electricity to where it is needed. A regulator keeps the supply of electricity stable as the alternator rotation speeds up and down according to engine speed. Regulators keep the alternator from producing too much or too little electrical current being fed into the battery and to electrically operated equipment and accessories.

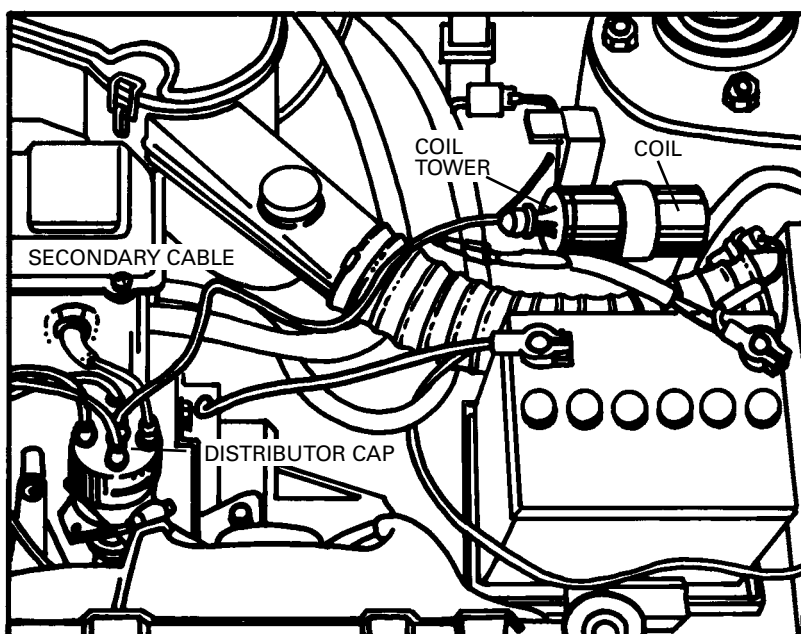
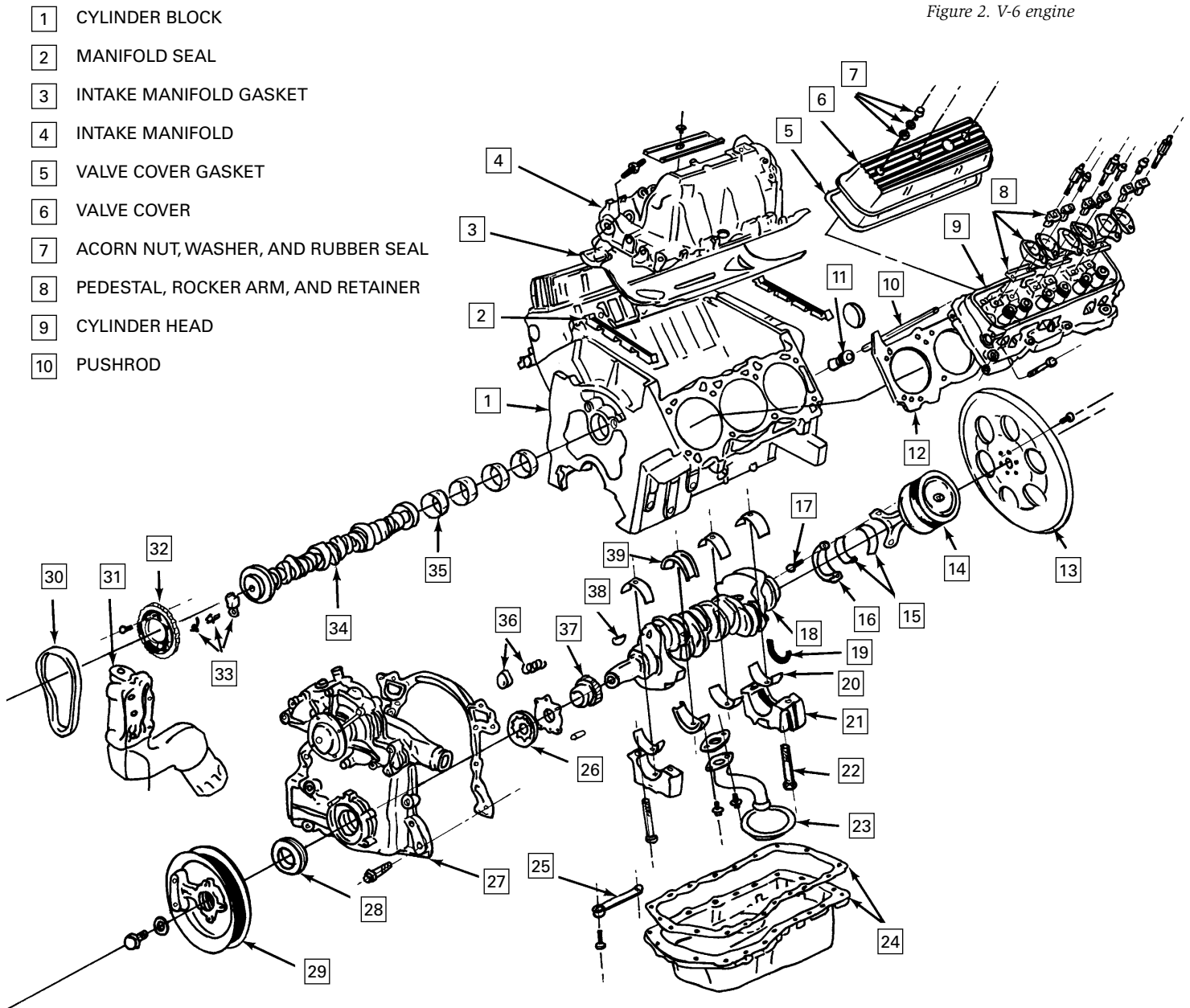
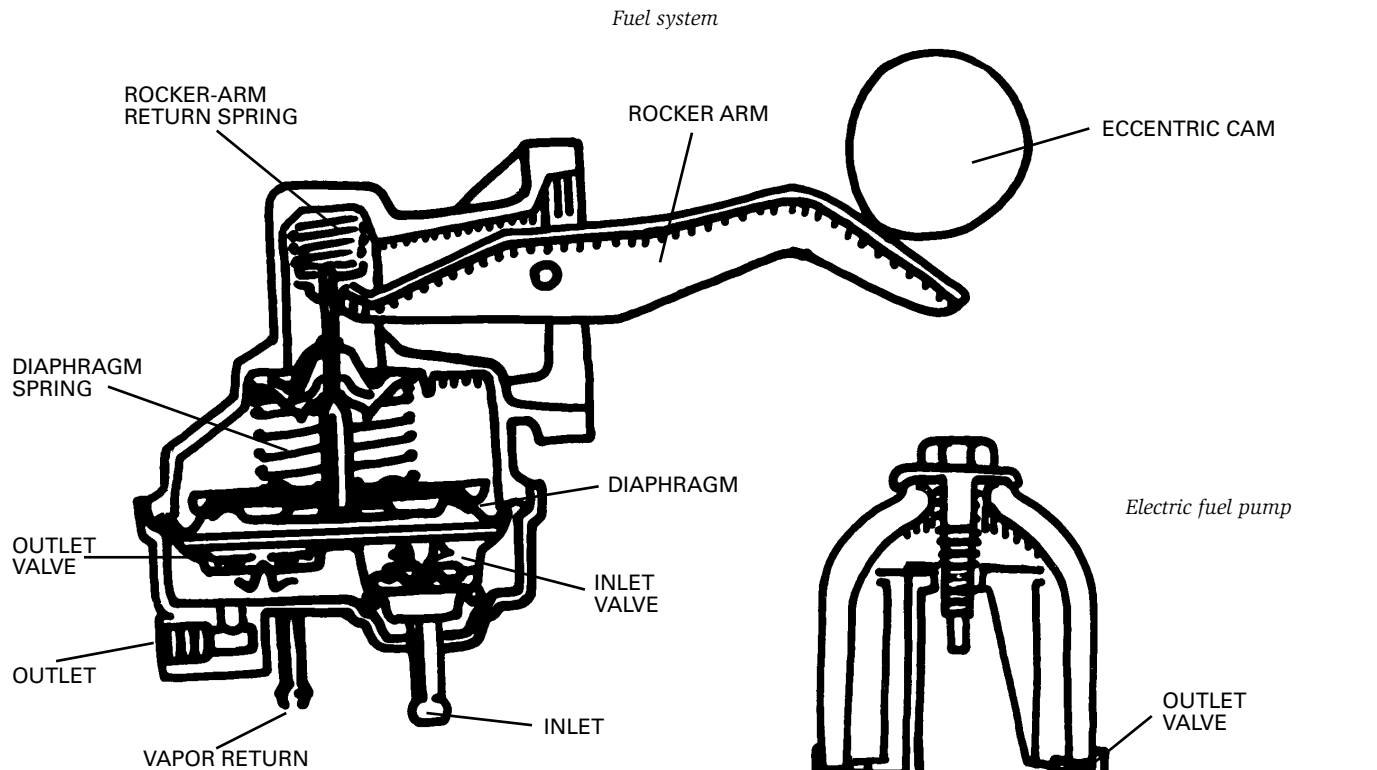


Figure 1. The secondary cable runs between the ignition coil and distributor cap.

Figure 2. V-6 engine





Mechanical fuel pump

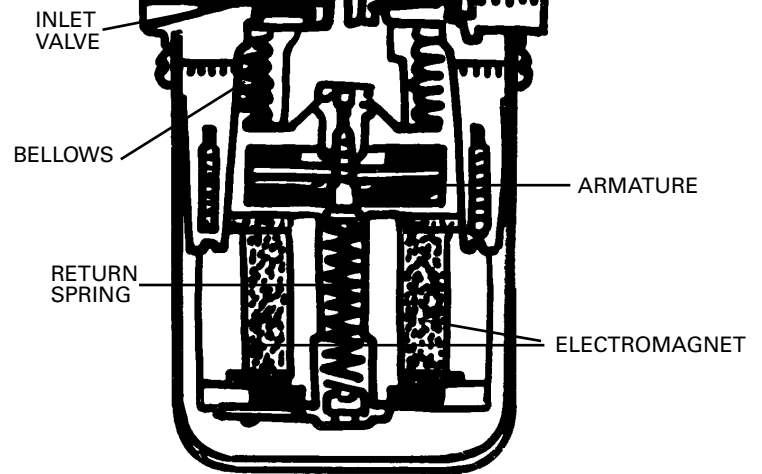
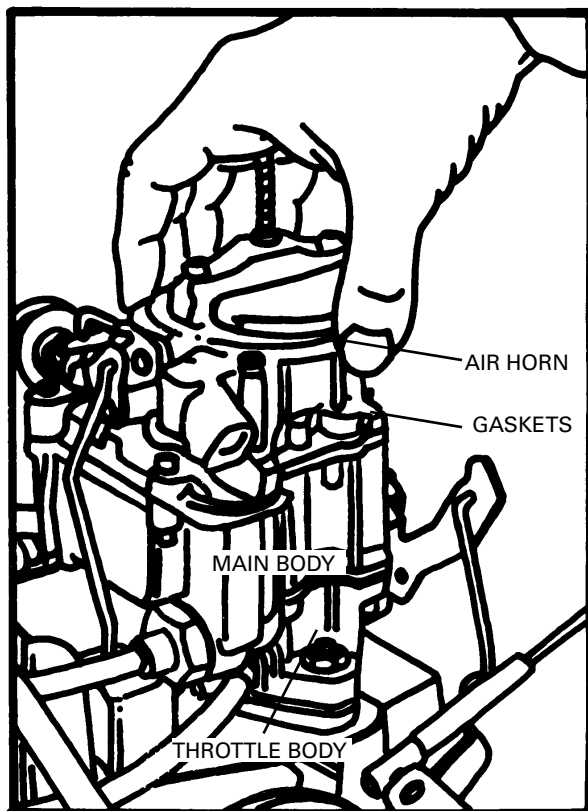
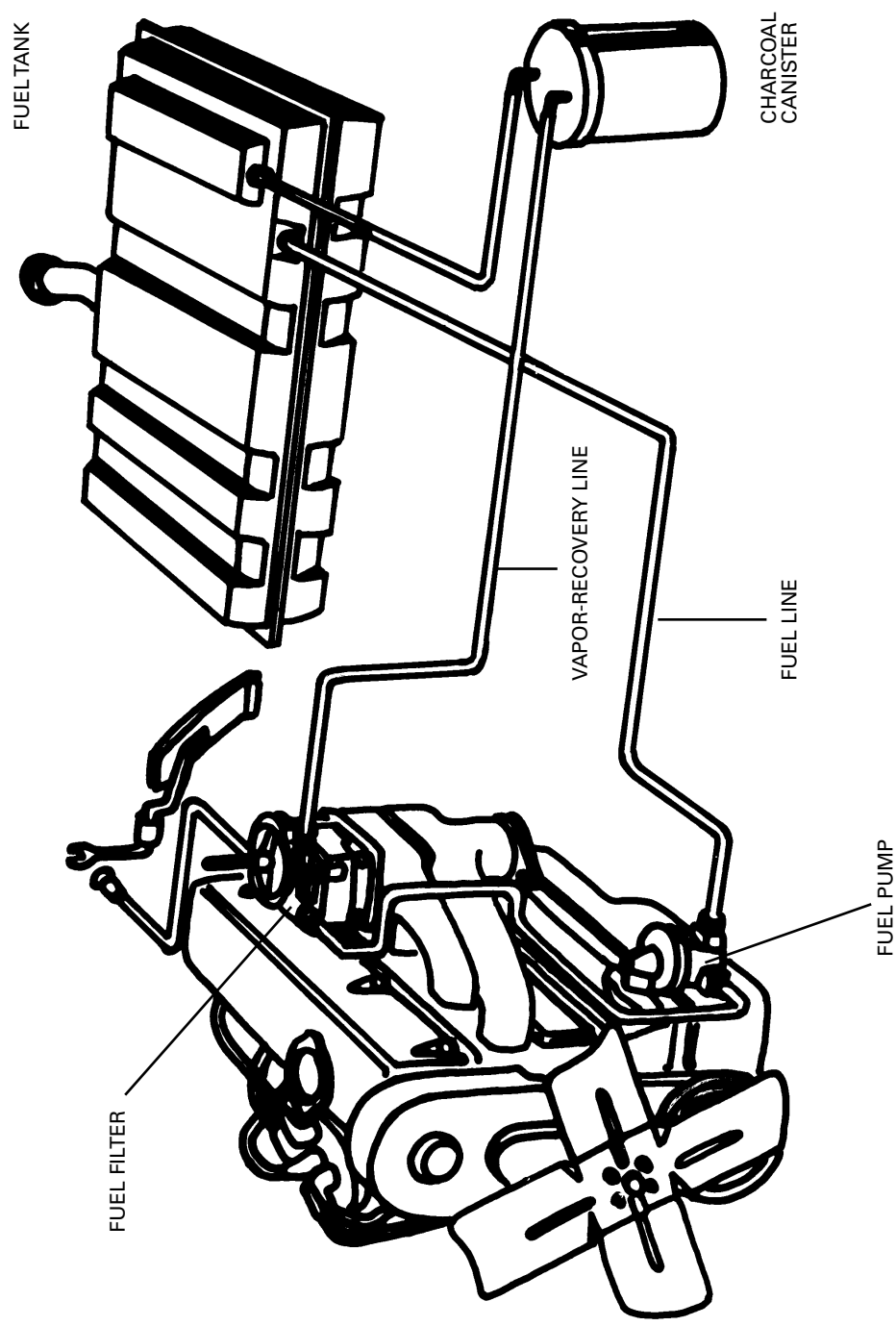


Figure 3. Mechanical and electric fuel pumps

Figure 4. Grasping the carburetor

Figure 5. Fuel-delivery and evaporation-control systems



When an engine performance problem develops, its cause often lies with one of these parts.

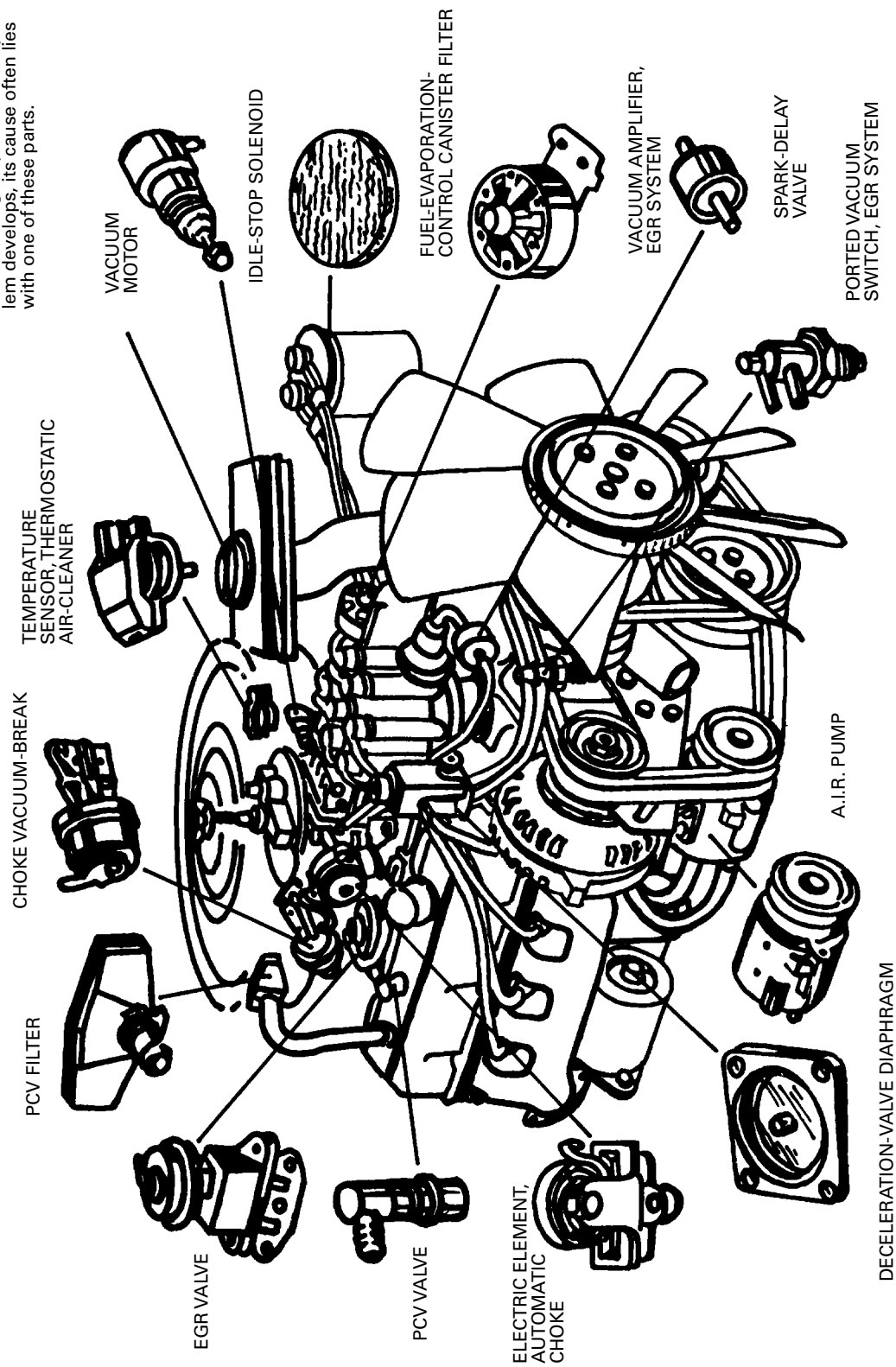


Figure 6. Emissions-control parts and systems

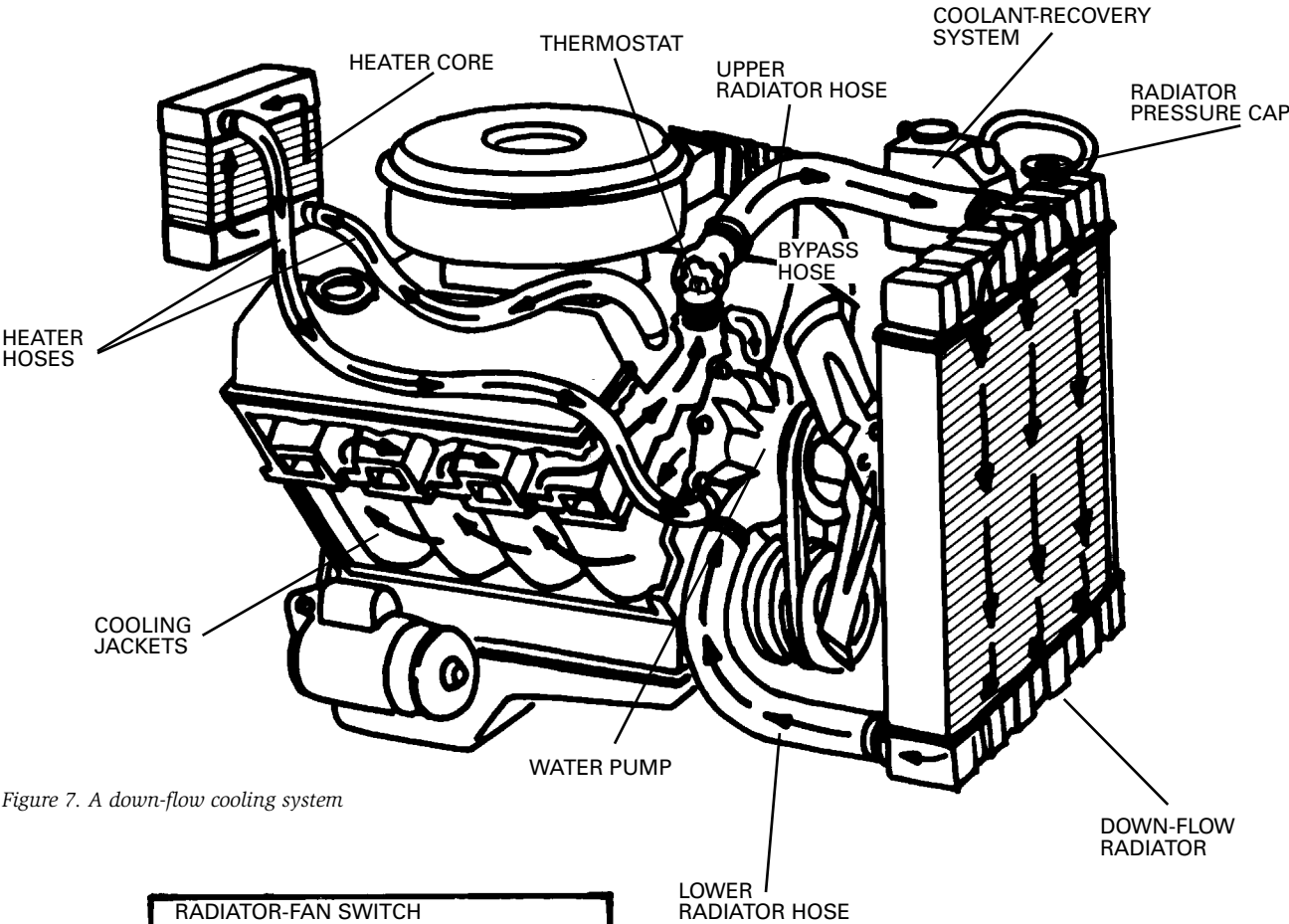


Figure 7. A down-flow cooling system

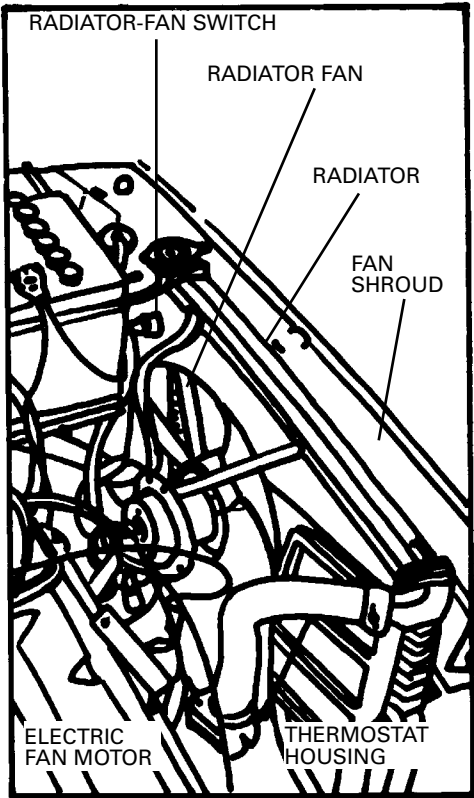


Figure 8. An electric fan

Braking system

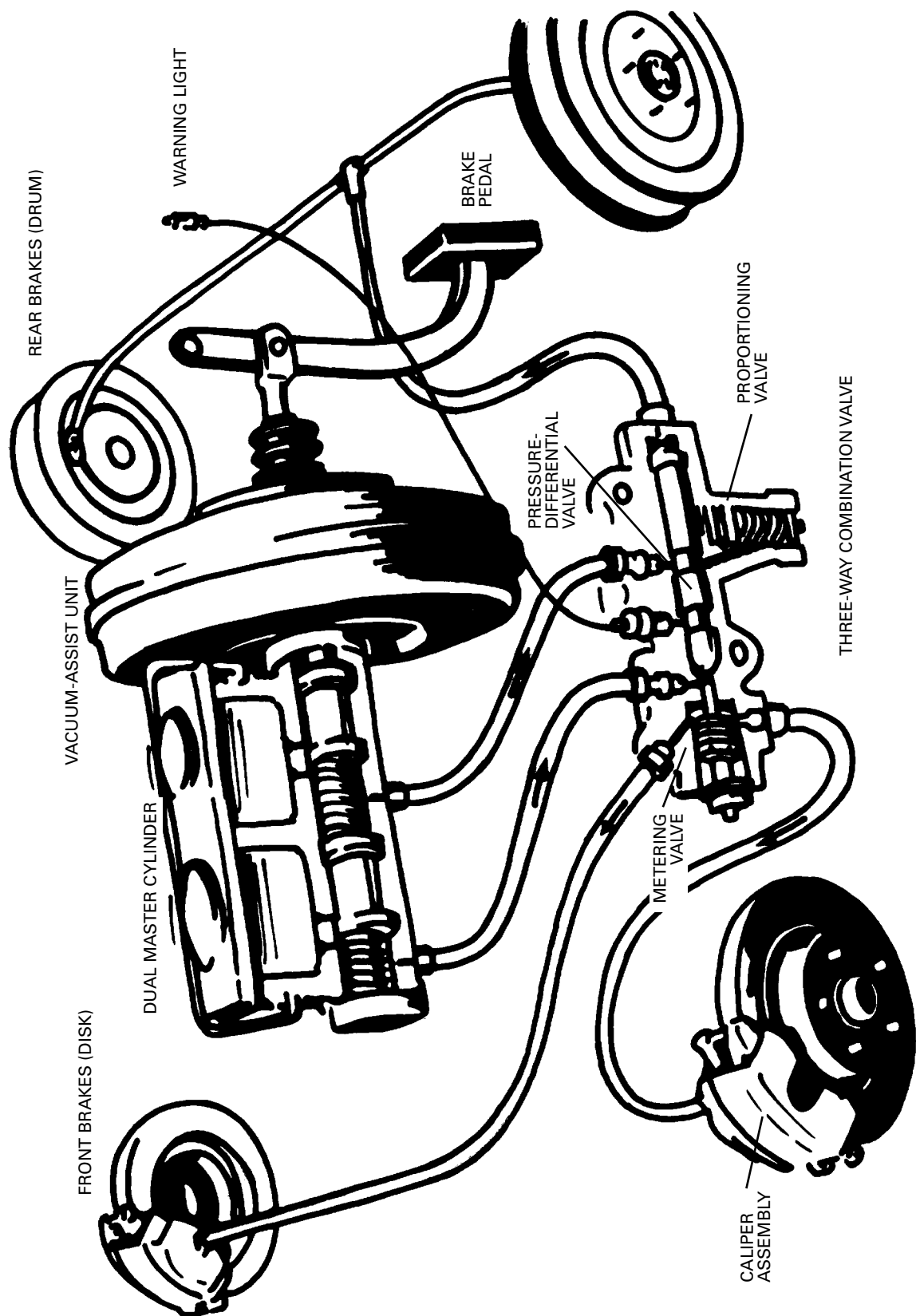


Figure 9. The brake system

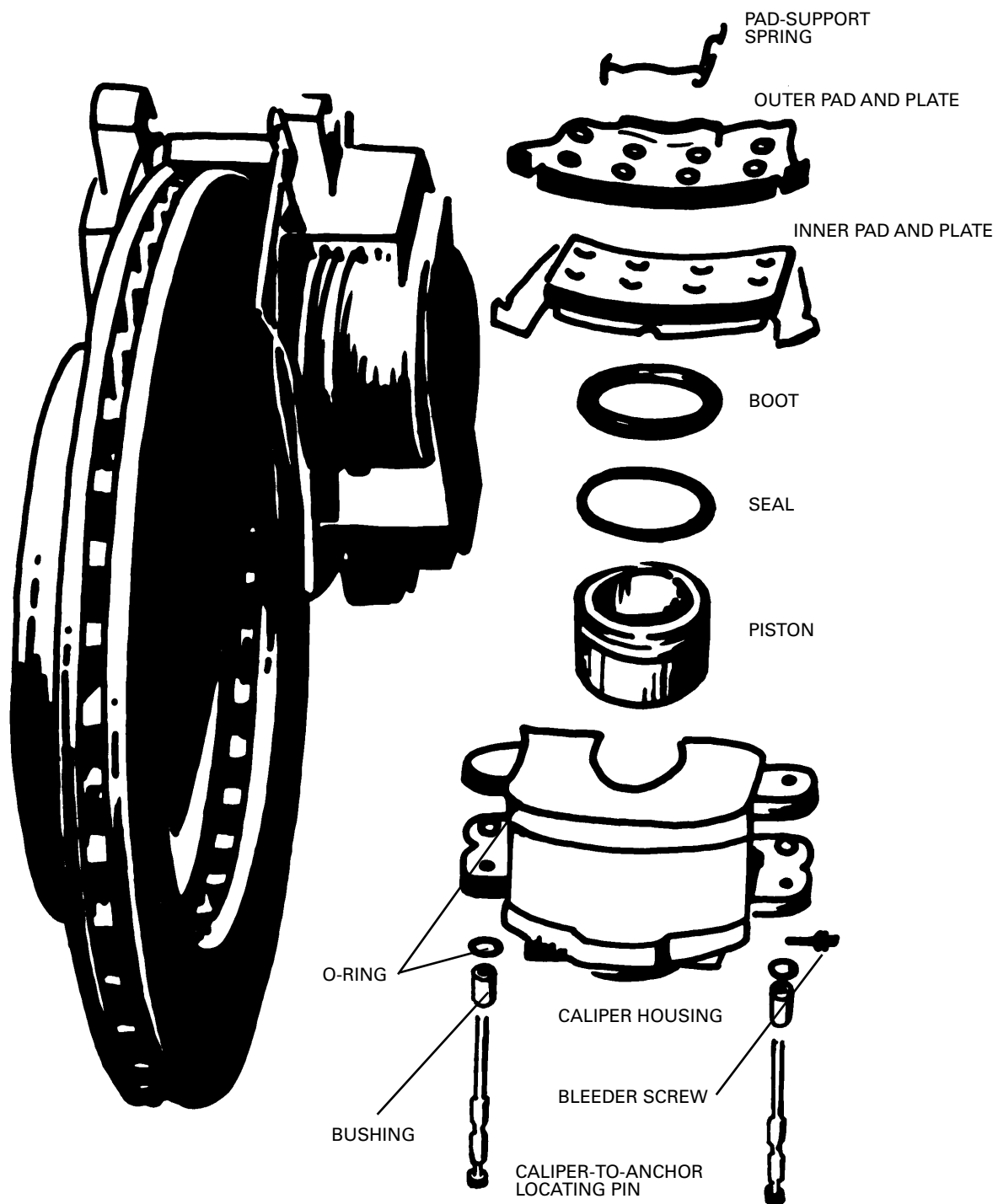
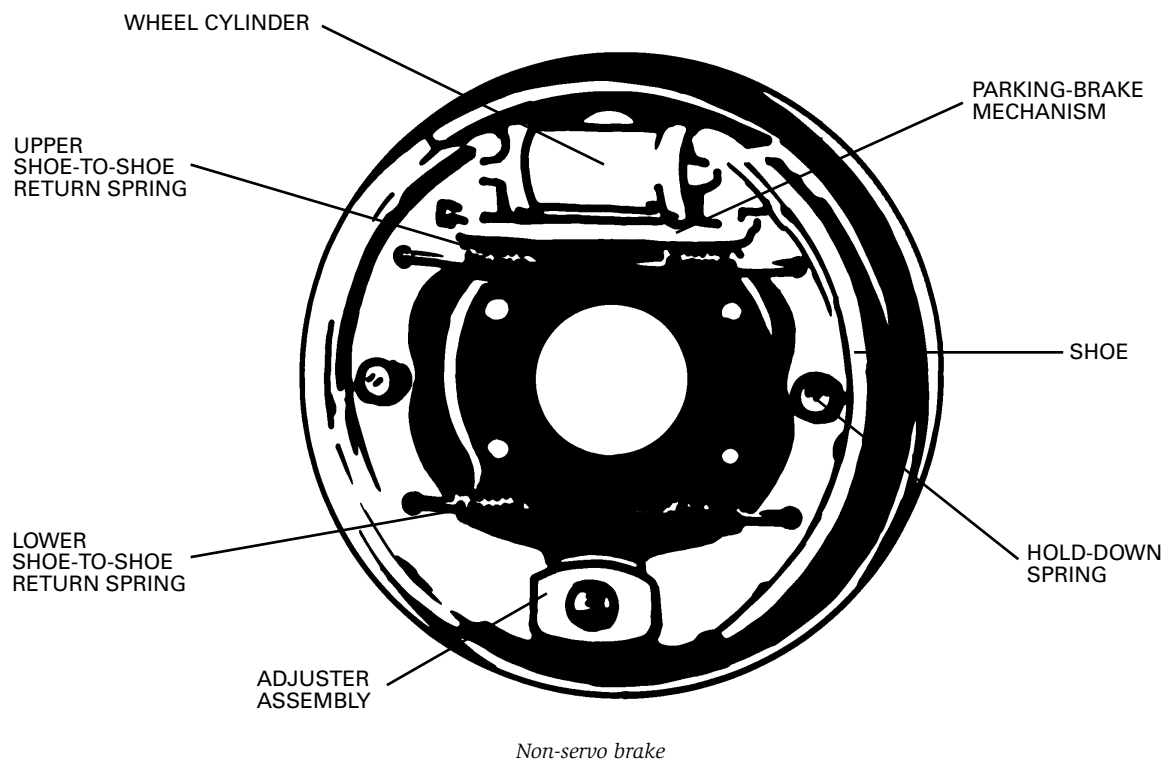
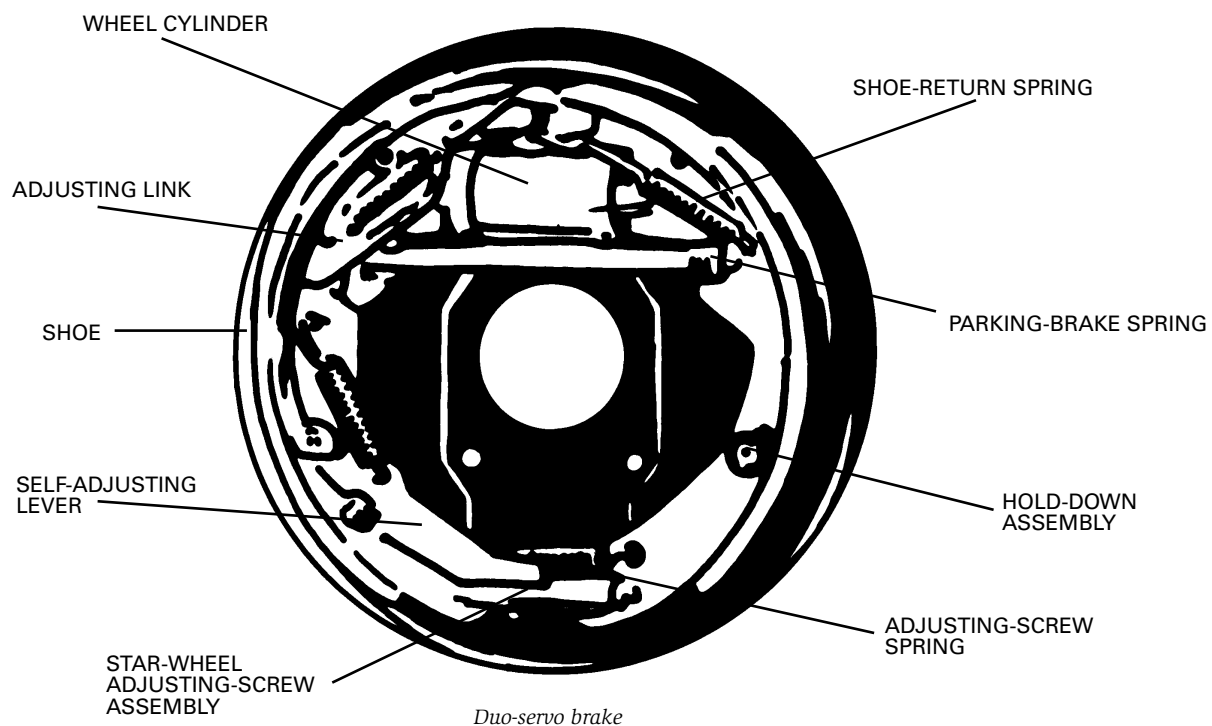


Figure 10. Disk brakes



Suspension system

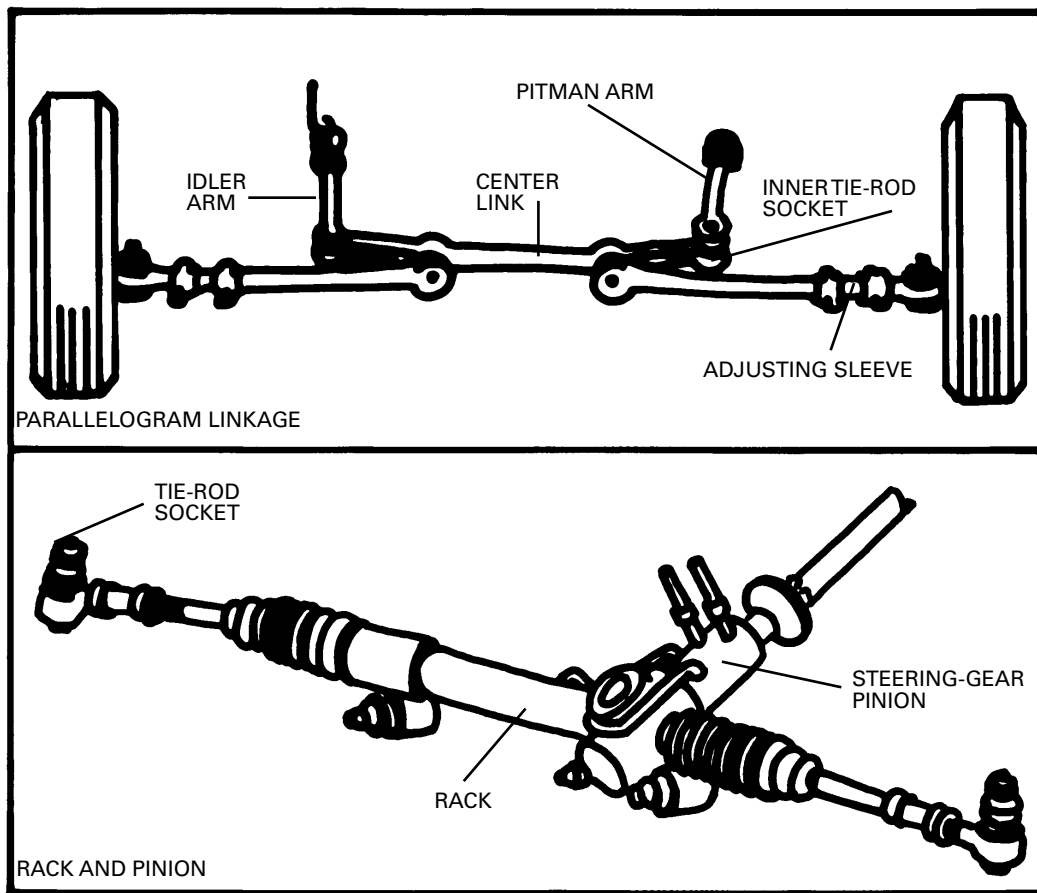


Figure 12. Steering systems

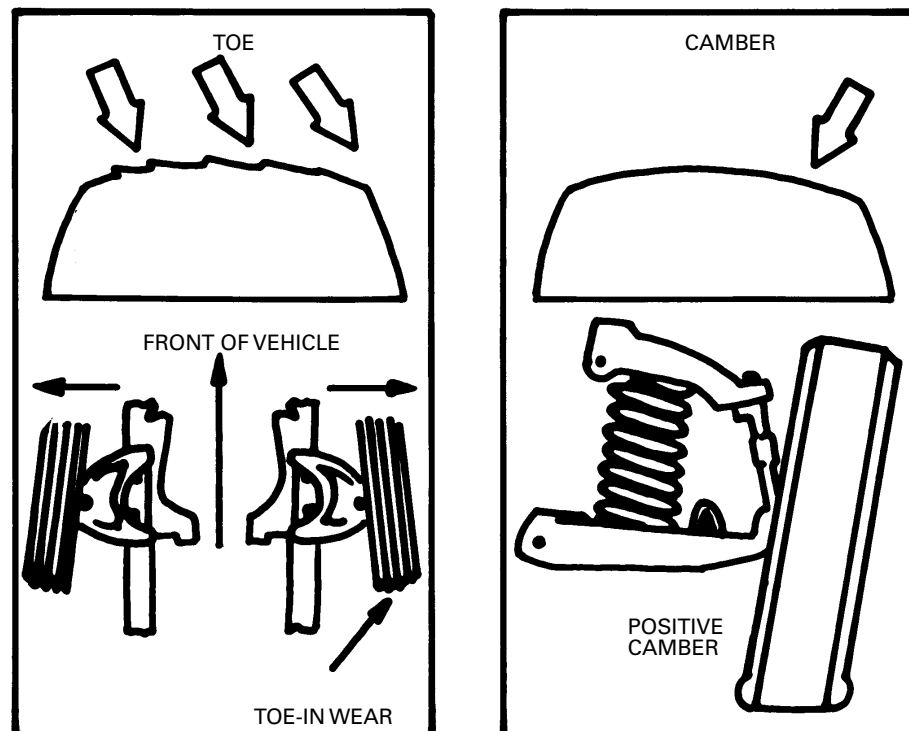


Figure 13. Wheel alignment

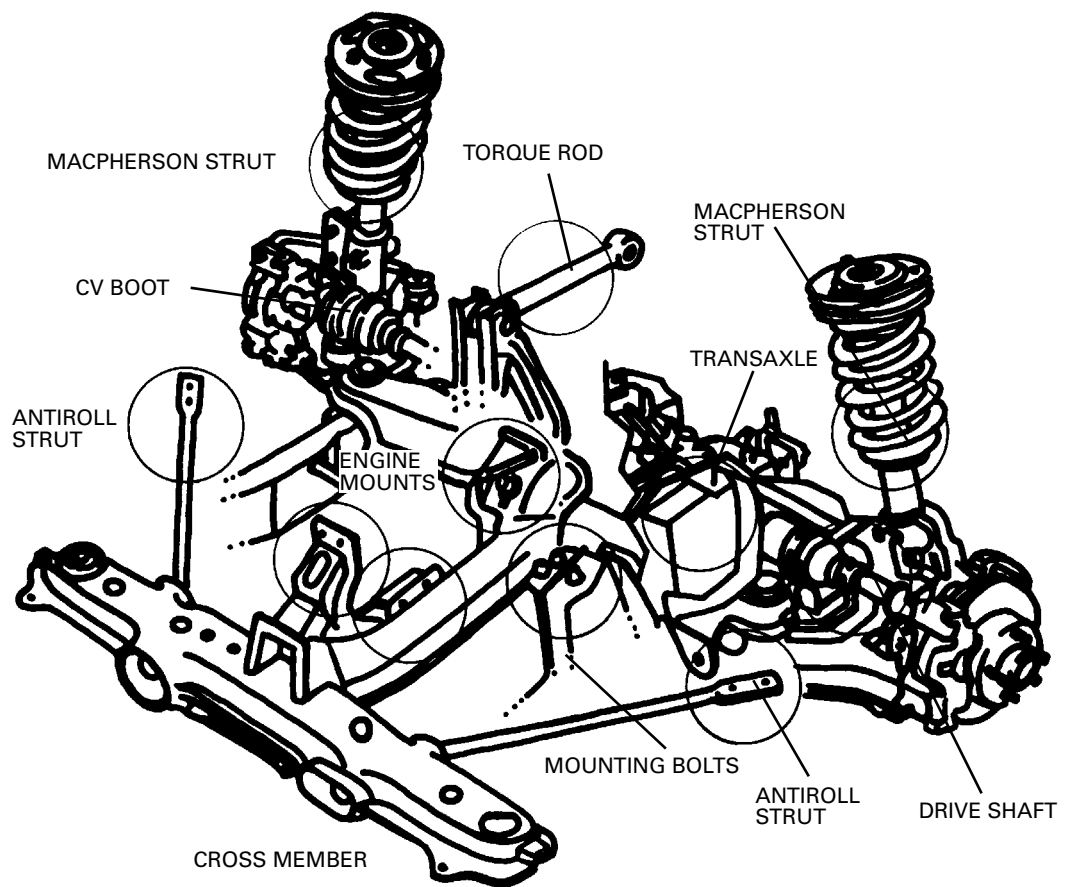


Figure 14. Front-end system of a front-wheel-drive car

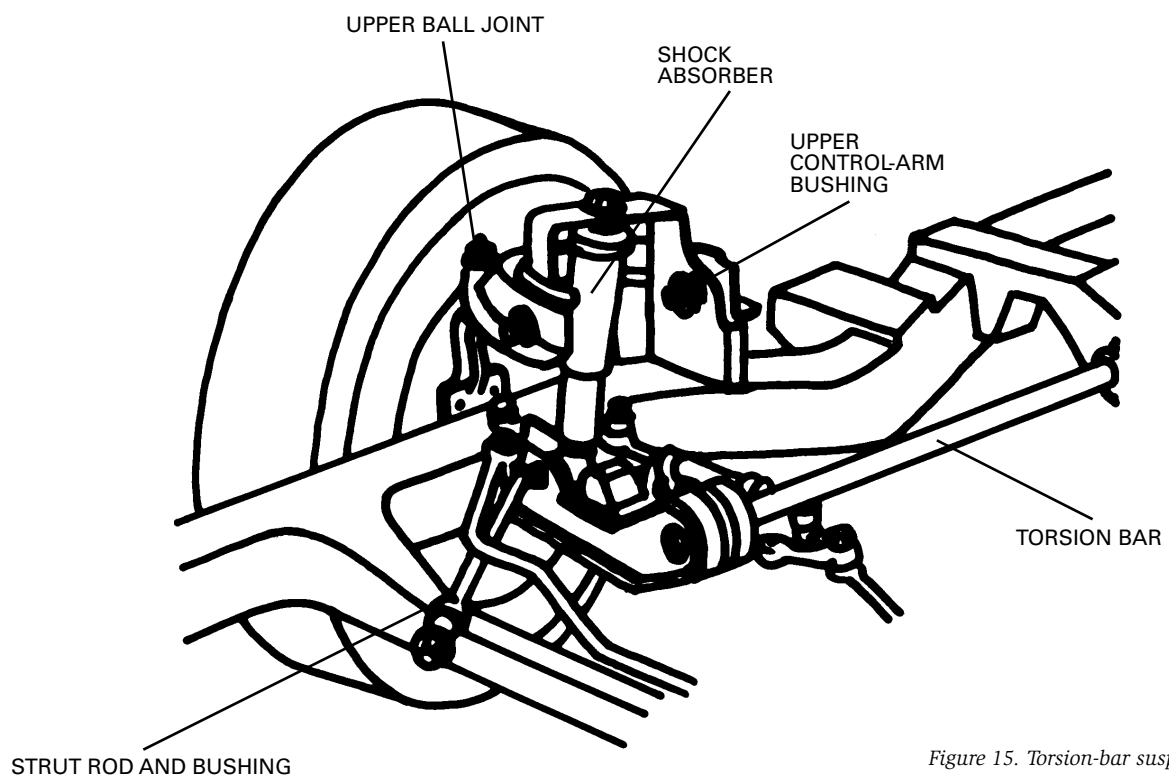


Figure 15. Torsion-bar suspension system

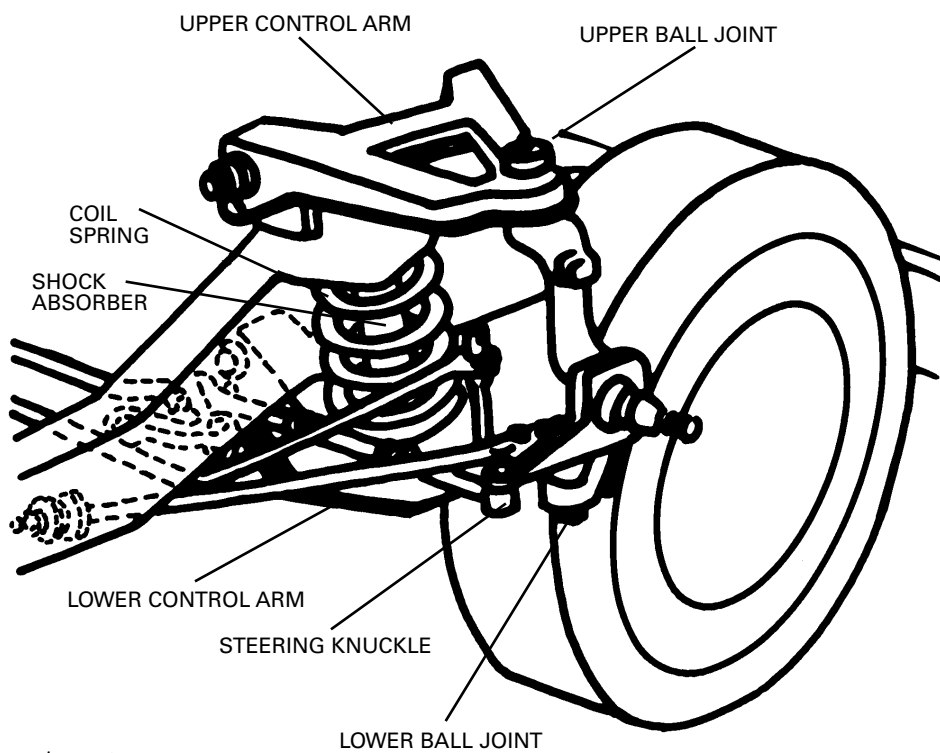


Figure 16. A-arm suspension system

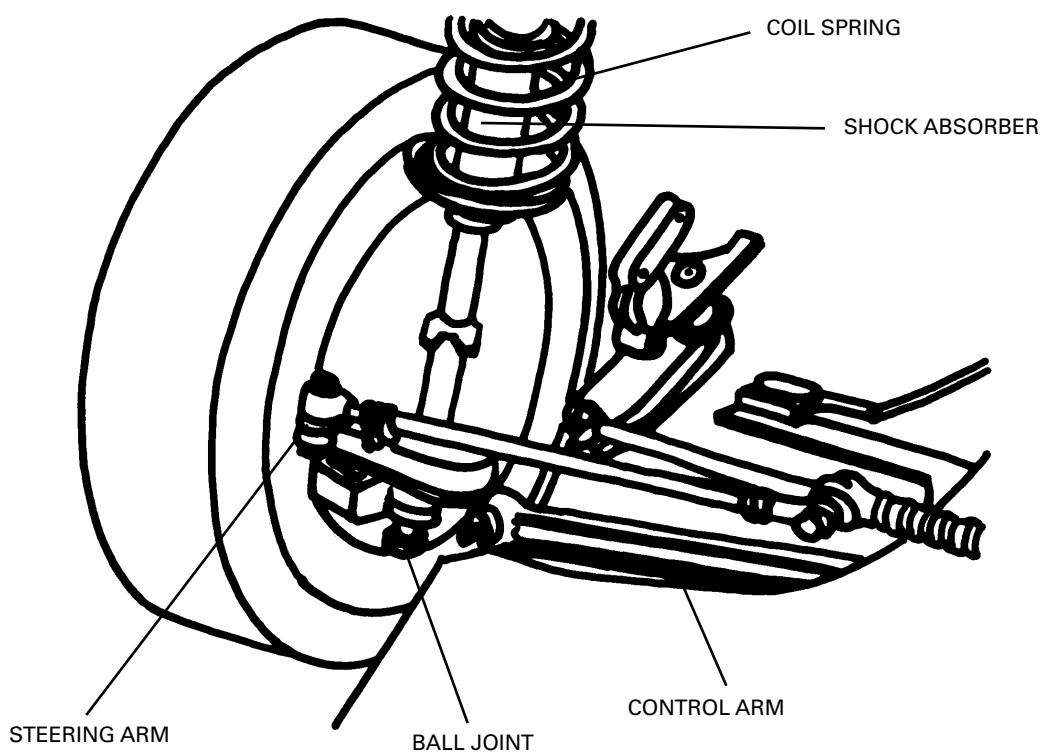


Figure 17. MacPherson strut with strut cartridge

TOOLS, EQUIPMENT, AND FASTENERS

A MECHANIC'S BASIC TOOLS

The basic tools a mechanic should have before beginning to work on a vehicle are

- A wide variety of flat-head and Phillips-head screwdrivers, including very small ones for electrical work and very large ones for working on heavy components.
- A complete set of metric or English open-end and box-end wrenches.
- A complete set of metric or English socket wrenches with short and long extensions, a spark plug socket with rubber insert, and adapters for extremely large and small sockets will be needed along with a swiveling-head attachment for reaching confined bolts and nuts.
- Needle-nose pliers, standard pliers, and lockjaw pliers.
- A rubber mallet, a small rounded ball-peen hammer, and a conventional hammer.
- A tire pressure gauge.

SPECIAL EQUIPMENT

Voltmeter, Ohmmeter, Tachometer, Ammeter. These gauges measure the flow, intensity, and strength of electrical current. They are used to detect weaknesses and breaks in the charging, wiring, starting systems, and engine management systems. Note: Digital multimeters are used and are required for computer-controlled systems.

Timing Light. This is a large, hand-held, gun-shaped device that uses a strobe light aimed at a mark on the engine's lower pulley (attached to the crankshaft) to match the motion of the piston with the firing of the spark plug. A timing light helps the engine know precisely when to ignite the fuel and air mixture for best power and efficiency.

Floor Jacks/Jack Stands. Floor jacks are hydraulically activated devices that lift the car from the ground. Although a floor jack can be quite powerful, **jack stands must be used before a mechanic works under the car.** Floor jacks can lose hydraulic pressure and let the car fall to the ground. Jack stands are steel supports designed to hold up the car firmly after the floor jack has raised it up. Jack stands are not able to actually lift the car, they just keep the car safely in place. Floor jacks should not be confused with the jack housed in the trunk that is used in emergencies to change flat tires. These jacks are not stable and are never to be used for supporting the car when a mechanic is under the vehicle.

Power Tools. The most commonly used power tool for automotive work is the air wrench. As the name suggests, an air wrench uses air pressure to turn various sizes of socket attachments. Often seen being used to remove the bolts that hold the wheels on, an air wrench can be used for tightly stuck and rusted bolts. Unfortunately, an air wrench creates a great vibration while loosening the bolt, and can sometimes completely break off the bolt. Air wrenches are powerful, and they should be used with respect and care.

Fasteners. Hose clamps, muffler clamps, exhaust hangers, and brass fittings are all common fasteners. *Hose clamps* are used to secure radiator hoses and fuel lines to their mountings. By using a screwdriver or wrench, the diameter of the hose clamp can be expanded or made smaller to clamp the hose in place. These clamps are also used for securing vacuum hoses in some cases. *Muffler clamps* function in much the same way when exhaust components need to be fastened to one another, and where welding is not needed.

Exhaust hangers connect the exhaust piping to the chassis of the car. These hangers use rubber fittings to keep the exhaust pipes from rattling and vibrating, and they allow the system to move slightly when the car is driven over large bumps. This flexibility keeps the welded and clamped fittings from breaking or cracking.

Brass fittings are used mostly to connect fuel lines to the carburetor or fuel injection systems. Special wrenches are used for these fasteners because the brass is soft and the threads can be easily stripped. Brass forms a good seal in places where liquid is flowing, so these fittings generally will be found where gasoline, oil, or transmission fluid is piped from one point to another.

VEHICLE IDENTIFICATION AND BUYING PARTS

MAKE, MODEL, YEAR

Make refers to the company that produces a vehicle. For instance, Ford, Chevrolet, BMW, Volkswagen, Chrysler, Dodge, Toyota, Mazda, and Nissan are all producers of a wide variety of models, but they are the general "make" of car.

Model refers to the specific model of a car. Where Ford is the "make," Mustang, Thunderbird, F100 pickup, and Escort are all "models" of Ford cars.

A car's *year* can be confusing, since makers don't always wait until the end of a year before they introduce the next year's model. Consult the owner's manual or information tag located in the driver's door jamb for the car's "model year." Never rely on the year that

the car was purchased new, because you might end up with a part for a different year of car.

VEHICLE IDENTIFICATION NUMBER (VIN)

This number is the car's individual identification information, and is most commonly located at the lower driver's side of the windshield. It is referred to as the VIN. This number is also found on the engine block and 13 additional major components of the vehicle. These numbers help to ensure that all of the components belong to that vehicle, and they also serve to identify that particular vehicle in the case of theft, or the theft of major parts.

Older cars are more valuable if all of the numbers match and are therefore original. Swapping major parts such as engines or transmissions will detract from the value of early models. These numbers can also help to identify modifications to a car that were made partway through a model year. A 1988 Camaro may have one type of transmission in cars built during the first half of the year, and a different one for the second half of the year, even though the parts may look similar. The VIN can identify when the car was produced during a given year. It might be helpful for you to visit a parts store to purchase replacement parts. When you have the correct make, model, year, and VIN for the vehicle, buying parts will be less of a mystery for you and the parts store clerk. By guessing on just one of these identifying factors, you can end up with the wrong part and possibly damage the car when that part is installed or used as an incorrect component.

PERFORMING ROUTINE MAINTENANCE

ROUTINE MAINTENANCE

The owner's manual for the family car will be a valuable guide in performing routine maintenance. In the back of all owner's manuals, there are sections on "maintenance" and "specifications." These sections will serve as specific directions for performing minor services.

Maintenance includes checking, filling, and/or changing all of the vehicle fluids. These fluids are very important, and knowing how to check and change them will ensure long, trouble-free operation. Ignoring the various fluids will often result in costly repairs and breakdowns. Fluids to be checked and changed are

- Engine oil
- Transmission fluid (automatic) or transmission oil (manual)

- Radiator coolant
- Steering fluid (power steering)
- Brake fluid
- Differential oil
- Battery water
- Windshield wiper fluid

CHANGING/CHECKING TIRES

Flat or worn tires can be changed with help from the owner's manual, the jack supplied with the car, and common sense. The following are things to remember when changing a tire:

- Set the parking brake and put the transmission into park (automatic) or leave it in gear (if equipped with a manual transmission).
- Block the tires to keep the car from rolling when it is jacked up and lifted from the ground.
- Loosening the wheel lug nuts or bolts before the wheel is completely off the ground will make the process easier and safer.

Checking the tires for proper inflation (using a tire pressure gauge) and signs of wear will keep the car safer and performing better. Underinflated tires cause the car to use more fuel, and can result in poor handling and a possible blowout. Overinflated tires will wear quickly and cause a hard ride. The owner's manual gives the proper inflation levels, and will illustrate the different signs of wear that can spell trouble.

CHECKING STEERING COMPONENTS

Steering systems are complicated in today's cars, and most owner's manuals will not refer to this as routine maintenance. Power steering fluid levels can be checked as a precaution, and the belt that drives the power steering pump also may be checked and replaced. Older car owner's manuals may have suggestions for detecting worn steering systems and give instructions on how to adjust a loose steering box. All other steering components require professional repair by a skilled technician. Steering systems that make noise while turning or make noise when the vehicle is traveling over bumps should be repaired. Steering that allows greater than 2 inches of free steering wheel motion on a power-steering equipped car (or 3 inches of free steering wheel travel on a car with manual steering) before causing the wheels to turn also should be inspected.

MISCELLANEOUS

The owner's manual will have special instructions for each model of car and should offer diagrams to aid in replacing blown fuses, burned-out bulbs and headlights, and items such as wiper blades and rubber fittings.

DIAGNOSING EARLY SIGNS OF TROUBLE

BRAKE NOISE

Squealing, grinding, or chattering can be signs of excessive wear. Most cars have sensors that cause a high-pitched squeal when the front brake pads are getting low. In any case, when brakes begin to make any type of noise, it is time for inspection. Brakes should be checked immediately following the start of the noise—ignoring the problem can result in costly repairs and even brake failure. Front brakes are usually the first to show signs of wear because they do most of the heavy work in stopping the vehicle.

ENGINE NOISE (INCLUDING BELTS)

Each type of engine has its own unique sound, but when new and different sounds are heard, it's time for attention. Some noises that signal trouble will be heard

only when the car is first started, while others will begin after the engine has had time to warm up; still others will be heard only when the engine is working hard. Any type of clattering, banging, ping, or echoing is a sign of potential trouble. Fan and power steering belts have their own shrill screams when they are too loose; this can cause premature wear and failure. A broken belt can cause overheating and loss of electricity (without a belt, the alternator will not rotate).

STEERING NOISE

As mentioned earlier, the steering pump on power steering units will whine and groan if there is not enough fluid in the system, and steering components will grind and clank if they are worn.

WARNING LIGHTS AND GAUGES—WHAT DO THEY MEAN?

The most common warning lights and gauges tell about oil pressure, water temperature, and voltage. Oil pressure gauges and warning lights alert the driver to a failed oil pump or low levels of oil in the engine. A gauge is the best indicator of oil pressure, but most cars have a red warning light. When the pressure falls on the gauge, or when the warning light comes on, the engine should be shut off immediately to prevent costly damage.

SUMMARY OF BATTERY AND CHARGING SYSTEM PROBLEMS

Problem	Indication
Battery has no charge.	The dashboard Alt (alternator) lamp is on or the alternator gauge shows zero or a slightly negative (-) reading.
Battery is discharging.	The dashboard Alt lamp is lighted or the alternator gauge shows a heavy discharge (-) reading, even with all electrical accessories on.
Battery is undercharged.	<p>The dashboard Alt lamp may occasionally glow dimly, or the alternator gauge shows a less-than-normal charge. The needle may point to the negative (-) side of the gauge when the accessories are on.</p> <p>The battery may slowly get weak and turn the starter more slowly than normal. Lights are dim.</p>
Battery is overcharged.	The Alt lamp is off, or the alternator gauge shows a higher-than-normal reading, even with all lights and accessories on. The battery uses water constantly. Lights are very bright, and bulbs and fuses may burn out rapidly. The battery gives off a rotten-egg odor.
Mechanical noises.	Electrical system mechanical noises are sensitive to engine speed and are usually caused by a bearing in the alternator.

Temperature gauges are more common, but some cars have a temperature warning light. When the cooling water becomes too hot, it is a signal that there is either too little water in the system or that the circulating water pump or pressure cap has failed. The car should be shut off immediately if a warning signal is seen. A voltage gauge or warning light tells the driver that the alternator is either not producing enough electricity or is overcharging and may damage the battery or components in the electrical system. A car will continue to operate in either condition, but not for long. (See chart.)

STARTING AND RUNNING PROBLEMS

There are a variety of reasons a car might not start or run properly. The three general failures that cause a vehicle to run poorly or prevent it from starting are: lack of electrical energy in reserve for the starter battery (low charge) or to the spark plugs, lack of fuel being delivered to the cylinders, or a fault in the ignition system.

PERFORMING SIMPLE MAINTENANCE AND REPAIRS

CHANGING THE OIL AND FILTER

Replacing the oil stored in the crankcase and the screw-on filter that keeps it clean is a fundamental service that should never be ignored. Keeping the engine oil clean is the easiest, most inexpensive, and most efficient way to avoid costly repairs.

CHANGING THE COOLANT AND FLUSHING THE RADIATOR

Engine coolant becomes weak and ineffective after a period of 12 to 24 months. When the coolant grows old, it may be less efficient at keeping the engine cool or preventing it from freezing up. Rust will be allowed to form in the radiator and engine block, especially if plain water is used to top off the system. Rust can clog the system and cause the engine to overheat, so pressurized water and cleaning solutions are used to remove any rust and to clean the insides of the cooling passages. Once the system has been flushed, fresh water and coolant can be added to ensure reliable operation. Coolant also serves as a lubricant for the water pump, so adding plain water to the system should be avoided except in an emergency.

CHANGING BRAKE PADS AND SHOES

Brake pads and shoes are made of fairly soft asbestos or semimetallic material that is designed to cause friction

and stop the car. As a result of this friction, they wear out at regular intervals. Because the brake pads and shoe surfaces are mounted to hard steel backing, worn brakes can cause metal-to-metal contact and damage the drum or disk surfaces.

Replacing the pads and shoes will keep expensive disks and drums from being scarred by the backing when the asbestos or semimetallic surface has been worn away.

CHANGING V-BELTS

Also called *fan belts*, V-belts are used to drive the water pump, cooling fan, alternator, power steering pump, emission control air pump, and air conditioner compressor. Because belts are made of a soft rubber compound, they are prone to wearing out. If a belt wears out, it can cause loss of electrical current, power steering failure, or inefficient engine cooling. Belts can be inspected to see if they are frayed, cracked, or loose, according to the owner's manual. Replacing belts is a fairly easy and inexpensive way to avoid a breakdown on the road.

CHANGING THE DISTRIBUTOR CAP, ROTOR, WIRES, AND PLUGS

The distributor cap, rotor, and spark plug wires supply energy to the spark plugs. Because of heat under the hood and ozone created by spark energy, these parts must be replaced at regular intervals to keep the car running efficiently. The owner's manual will suggest how often to change various ignition parts.

Many new cars no longer use a distributor; these vehicles are equipped with what is referred to as *electronic-direct* or *distributorless* ignition. Heat under the hood can cause the spark plug wires to become brittle and crack; the wires can short out (ground) on the metal components of the engine. When the wires short, the electricity does not get to the spark plug, and the plug will not fire. Distributor caps can crack as a result of the heat, and this allows moisture to seep into the distributor. Bakelite caps and rotors can also carbon-track from the high voltage caused by a bad plug wire; this causes the spark to ground internally. Both conditions make the car hard to start or cause it to run rough.

CARING FOR A CAR

Keeping a car clean protects the finish, preserves the materials used in the interior, and ensures longer life for the rubber fittings around the windows, doors, hood, and trunk.

Exterior Wash. Washing the exterior removes deposits from trees, birds, minerals in water, and road grime. These substances can damage the paint and chrome. Household detergents are not recommended for washing a car; car washing detergents available at parts stores are preferred because they are mild cleaners and many promote spot-free drying, thereby reducing the extent of wiping down the car after it is washed.

Clean Windows. Dirty windows are a safety hazard in both day and night driving. Keeping the windows clean inside and out will avoid subtle distortion caused by buildup of exhaust fumes, road grime and dirt, and interior hazing.

Vacuum. Vacuuming the interior will extend the life of the carpeting and upholstery. This also keeps dust and dirt from settling in other parts of the interior such as on the dashboard and door panels.

Armor-All. Armor-All will improve the appearance of the tires and rubber and vinyl fittings of the exterior. Although Armor-All can also make an interior look cleaner, it will leave a slippery finish on the surface of the steering wheel, and can cloud the windows if not used carefully. Armor-All may not be safe for all interior materials; consult the owner's manual before using the product inside the car. Armor-All is a commercial brand; there are others of equal quality for treating rubber and vinyl surfaces.

Waxing a Car. This provides the finish with added protection against road grime and deposits left on the paint. Waxing also gives the paint added shine, and can restore dull finishes on older cars, especially if used after cleaning the finish with a mild rubbing compound. Even on late-model cars, never apply wax without first cleaning the paint surface with a polish/cleaner to remove all road grime and oxidized paint. On brand-new cars, a wax that contains a mild cleaner in its content can be used without first cleaning the car with a strong polish. As with any product intended for use on the interior or exterior of the car, check the owner's manual to make sure the chemicals selected won't damage the finish.

SAFETY PRECAUTIONS

All hobbyists and professionals who have an interest in cars are very careful to follow commonsense safety precautions when working on or around any type of motor vehicle. Scouts must follow the same rules to avoid injury.

1. Never open the hood of a car while the engine is running.
2. Be sure the engine has cooled down after being shut off before touching any engine parts; they may be very hot and can cause serious burns.
3. When looking at or working on the engine of a vehicle, check to be sure no one else will start the engine. A Scout must never start an engine without an adult supervisor. Also, before starting an engine (and with supervision), be sure no one else is near the engine compartment. Before starting, shout "All clear!"
4. Keep hands and fingers away from the fan and other rotating parts under the hood, even when the engine is shut off. (If the car is started accidentally, fingers and hands can be lost in a fan or in a belt.) Some vehicles are equipped with electrically operated fans that can come on at any time with the ignition turned on or engine started. Always keep hands and fingers away from all fans.
5. Do not remove the radiator cap until the engine has cooled down completely. Cooling systems are under pressure; if the radiator cap is removed while the engine is hot, scalding steam will be forced upward, possibly into the face of the person removing the cap.
6. Never crawl under a car while it is raised on a jack. Only a vehicle supported by jack stands—or on a lift or hoist in a repair station—is sufficiently supported to allow anyone to be beneath the vehicle safely.
7. Be sure to set the parking brake on any vehicle before jacking it up.
8. Always block two wheels of a vehicle before jacking it up. Failure to block the wheels can result in the vehicle rolling forward or backward, off the jack, and running over a person, causing injury or death, or colliding with a stationary or moving object. It would cause serious damage to the vehicle and/or the object with which it collides. To block a wheel, put a brick or large square piece of wood at the front and back of the tire.
9. No flames or sparks of any kind (including matches and lighters) are to be used near a vehicle.
10. Precaution 9 is especially important when you are near a vehicle battery. When a battery is charging (either from the vehicle alternator or a separate battery charger), fumes that escape from the battery vent holes in the tops of the caps are highly flammable and can explode.

- 11.** Take every precaution to guard against battery acid coming in contact with skin or clothing. Battery acid will eat into the skin and will rot the fabric of clothing. If battery acid is allowed to reach a person's eyes, it will cause blindness.
- 12.** Never use an incorrect size wrench or pliers on a nut or bolt being removed or tightened. The wrong size wrench can cause the tool to slip off the bolt and seriously injure the user's fingers and hands.
- 13.** Do not use gasoline or similar fuels to clean auto parts or your hands. Exposure of human skin to gasoline and other fuels can cause injuries to the skin. Similarly, avoid inhaling the fumes from gasoline. For proper cleaning, use only commercially available products, such as parts cleaners and hand cleaner.
- 14.** Read and be sure you understand all warning labels—on both the vehicle (including those under the hood) and the products you use, including chemicals.

The precautions reviewed here are basic. They serve to remind Scouts of the importance of thinking "safety first" in all activities related to motor vehicles. Failure to observe all safety precautions, including those published here, can result in serious injury or death. Never attempt any work on a motor vehicle without adult supervision.

GLOSSARY OF MECHANICS TERMS

Air dam. A valance or apron device placed below the front bumper, intended to help reduce the amount of air rushing under the car at highway speed. The air dam channels the air around to the sides of the car. This reduces drag as a result of air being trapped under the car, and pressure, which can cause the front of the car to lift slightly at high speeds.

Air/fuel mix. The ratio of air and fuel delivered through the carburetor or fuel injection system to the cylinders for combustion.

All-wheel drive. On certain late-model cars, all four wheels deliver power (as opposed to two wheels, either front or rear, delivering power on most cars). The all-wheel-drive systems are computer controlled; these are not to be confused with four-wheel-drive systems, which are controlled manually by the driver of a vehicle.

Alternator. An engine-driven device that changes mechanical energy (the spinning of the alternator internal parts) to electricity for various systems on the vehicle. Alternators are lighter, smaller, and more efficient than the generators used on older cars. The alternator also charges the vehicle storage battery.

Anticorrosion treatment. The application of an undercoating or primer to prevent metal components on the car from rusting. Many new cars have extensive anticorrosion treatments applied while they are being assembled at the factory.

Antidive geometry. A front suspension system designed to keep the front of the car from dipping and the rear from lifting when the brakes are applied in panic-stop situations, particularly at high speeds.

Antifreeze. A chemical-based liquid added to the vehicle cooling system to prevent engine freeze-ups in very cold weather. The liquid is added to the water used in the radiator; it is also a rust inhibitor and serves to lubricate the water pump.

Antilock brakes. Computer-controlled brakes equipped with a sensor to keep them from locking up and causing a car to go into a skid when brakes are applied at moderate and high speeds. Antilock brakes are a very important safety device.

A-pillar. The vertical body posts that frame the windshield and support the front of the roof.

Aquaplaning. A condition in which a tire rides up on a thin layer of water that separates the tire from the road. Also called *hydroplaning*, the condition can cause the car to go out of control because the tire loses contact with the road. Worn and very wide tires are sometimes a cause of aquaplaning.

Aspect ratio. A term that refers to the ratio between tire height and tire width. Height is measured from the rim to the outside edge of the tire tread, and width refers to the distance across the tread.

Asymmetric tire. A tire that has an aggressive, zig-zag tread pattern to give it added traction in poor weather conditions.

Automatic choke. A device used to help start a cold engine. The choke reduces the air coming into the engine and the spark plugs fire a richer gasoline mixture for better starting.

Axle tramp. A rapid shaking of the rear axle when the car is given heavy throttle. The wheels tend to bounce up and down as they try to grip the road.

Ball joint. A ball-and-joint arrangement used for independent front suspension systems. The ball joint connects the upper and lower suspension arms (called *A-arms*) to the stationary part of the wheel (called the *wheel carrier*).

Bead. A steel wire ring that runs along the inside rim of the tire sidewall. The bead is bonded to the tire and is used to secure the tire to the rim.

Beam axle. A simple one-piece axle connecting the rear wheels of front-wheel-drive cars and minivans. Also called a *dead axle*, this design is also used on the front of large trucks and older pickups.

Black box. A term used to identify any number of solid-state electronic devices that rely on high-tech electronics circuitry to control ignition, emission devices, or other computer assists for the engine, transmission, brakes, or interior accessories.

Blowby. Fuel and exhaust gases that slip past the piston rings. Excessive blowby can contaminate the engine oil; it is caused by worn or poorly fitted piston rings. A PCV (positive crankcase ventilation) valve will normally recycle the leaked gases through the carburetor or fuel injection to be completely burned and also keep excessive pressure from forming in the crankcase.

Boost. The amount of extra pressure in an engine's intake system caused by a turbocharger or a supercharger.

Bore. The hole (cylinder bore) in the engine block in which the piston rides up and down. Bore also refers to the specific measurement of the cylinder diameter.

Bottom dead center (BDC). The lowest point to which the piston can travel in the engine block. The opposite of top dead center (TDC).

Boundary layer. A thin layer of somewhat still air that rides close to the car body while it is moving.

B-pillar. The second or middle pillar used to hold up the car's roof. This pillar is commonly found behind the front-door side window at the center of the car. On some coupes, two-door sedans, and most convertibles there is no center or "B" pillar.

Brake booster. A device intended to increase the amount of braking power going from the brake pedal to the wheels. Boosters use engine vacuum or a separate hydraulic pump for the added power. This is the "power" in power brakes.

Brake fade. A condition in which the brakes are less effective because they have become too hot, usually the

result of continuous use (as in heavy traffic) or keeping the brakes applied while the vehicle is traveling downhill.

Brake horsepower. The amount of power developed by an engine and rated by a dynamometer. It is referred to as BHP.

Brakes. In simple terms, brakes are friction devices used to stop a car. There are two basic varieties: disk and drum. A disk brake, generally regarded as more efficient, and most often used at the front wheels, consists of a movable rotor attached to the wheel. A stationary caliper is bolted to the wheel carrier (the part of the wheel that does not turn) and fits over the outside of the rotor. The caliper uses a hydraulically operated piston to squeeze the removable brake "pads" into contact with the rotor. Rotors have venting inside the outer and inner halves to reduce the heat caused by friction. For added cooling, some rotors found on high-performance cars have holes drilled into them.

Bump steer. A condition in which the wheel wobbles when it hits a bump or uneven surface. Bump steer causes the car to veer slightly from side to side.

Bump stops. Rubber cushions used to keep the suspension parts from banging the frame of the car when it is heavily loaded or hits a severe bump.

Camber. An angle of the car wheels (usually the front wheels) where the tires either stand straight up and down, tilt slightly in at the top (called *negative camber*), or tilt slightly out at the top (called *positive camber*). If you look at the tires of a car from the front of the vehicle, negative camber exists if the top of the tires are leaning closer together; it is called positive camber when the top of the tires lean away from each other.

Capacitive discharge ignition (CDI). A type of electronic ignition that first uses the 12-volt battery power to create and store 300 volts of primary coil voltage for additional firing power for the spark plugs.

Carburetor. A device that mixes gasoline with air and sends it in metered amounts to the engine to be burned.

Caster. If you drew a straight line up and down through the center of a wheel as you viewed it from the side, and then tilted the line toward the front or rear of the car, this would give you caster angle. Imagine how the front forks on a bicycle are angled slightly toward the back of the bike; this is called *negative caster*. If the forks were angled over the front of the wheel and caused the handle bars to extend in front of the wheel, this would be positive caster. The same angles apply to car wheels; they refer to where the suspension contacts the top and bottom of the wheel.

Catalytic converter. A muffler-size device attached to the exhaust system that uses heat and special metals to convert the car's exhaust pollutants to harmless emissions.

Center of gravity. That point in a vehicle body around which its weight is evenly distributed or balanced.

Chapman strut. A type of shock absorber/spring arrangement used on the rear suspension. The Chapman strut is similar to a MacPherson strut and is named after Colin Chapman of the British sports car company Lotus.

Chassis. A term referring to a complete vehicle without its body and interior components (for a car that uses separate body-on-frame construction), or just the drive train, including engine, transmission, steering, suspension, brakes, wheels, and tires (for a car that uses unibody construction).

Choke. A mechanism, either manual or automatic, to limit the amount of air allowed into the intake system while the engine is being started cold. This creates a rich fuel mixture that is easier to ignite.

Clutch. A friction mechanism that allows the engine and manual transmission to be disconnected while gears are being changed or the car is running in neutral. The clutch also reconnects the engine and transmission gradually to aid in pulling away from a total stop. A clutch is operated by either mechanical (cables or rods) or hydraulic pressure.

Clutch judder. Sometimes called *chuck chatter*, the shaking sensation caused by the uneven or slipping connection between the clutch, engine, and transmission. Worn clutches or clutches with oil leaking on them will cause judder or chatter when the car is pulling away from a stop or when gears are changed (shifted).

CO. Carbon monoxide, a colorless, odorless, and highly toxic mixture of gases produced when an engine burns gasoline.

Coil. An ignition system component that boosts electrical current and supplies the high-voltage electricity necessary to fire the spark plugs.

Coil spring. A spiral of heat-treated steel used in a car or truck suspension system to hold the vehicle up, away from the ground.

Collapsible steering column. A steering column that is either jointed or fitted with special sleeves designed to collapse easily in an accident, preventing serious injury to the driver in a front-end collision.

Combustion chamber. The space above a piston and inside the cylinder head where the air and fuel mixture is compressed and ignited.

Compression ignition. Characteristic of a diesel engine operation. The diesel fuel is ignited by the heat created from high compression instead of by spark from a spark plug.

Compression ratio. The difference between the amount of space in a cylinder when the piston is at bottom dead center (BDC) versus top dead center (TDC), expressed as a ratio.

Constant velocity joint. A flexible coupling between two shafts that allows each to keep the same rotational speed as the other, regardless of the angle that exists between them.

C-pillar. The pillar that supports the rear of the car roof and the back window.

Crossflow cylinder head. A cylinder head in which the intake ports are located on the side opposite the exhaust ports. This is a more efficient design than those on which the intake and exhaust are on the same side.

Crush zones. Areas in the front and rear of a vehicle body, designed to crumple easily and absorb the impact of a collision.

CVCC engine. Called *compound vortex controlled combustion*. A cylinder head design that uses a small combustion chamber in each cylinder in addition to the regular one. A rich mixture of fuel and air is first ignited in the small chamber and then expands to ignite the lean mixture in the main combustion chamber. Also called a *stratified-charge engine design*.

Cylinder head. Part of an engine that is bolted onto the block. Contains the combustion chamber, valves, and valve-actuating mechanism.

Cylinder liners. Devices pressed into the cylinder bores of the engine. There are two varieties: wet and dry. Dry liners are fitted into the cylinder bores, but do not come into direct contact with the water jacket; wet liners are also press-fitted into the bores, but they do contact the water jacket. Dry liners are generally used to save engines when the cylinders are worn beyond a point at which they can be bored out.

Decibel. A unit of sound pressure measured on a logarithmic scale. Decibels (DBs) are used to measure the level of noise inside and outside a car.

deDion axle. A type of rear suspension that functions as a cross between a live axle and an independent suspension. This axle uses half-shafts, but the driven wheels are held rigidly upright as if they are in a solid axle and the differential is attached to the body. The design reduces the amount of unsprung weight at the drive wheels.

Detonation. Also referred to as “pinging”; the sharp sound of cylinder wall vibration that results from the fuel and air mixture igniting too soon. In extreme cases, the high heat and pressure caused by the pinging can damage the piston tops and piston rings, often caused by ignition timing that is advanced too far or by using gasoline of a low octane rating.

Diesel. An engine that relies on the heat generated by high compression to spontaneously ignite the fuel in its cylinders. Named after its inventor, Rudolph Diesel, the engine operates by compressing air to about a 23-1 ratio and then uses a fuel injector to spray fuel into a pre-chamber. The temperature generated by the extremely high compression causes the fuel to mix with the air and ignite.

Dieseling. The problem, sometimes referred to as run-on, wherein a gasoline engine continues to run after the ignition has been turned off. It is caused by carbon buildup in the engine that stays hot and continues to ignite fuel in the cylinders.

Differential. The drive-line component that splits the power being transmitted from the drive shaft to the driven wheels. By using a differential, the rear wheel on the outside of a turn is allowed to rotate faster than the wheel on the inner side of the turn, designed to prevent excessive tire wear.

Digital instrument. Any electrical instrument that uses digital displays instead of analog instruments, which rely on a pointer that sweeps across the face of a dial.

DIN. The German equivalent of horsepower and torque ratings.

Directional stability. Refers to the ability of a given vehicle to maintain a true course of travel, despite bumps, crosswinds, uneven road surfaces, etc.

Disk. Refers to the disk-brake system. Components include a rotor, which turns with the wheel, and fixed disk-brake pads that clamp to the rotor using hydraulic pressure when the brakes are applied to slow or stop a vehicle.

Displacement. The actual volume covered by the piston between top (TDC) to bottom dead center (BDC), multiplied by the number of cylinders.

Distributor. A component in the ignition system that distributes a high-voltage charge to each spark plug at the proper moment.

Doughnut. A flexible rubber coupling used between an input and an output shaft in situations where a small amount of flexing is unavoidable. It is similar to a constant velocity joint but less costly.

Drag coefficient. An aerodynamic term applied to the vehicle body work. It measures its ability to pass through air. A flat surface would have a high rating of Cd No. 1.25; the ideal shape, a teardrop, is rated low at Cd No. 5 .03.

Drive shaft. A mechanical link that joins the transmission to the differential in a front-engine/rear-drive car.

Drive train. The components that produce and transmit power to the road. The drive train includes the engine clutch, transmission, drive shaft, differential, and drive axles.

Drum brakes. Brakes composed of an outer circular drum that rotates with the wheel and two fixed brake “shoes” that are pressed against the inside of the drum. A hydraulic cylinder is used to press the shoes against the friction surface. Drum brakes are most commonly used at the rear of cars and trucks, and were used on the front wheels of most cars until the middle 1960s.

Dry sump. A form of engine lubrication that uses a holding tank instead of the crankcase to store oil. Normally associated with more performance-oriented vehicles, the dry sump system eliminates oil foaming and starvation problems and allows for more efficient cooling and greater oil capacity.

Dry weight. The weight of a vehicle measured without any fluids in its various components.

Dual-circuit brakes. Brakes designed to provide two separate fluid reservoirs, each controlling at least one pair of wheels. The purpose is to provide a backup system in case one of the systems fails. Today’s systems generally split the wheels front to rear.

Dynamometer. A device used to measure the power of a vehicle’s engine, or the power sent to the drive wheels.

Electronic ignition. A modern ignition system that does not use mechanical breaker points. In an electronic ignition, the switching is done by what is known as a *pulse generator* and a number of transistorized circuits.

Electrophoretic dip. A method of applying undercoating, primer, or anticorrosive materials in which the body parts are charged with a slight positive charge and then dipped into a liquid bath that is slightly negatively charged.

Emission control systems. Devices that are designed to control the harmful emissions that result from gasoline being burned. These devices reduce some of the harmful pollutants that result from the combustion process.

Engines. Today there are three types of engines commonly used: gasoline, diesel, and gasoline rotary. All are four-cycle power plants, which use the explosive force generated by the burning of fuel to produce power. See *reciprocating gasoline and diesel engines* and *rotary engines*.

Ergonomics. The study of how a human being relates to his environment. In an automobile, ergonomics commonly refers to the placement of controls and the ease with which they operate.

Exhaust back pressure. Restriction within an exhaust system caused by bends in the pipes or by the presence of a muffler(s) or a catalytic converter(s).

Exhaust manifold. A component bolted directly to the engine head, aligned with the exhaust ports in the head, to carry burned exhaust gases to the exhaust pipe.

Expansion tank. Specifically, an overflow tank used to catch and retain reserve liquids such as radiator coolant when it expands as a result of the heat of the engine.

Fan. A rotating device with curved blades used to draw or push air through a radiator. Fans may be driven mechanically by the engine or powered by an electric motor.

Final-drive gear. The last gear in a drive train, housed in the differential.

Final-drive ratio. The ratio between the number of turns of the drive shaft and the number of turns of the axle shaft. As an example, in a 3-1 final drive, the drive shaft would be turning three times for each revolution of an axle attached to the wheel.

Firewall. The partition dividing the engine compartment and the passenger compartment.

Flame travel. The distance traveled by the flame caused by ignition, measured from the spark plug to the most distant point the flame travels in the combustion chamber.

Flat spot. Refers to a momentary hesitation at some point in the engine's rpm or power curve, normally found in an engine with a malfunctioning or improperly adjusted carburetor, or improperly set ignition timing.

Float. A device in a carburetor to regulate the level of fuel in a carburetor.

Fluid coupling. A system that relies on some type of liquid to provide the connection between two shafts (one propelling the other) that have vanes attached to them.

Flywheel. A large, heavy, rotating disk fitted to the end of the crankshaft to smooth out the individual power pulses produced by the engine's pistons. The flywheel has gears on the outer edge; this gear is known as a *ring gear*. The ring gear is driven by a gear off the starter motor and is used to turn over the engine to start it.

Foot-pound. A unit of measurement used to define torque. The foot-pound is equal to the effect of one pound of force acting with a one-foot distance of leverage.

Four-bar link. A common method of locating live rear axles that relies on a pair of upper and lower control bars to locate and stabilize the axle.

Four-valve head. A cylinder head, generally hemispherical in design, that uses two intake and two exhaust valves per cylinder, a system that allows greater efficiency at higher rpm than a two-valve head.

Four-wheel drive. A drive train in which both the front and the rear axles transmit power to all four wheels as chosen by the driver of the vehicle, who can select two- or four-wheel drive.

Frame. A substructure that supports the vehicle bodywork and interior. Separate frames are rapidly being replaced by unibody construction, a design that uses body sections and subframes to support the car.

Frontal area. The total area of a vehicle struck by the wind when the car is traveling straight ahead.

Fuel filter. An in-line filter to ensure that residue-free fuel is fed to the carburetor or fuel injector.

Fuel flow meter. A device that measures the amount of fuel consumed by an engine over a certain distance.

Fuel injection. A method of distributing fuel to an engine. Used in place of a carburetor, fuel injection can be either mechanical or electronic and is more precise and efficient than a carburetor. Throttle-body, port, and sequential-port fuel injection systems are the three types commonly used on today's cars. Most current automobiles and light trucks use electronic fuel injection, and older cars are equipped with a mechanical system.

Fuel pump. A pump that supplies a constant flow of fuel to the engine. It may be either mechanically driven by the engine or electrically operated; the fuel pump may be located within the fuel tank itself. Some cars are equipped with two fuel pumps.

Full floating axle. A type of drive axle where half-shafts are not required to carry any weight or loads, but serve only to transmit power to the wheels.

Fuse. A safety mechanism, usually a thin strip of metal, to prevent overloading electrical circuits by acting as the point of least resistance. If there is too much current fed to a system, the fuse will sense the overload and break the circuit, i.e., “blow a fuse.”

Gasket. A thin layer of material used to provide secure sealing between engine parts. Gaskets are often used to keep fluids or gases from leaking out of components that are bolted together.

Gasohol. A blended automotive fuel used in some conventional gasoline engines. Federal law requires that gasohol consist of 10 percent ethanol or methanol and 90 percent normal gasoline.

Gear ratio. A ratio that describes the relationship of a gear that is supplying power to a gear receiving the power.

Gearbox. Usually refers to a manual transmission.

Greenhouse. Refers to the window area of a vehicle.

Half-shaft. A rotating shaft, normally one of two, that transmits power from the differential to a drive wheel.

Harmonic balancer. A device used to reduce or eliminate the effects of vibrations that occur along the crankshaft, achieved by adding weights to balance the shaft. Sometimes called a *vibration damper*.

HC (hydrocarbon). Any hydrogen and carbon compound, but in automotive terms, the compound produced as one of the byproducts of combustion (unburned fuel). Hydrocarbons are a main ingredient in smog.

Heated intake manifold. A manifold designed to warm the fuel being fed to the engine to help the fuel mix with air (called *atomizing*) and burn more completely and efficiently.

Hemispherical combustion chamber. A cylinder head design in which the combustion chamber is dome-shaped and the valves in the head are tilted at a 45-degree angle to the piston top. The “hemi” head allows for the use of larger valves, allowing better operating efficiency and power.

Horsepower. A standard measure of work force equal to 33,000 foot-pounds per minute.

Hotchkiss drive. A method of mounting a live rear axle that uses a semicircular (called *semielliptic*) leaf spring to locate and secure the axle and drive assembly.

Idle circuit. The system within a carburetor to properly control fuel while the engine is running at low speed.

Ignition system. The system of circuitry that provides for the spark in a combustion chamber, consisting of a battery, ignition switch, coil, distributor, spark plug wires, and spark plugs. Some current cars no longer use a distributor. An individual coil is positioned over each spark plug. The coil receives a signal from a sensor on the crankshaft, then delivers electrical energy to the spark plug. It is a system referred to as direct ignition.

Inboard brakes. A brake system in which the brakes are located on the axles, not on the wheels. The advantages of inboard brakes include better brake cooling and reduced unsprung weight.

Induction system. The engine system that delivers the fuel and air mixture to the cylinders. It consists of the air intake (called the air cleaner), carburetor or injectors, intake manifold, and intake valves.

Intake manifold. A component that directs the air and fuel mixture from the carburetor or injection system into the intake ports and intake valves in the cylinder head.

Jet. In a carburetor or injector, a specifically sized and calibrated nozzle through which a measured quantity of fuel is passed.

Jounce. A term that refers to the compression of a shock absorber. Jounce takes place when the suspension is moving upward. When the suspension moves back down and the shock extends, the action is called rebound.

Journal. That portion of a shaft that makes contact with a bearing or group of bearings.

Kamm. The last name of a German aerodynamic scientist who devised a chopped-off rear-end body style known as a *Kammback*. A Kammback often looks similar to a short station wagon.

Kaminated windshield. A shatterproof front window that meets United States safety specifications; a thin layer of clear plastic is sandwiched between two sheets of glass.

Lateral acceleration. The side force on a vehicle caused by the effects of centrifugal energy as it goes around a corner. The force itself is a function of the tire's grip on the road, the weight of the vehicle, the speed it is traveling, and the radius of the turn.

Lifter. A device that rides on the camshaft and activates the pushrods on an overhead-valve engine (not to be confused with an overhead-cam engine). It may be either a solid or hydraulic lifter, the latter using internal oil pressure to keep the valve clearance constant and even. Solid lifters require a small gap between the lifter and heel of the camshaft to keep the action even, necessitating periodic adjustment; mechanical lifters are noisier than hydraulic.

Limited-slip differential. A variation on a conventional differential, a limited-slip uses an internal clutch to ensure that both axle shafts act as a single unit for the purpose of added traction at the drive wheels. The term limited-slip refers to the fact that even with this setup, a modest amount of differential action is still permitted to take care of normal cornering needs. The limited-slip differential allows the greatest amount of force to be applied to the wheel with the best surface traction.

Leaf spring. A flexible suspension device made up of one or more narrow plates held together with a central clamp.

MacPherson strut. A type of suspension component employing a coil spring and shock/strut as a single integrated unit. MacPherson struts “locate” the wheel and are most often used at the front of the vehicle.

Main bearings. The bearings that contact the crankshaft journals at the points of mounting the crankshaft to the engine block.

Manifold vacuum. The negative pressure developed in the intake manifold that results when outside air is forced into the cylinders by the action of the pistons moving down.

Master cylinder. The main cylinder in the brake system; it serves as a reservoir for hydraulic brake fluid. The master cylinder movable piston is activated by foot pressure on the brake pedal. The piston movement, in turn, creates the hydraulic power necessary to activate the individual wheel cylinders of the vehicle brake system.

Multiple-disk clutch. A clutch of two or more disks to aid in the reduction of slippage and wear (usually used with high-performance engines).

NACA duct. An inlet in the vehicle body intended to minimize external air drag; it was originally developed for use on jet planes by the National Advisory Committee on Aeronautics, hence the name.

NOx (Oxides of nitrogen). An element of exhaust emissions produced when gasoline is burned, especially at high cylinder temperatures.

Octane number. The index number that references the relative antiknock qualities of a specific fuel. The rating system is based on the percentage of isooctane in a fuel. For general purposes, the higher the octane number, the less chance there is of detonation.

Oil cooler. A cooling device mounted in a fashion similar to a radiator, used to reduce the temperature of engine or transmission fluid.

Overdrive. A small auxiliary gearbox generally mounted to the end of the main transmission shaft. Overdrive provides an additional gear that allows the engine to turn more slowly, yielding improved fuel economy and longer engine life. Many cars with “overdrive” simply have a higher fourth- or fifth-gear ratio in the normal transmission shift pattern to achieve the same result. Any gear reduction allowing less than one engine revolution to one drive shaft revolution is “overdrive”; i.e., 1-1 versus 8-1.

Overlap. The number of degrees of crankshaft rotation when both the intake and exhaust valves are open at the same time. Overlap takes place at the end of the exhaust stroke and beginning of the intake stroke. Variable valve timing used on modern cars allows for overlap to be adjusted while the car is running for better performance.

Oversquare. The relationship between a cylinder bore and stroke. If the bore/stroke ratio exceeds 1-1, the engine is oversquare. Other possibilities are undersquare or square relationships between the bore and stroke.

Oversteer. The tendency for the rear end of a car to break away and slide toward the outside of a turn when the vehicle is cornering briskly.

Panhard rod. A transverse rear suspension link that ties the body to the rear axle assembly. Also known as a *track bar*, its purpose is to help locate the rear axle so it can't move from side to side.

Pinion. A small gear used to mesh with a larger gear, generally at right angles. It is found in the differential and in rack-and-pinion steering assemblies.

Piston. A cylindrical metal component located in the cylinder bore of an engine. The piston transmits power created by the expansion of the burning fuel mixture to the crankshaft via a connecting rod.

Piston rings. Thin metal bands that surround the upper portion of the piston. Normally the two top rings are used as a sealing device to build compression, while the lowest ring, the oil ring, is used to scrape oil from the cylinder wall and return it to the crankcase.

Planetary gears. A gear set consisting of a large central “sun” gear that has several smaller “planet” gears contacting its outer teeth and rotating around it in a surrounding ring gear. Planetary gear systems are often found in automatic transmissions and overdrive units.

Pour point. The temperature at which paraffin crystals begin forming in diesel fuel. For No. 2 diesel (used in automotive and light truck engines), this happens at about 20 degrees F.

Preignition. Any burning of fuel not caused by spark from a spark plug.

Pushrod. The hollow, cylindrical rod that activates the rocker arm in an overhead valve engine. The pushrod is activated by the lifter, which, in turn, is moved by the camshaft.

Quartz-halogen bulb. A high-intensity headlight bulb in which the central tungsten element is surrounded by a quartz glass filled with halogen gas. Most current cars and trucks use quartz-halogen bulbs for brighter headlights.

Quench area. The part of a cylinder head not considered part of the combustion chamber that overlaps the cylinder bore. The quench area helps reduce the chance of detonation by increasing turbulence, and cools the unburned gases left over after the combustion process.

Reciprocating gasoline and diesel engines. In the case of reciprocating engines, the pistons are linked to a crankshaft by connecting rods. The crankshaft serves as the mechanism that turns the reciprocating motion (up and down travel of the piston) into rotary motion, which is then passed on to the drive train. The camshaft, which may be located in the cylinder head (overhead cam) or in the block, is tied to the crankshaft by a timing belt, chain, or gears. This link enables the cam lobes to open and close the valves in a specific sequence.

The ordered cycling sequence of a four-stroke power plant is: intake, compression, combustion (power), exhaust. With reciprocating engines, on the intake stroke the camshaft lobe (an egg-shaped feature) activates either a lifter/pushrod/rocker-arm assembly (when the camshaft is located in the block) or a cam follower (when the cam is located above the valves), which causes the intake valve to open. As the piston moves downward, outside air (in a diesel) or an air and fuel mixture (gasoline-powered) rushes into the cylinder.

During the compression stroke, both valves are closed and the piston moves upward, squeezing the contents of the cylinder. At the beginning of the combustion stroke,

both valves remain closed as the fuel is ignited. With a conventional engine, the spark plug fires to ignite the fuel mixture. In a diesel, the air is much more highly compressed and very hot. At the proper moment, a fine mist of diesel fuel is injected into a small chamber atop the cylinder. The high temperature of the engine, combined with the heat of compression by the piston, causes the fuel and air to mix quickly and explode (burn or ignite). In both cases, the piston is driven downward in the cylinder, producing the work force. In the exhaust stroke, the piston rises as the exhaust valve opens, permitting the exhaust gases to be forced out of the cylinder.

Road noise. The sounds inside a vehicle generated by the tires rolling over broken pavement, and the noise created by the tires in general while the vehicle is in motion.

Rolling resistance. The resistance of a vehicle to forward motion; drag caused by the weight of the vehicle, its tires, and the friction of bearing surfaces.

Roots supercharger. An engine-driven device to increase the volume of air fed to the intake manifold by using a pair of impellers (fans) that spin inside the blower body. The roots design is different when compared to a turbocharger because it is driven by a belt, not by exhaust gases.

Rotary engines. The rotary engine was invented by Dr. Felix Wankel of Germany. It is designed around a rotor shaped as an equilateral triangle, which revolves around a center shaft located within an oval chamber (called a *casting*). Because of its construction, the rotary is able to generate twice as many power pulses (combustion cycles) for each rotation of the crankshaft (called *mainshaft in a rotary*). Besides being a fairly simple design, rotary engines are smaller, smoother, and relatively light compared to piston engines. They can be easily enlarged by adding on more rotors, but they tend to use more fuel than a piston engine.

SAE (Society of Automotive Engineers). Engineering group whose purpose it is to set industry standards, notably the widely accepted figures for horsepower and torque.

Scuttle shake. Vibration of the scuttle or cowl bulkhead (the area around the firewall, windshield, and dashboard), which results in unwanted noise and vibration around the dashboard—often referred to as a condition in convertible cars because these models don’t have a rigid cowl section (no solid top).

Sealed beam. A headlight that is sealed and has an electrical element permanently affixed inside the lamp unit.

Semisealed beam. A headlight that is sealed, but has a replaceable halogen bulb.

Shock absorber. A damping device used to control spring motion. A shock absorber consists of a piston that moves through a viscous fluid or a combination of viscous fluids and gas to control excessive body motions.

Short. In electrical jargon, the term means an involuntary or accidental ground. (For example, if the insulation of a wire is damaged and the inside wire touches a metal component, the result is a ground, or *short*.) An improper ground—or *short*—will blow a fuse. Short and ground are not to be confused with an open connection, which means that a wire is cut or separated. An open circuit means the flow of current is stopped.

Siamesed. Refers to cylinders located relatively close together in the engine block because there is no water jacket between them.

Slip angle. A measure that describes the difference between the actual course followed by a tire and the course that would have been traveled if the tire had not been leaning in a turn.

Solid-state. Refers to components that rely primarily on transistors and integrated circuitry to function.

Space frame. A type of chassis based on a system of interconnected steel tubes tied together in a fashion that is very resistant to bending; often used in racing cars that require great strength.

Spark plug. A device to transmit the electrical charge sent by the distributor and coil; a spark from the spark plug ignites the air and fuel mixture in the combustion chamber.

Spindle. The part of a front or rear suspension that functions as a short axle and serves as a mounting surface on which the bearing of the wheel rides.

Split links. A variant of the A-arm suspension. Split links use a pair of transversely mounted control links, each of which can function independently of the other. Also called the *double-pivot front suspension*.

Squat. The dipping of a vehicle rear end while it is accelerated from rest or when it is accelerated briskly at high speeds.

Squish. The interaction of a piston and cylinder head where the air and fuel mixture is compressed and mixed completely when the piston moves toward top

dead center (TDC). Well-designed “squish areas” help the engine burn fuel more completely and emit fewer harmful emissions. Also referred to as swirl.

Stabilizers. Stabilizers or sway bars (also called *antiroll bars*) are transversely mounted links used to control the tilt of the car when it is going around a turn. They tie together the left and right wheels of a given axle and can be mounted in a number of different ways. By using one of these bars at either end of a vehicle it is possible to control handling without making the ride uncomfortable.

Steering. On any vehicle the steering system includes the steering wheel, the column on which it is mounted, a steering gearbox, actuating arm, and assorted steering links between the gearbox and the wheels.

There are a number of different types in use, most named after the specific kind of steering gearbox used (rack-and-pinion, worm-and-roller, recirculating ball). The mechanism itself may be a straight mechanical variety, known as manual or direct acting, or it may be a power-assist system incorporating a hydraulic pump to multiply the amount of effort developed by the normal gearing, thus making it easier for the driver to turn the wheels. Steering geometry is a term that refers to the relationship of the wheels and the various steering links to the road. This includes caster, camber, toe-in, and toe-out adjustments, all of which have an affect on the system.

Steering feel. The sensation a driver feels through the steering wheel; it may include centering action, amount of effort, responsiveness, and torque steer. Steering feel can tell the driver about the surface of the road, the grip of the tires, and the available traction in poor weather.

Stratified charge. Refers to a combustion chamber designed to enable the fuel and air mixture to enter very close to the spark plug where it can be burned quickly and efficiently. By keeping the rich part of the mixture close to the spark, the temperatures in the cylinder stay lower, fuel economy increases, and exhaust emissions are reduced.

Stressed member. The sections of a unibody that serve as load-bearing components for the overall frame of the vehicle—important parts of the unibody that help hold the car together.

Stroke. The maximum vertical distance traveled by the top of the piston in a cycle of the engine.

Suppressor. A term used to describe the design of spark plugs and spark plug wires; or suppressors can be separate units used in the ignition system to reduce or

prevent interference in the vehicle radio. Also referred to as *noise suppressor*.

Suspensions. There are a number of different suspension designs, but all are concerned with linking the body and chassis of the vehicle to the wheels, brakes, and axles. While suspension systems vary in specific design, depending on the location of the engine and drive wheels, they are all based on the principle of using a flexible connection between a vehicle's undercarriage and its body (passenger compartment).

Front suspensions are almost universally of independent design with the exception of some four-wheel-drive vehicles and trucks. Independent means that one wheel can react to the road without directly affecting the other wheels. Two main components are important to any setup: the spring itself (or torsion bar) and a damping device (shock absorber). Many suspension systems rely on a combination strut-type device. The best known is an integrated coil/shock absorber combination named after its inventor, Earle S. MacPherson. Struts are especially adaptable to front-drive vehicles.

Many cars use components known as A-arms (often called wishbones) to position the springs and shocks. These triangular metal parts mount to the frame or unibody on their base side and connect the point to the wheel's hub.

Rear suspensions vary even more widely. Variations on the strut are used, and a rear axle can be a "dead" solid beam, a "live" unit with a differential, a semi-independent deDion type, or a fully independent variety. This means that leaf springs, coil springs, or torsion bars may be employed to suspend the assemblies, while a variety of secondary links may be used to hold the axle and other suspension pieces in place.

Locating devices or locating links, both front and rear, are used to position the suspension components to prevent unwanted movement in the suspension and wheels. Links may extend forward, backward, or sideways. Depending on the specific application, these important locating devices may be called *links*, *rods*, or *arms*.

Swept volume. The amount of space covered by a piston in each stroke.

Swing axle. A type of independent suspension system that employs a single joint at the inside of the half-shaft. The angle between the wheel and the outer end of the axle shaft remains at a constant right angle, allowing only the axle to pivot from the center of the car.

Swirl. The circular movement of the air and fuel mixture in a cylinder. Good swirl of the mixture helps the fuel burn more completely and efficiently.

Synchromesh. A manual transmission incorporating a synchronizer gear to match the speed of the main shaft in the transmission (engine speed) to the speed of a particular gear being selected. This prevents the gears from grinding in a manual transmission at time of gear change or "shifting."

Targa top. A style of removable top featuring a permanent, wide, and flat type of roll bar. The bar adds stiffness to the body of the car when the top is removed, and is a safety feature in the event of an accident.

Thermal efficiency. A measurement that compares the amount of energy potential in a certain fuel with the amount of actual work accomplished by the engine using that fuel.

Thermal reactor. An exhaust-mounted mechanism designed to get hot enough to reburn the exhaust so that some of the emissions are eliminated before they are released into the air. HC and CO emissions are reduced by this device used in earlier cars.

Thermostat. A device that incorporates a temperature-sensitive element to decrease or increase the circulation of coolant throughout the cooling system to maintain a constant engine operating temperature.

Third member. The differential, a major component of the rear end.

Threads. Circular ridges on the inside of a nut or the outside of a bolt that join with opposing threads to fasten together a nut and bolt.

Thrust bearing. The crankshaft bearing responsible for absorbing the thrust load created when the clutch is disengaged. The thrust bearing also reduces the amount of play (movement) in the shaft itself.

Toe-in/toe-out. Refers to the front-end geometry. If the wheels are pointed slightly away from each other, it is referred to as *toe-out*; if pointed slightly toward each other, it is known as *toe-in*.

Torque steer. The sensation encountered in front-drive cars in which the engine power turns one of the wheels more than the other and the steering wheel tugs from one side to the other. A condition generally evident at low speed during heavy acceleration.

Torque tube. A hollow cylinder connected to the rear end of the transmission housing and the differential through which the drive shaft is routed. The torque tube reduces the twisting effects of the engine's power on the drive shaft and suspension components.

Torsion bar. A suspension component made of heat-treated steel. It acts as a spring by twisting in a rotation (along its longitudinal axis); the torsion bar may be mounted either transversely or longitudinally.

Torsional rigidity. The resistance of a vehicle body to twist and flex over uneven pavement.

Torsional vibration. Harmonic motion (vibrations) within the drive line produced when an engine is being operated at low speeds.

Track. The exact distance between the front wheels or rear wheels. Greater track generally results in a more stable vehicle.

Trailing throttle. The condition that exists when one's foot is lifted off the accelerator pedal; it usually refers to how the car responds in a turn when the driver releases the gas pedal.

Transmission. Transmissions are devices that use a system of gears to multiply the torque from an engine. In a manual transmission, the driver is required to change the gears ("shift") by moving the shift lever while depressing the clutch pedal, which momentarily interrupts the link between the engine and the gearbox. After the proper gear is selected, the clutch is re-engaged.

An automatic transmission is a gearbox that selects and changes gears by means of a system of hydraulically (fluid) activated clutch and band mechanisms. These are energized by signals that respond to engine speed and load and/or road speed. Many current transmissions have an electronic connection between the engine and transmission that tells the gears when to change at very exact times. Between the engine and transmission is a fluid coupling device called a *torque converter*. Most modern vehicles use what is called a *lockup torque converter*. Unlike a torque converter that does not lock, the lockup converter makes a direct mechanical link between the engine and transmission. This eliminates the slight slippage that takes place with a fluid coupling and increases the fuel economy.

Transaxles are units that combine transmissions and differentials into one assembly. They are primarily used in front-wheel-drive cars, but mid-engine vehicles also use this system. In some cases, front-engine/rear-drive cars will also use a transaxle to distribute weight evenly by placing the transmission at the rear of the car, far from the engine's weight.

Transverse link. A suspension-locating device mounted at right angles to the direction of a vehicle's travel. A suspension component that extends from side to side under the vehicle.

Tumblehome. The inward slope of a vehicle greenhouse when the vehicle is viewed from the front.

Tuned manifolding. Intake or exhaust runners of a mathematically selected length and diameter to provide better "breathing" and flow of gases in an engine.

Turbocharger. An exhaust-driven device that uses a vaned fan (impeller) to increase the amount of air or air and fuel mixture sent to each cylinder. It increases engine power by feeding more air/fuel to the cylinder than the normal cylinder volume in a nonturbocharged engine.

Twin cam. A double overhead camshaft engine.

Understeer. The tendency for a vehicle to resist going through a turn. Often the car will head for the outside of the turn if it is going too fast.

Unibody. A type of construction design in which the body and chassis are combined into one structure. The elimination of a separate frame reduces the vehicle weight and results in a more rigid, stronger assembly.

Universal joint. A mechanical joint that swivels in any direction. It is used to connect the drive shaft and/or half-shaft to other drive shaft components.

Unsprung weight. The amount of vehicle weight not supported by the suspension springs of the chassis.

Vacuum advance. A distributor or control-module mechanism that relies on engine vacuum (load) to advance the spark timing to the spark plug to compensate for the extended burning time required when the engine is operating under light load. The vacuum advance action actually makes the spark plug fire earlier to completely burn the leaner fuel mixture.

Valve bounce. A result of high engine speed that keeps the valves from returning to a fully closed and seated position before the next cycle of opening and closing begins. Also called *valve float*.

Valve clearance. The distance between the end of a valve stem and the rocker arm or cam follower that actuates it. A gap is required in all engines not equipped with self-adjusting hydraulic lifters to compensate for the expanding and lengthening of the valve stem, which results from engine operating heat.

Valve spring. The spring that returns a valve to its closed position during the appropriate portion of each engine cycle.

Vapor lock. A condition caused by warmed gasoline that, in effect, boils while it is still in the fuel system, creating an air bubble in the fuel line. A vapor lock causes the engine to stall because the carburetor has no fuel.

Variable-rate spring. A coil spring that does not compress at an equal rate throughout its entire length. Variable-rate springs are usually softer at the lower end and become stiffer as the spiral moves upward.

Variomatic transmission. An automatic transmission that offers a range of continuously variable gear ratios. Also called a *CVT*, for consistently variable transmission, the design uses a pair of variable-size pulleys connected to a V-shaped belt.

Venturi. The narrowed area in a carburetor throat. It creates a low-pressure area (vacuum) that draws gasoline out of the carburetor float bowl through the jet and into the intake manifold.

Viscosity. The resistance of a fluid to flow and pour. The tendency for lubricants to thin out and become much less thick at higher operating temperatures led to the development of multigrade oils and fluids that are thin when cold to allow easy starting and become progressively thicker as they heat up.

Viscous coupling. A liquid link between two shafts with vanes attached to them. There is no direct mechanical link in a viscous coupling.

Voltage regulator. A device to maintain the appropriate level of voltage throughout a vehicle's electrical and charging system.

Volumetric efficiency. The ratio of air drawn into a cylinder at outside temperature and pressure compared to the amount of air that could possibly be drawn in.

Wastegate. A pressure-sensitive relief valve used to limit the amount of maximum boost pressure that can be fed to a turbocharged engine.

Water injection. A system to control cylinder temperatures and ping by injecting water or a water-alcohol blend into the air and fuel mixture as it passes through the carburetor or intake manifold. Water injection is often used on turbocharged engines.

Water jacket. The coolant-filled channel that runs throughout an engine block.

Watt linkage. A three-link system that relies on two transverse links mounted to a central pivot. The linkage is used with live or deDion rear axles to limit the side-to-side and lateral movement of the assembly.

Wheel balancing. The process of ensuring that weight is distributed evenly around the wheel-and-tire combination to prevent wheel shimmy and uneven tire wear.

Wheelbase. The distance between the center of the front and rear axles to which the wheels are attached.

Wheel cylinder. The two-piston cylinders of a brake system located within the brake drum on the mounting plate. The wheel cylinder responds with hydraulic pressure to input from the master cylinder, pushing the pistons outward and forcing the brake shoes to contact the rotating drum, or in a disk-brake system, the pads contact the rotor.

Wiring harness. A collection of color-coded wires used to properly interconnect all of the electrically operated components on a vehicle. A harness is the car's electrical "map."

Yaw. The pitching motion or rotation of a vehicle around its own middle section, a form of limited turning or change of direction.

RESOURCES

BOOKS

What's Wrong With My Car: A Guide to Troubleshooting Common Mechanical and Performance Problems, Mort Schultz with Alfred W. Lees and Ernest V. Heyn, eds. Consumer Reports Books, 1990.

Basic Car Care Illustrated. 3rd edition. Morrow Publishing, 1987.

Chilton's Easy Car Care. 2nd revised edition. Chilton, 1989.

OTHER SOURCES

Automobile dealers, auto repair shops, libraries, car clubs

ACKNOWLEDGMENTS

This manuscript was prepared with the cooperation of the Specialty Equipment Market Association (SEMA), a trade association serving the automotive aftermarket. The Boy Scouts of America wishes to thank the following people for their contributions to this project: Jim McFarland, Damian Geddry, Robert C. Burch, Dick Wells, and Harry Hibler.

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This program feature was written and developed in part through the cooperative efforts of professional and volunteer Scouters in the Great Salt Lake Council, Boy Scouts of America.

OPERATION ON-TARGET

BACKGROUND



The Operation On-Target program feature is an exciting one that tests many of the skills of Varsity Scouts. Operation On-Target can be anything from a wilderness backpacking trek to a high-tech experience with radio and movie-making equipment. It can also include a variety of activities such as radio communications, photography, wilderness survival, mountain climbing, nature study, and making video movies. This event is sometimes called the “mountaintop experience,” although the Varsity Scout team can carry out this program feature without having a mountainous area.

On the third Saturday in July each year, teams from all across America will be climbing high-rise buildings, mountain peaks, and tall trees to flash their signal mirrors in the direction of another team. Just about any elevated spot will do. When contact has been made, both teams have concluded many months of preparation and are now “on target.”

In the past, Varsity Scouts have signaled from every high point imaginable, from the top of the Empire State Building to the Rocky Mountains, and from ship to shore on the Pacific or Atlantic coasts. Teams have even completed a signaling network through the Rocky Mountains from Canada to Mexico in one day!

Varsity Scout team program managers will have the opportunity to lead portions of the Operation On-Target program feature. Your huddle commissioner will provide you with lots of how-tos in carrying out this feature, including literature from your local council service center.

PROGRAM FIELDS OF EMPHASIS

The following are some suggested ideas that will help you plan a well-rounded program feature. Program managers assisted by a team committee member carry out these ideas.

ADVANCEMENT

- Review each Varsity Scout’s advancement status.
- Conduct a merit badge clinic or refresher session for the Signaling, Backpacking, Hiking, and Camping merit badges.
- Monitor the team advancement charts regularly.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team’s annual high-adventure event (Philmont, Florida Sea Base, etc.).
- Monitor the team’s progress in carrying out the Operation On-Target program feature.

PERSONAL DEVELOPMENT

- Conduct a forum on why being “on target” in your everyday life is important.
- Plan a fitness program geared to the physical demands needed to reach the “peak” for Operation On-Target.

SERVICE

- Assist a new team in building its signal mirrors.
- Plan a service project that can be carried out during the Operation On-Target program feature.

SPECIAL PROGRAMS AND EVENTS

- Hold an open house for new members. Discuss with them the team’s On-Target plans and invite them to join the team.
- Conduct a family night program to share photos, slides, or videos made during the team’s On-Target participation.

MOUNTAINTOP CEREMONY

The mountaintop ceremony may be the most rewarding portion of your Operation On-Target experience. The ceremony may be held around a campfire on Friday evening or after the mirror signaling on Saturday.

After gathering your team in a secluded spot, follow the team’s outline, have a reverent (Scout Law) mountaintop ceremony that includes:

1. The letter from a famous person
2. The letter from a religious leader
3. Time capsule memorabilia
4. The Coach’s Corner

The ceremony might also include a song, prayer, reflection, guest speaker, religious emblems recognition, or history of the peak the team will be using during its Operation On-Target event.

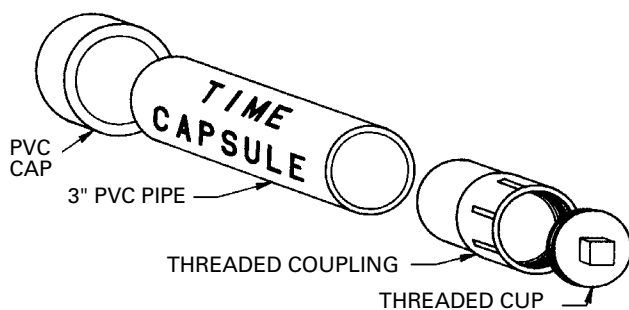
SAMPLE COACH'S CORNER

Use the mountain you have climbed as an object lesson. The peak is your goal and/or life. At any one moment you are either climbing toward your goal, at your goal, or moving down from your goal. Relate to religious situations or self-reflection if appropriate.

OPERATION ON-TARGET TIME CAPSULE

The time capsule is a container made to store special items from Operation On-Target and all other special Scouting events. Future Varsity Scouts will enjoy the years of memorabilia from your team's past events. The time capsule could include:

- Photographs
- Special letters and Coach's Corner
- Varsity Scout team roster and guests
- Operation On-Target pin
- Personal totems and comments
- Team history and location
- Similar items from other events
- Summary of the day



Available at most hardware stores in black or white

Time Capsule

PLEASE DON'T POLLUTE:

BRING MIRRORS AND TIME CAPSULES HOME.



BEST STORY TOLD

In the days before television or cinema, telling stories of places we had been to or things we had done was a form of entertainment and communication. A great deal of competition would develop over who could tell the "best story told."

In Operation On-Target, the opportunity is given for each team to tell its own story using slides, videos, or any other imaginative visual or audio medium.

In developing your own "best story told," you must try to develop those same feelings of excitement, companionship, or the sense of accomplishment you felt on that mountaintop, seeing the response to your mirror flashes in hundreds of beams of lights returned to you.

YOUR STORY

Before putting your own story together, you will want to check with your local council and find out what restrictions or rules it has established for the "Best Story Told," if any.

The story you tell can start from the day you first talked about your Operation On-Target adventure. Make recordings and take photographs or slide shows or videos from early on in your program. (Take lots of pictures; you will need them in editing later.) The type of story you put together and the medium you use to tell the story will depend largely on the resources available to you in your team or neighborhood.

SLIDE SHOWS

Slide shows can be a great way to tell your story. Taking slides can involve the entire team. Now is a good time to make use of your Photography merit badge counselor to help train the team to take quality photos. Slides can be taken fairly easily and inexpensively with a 35mm camera, and can be developed and edited at your leisure. A simple slide projector can then be used to show your story with the help of a prerecorded cassette with music or words, or both, to tell the story, with cues to indicate when slides should be changed.

To get really fancy with slides, you will have to do some research and find resources with the know-how and equipment to extend your capability to 2-, 3-, 6-, or more rack-mounted slide projects run by dove units or computer with automatic cues, fade-in/fade-out, and all sorts of special features offered by your equipment.

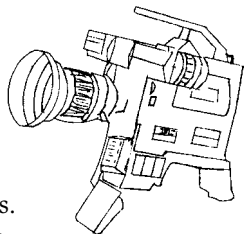
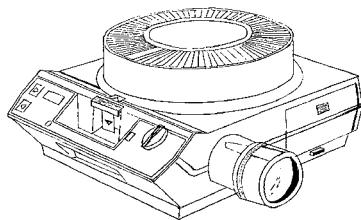
There are no limits except those set by time, effort, and your local council.

VIDEOS

Video cameras have become common, and their versatility allows the user to be creative with a number of editing features. Videos perhaps allow more room for creativity than slides, but the cost and availability of equipment might be prohibitive to many teams.

THEORY

Whatever visual medium you select, you should start recording your Operation On-Target adventure early both with your camera and recorder. Studies of media impact have shown that the audio, or sound, from a production has a stronger impact on the senses than the visual. Consequently, you will want to put at least as much emphasis on your sound track as your visual. Try taking a recorder with you and capture your activities on-site—a colorful panorama of sound from the natural environment of birds and wind to the chatter of the Varsity Scouts and the static of a ham radio conversation. If live recordings are not possible, a creative sound track can be put together in somebody's living room.



SUMMING UP

Plans and goals should be made early in your program—perhaps a theme to base your photograph or sound track around. Draw the entire team together to help plan the show, listen to everyone's input, and let the team design the story. In the end you will not just tell a great story and pass your excitement and experiences on to others, but create wonderful memories, both with each participant and visually on film—something that can be enjoyed by family and friends now and years down the road.

Every time you watch the “Best Told Story” you helped create, the memories and sense of accomplishment will be a reward felt over and over.

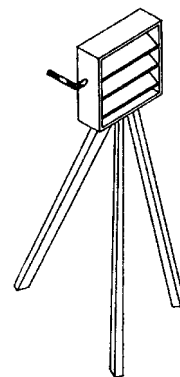
HELIOGRAPH

The heliograph was an instrument used to send signals by reflecting sunlight with a mirror or mirrors. Heliographs were used by the armies of several countries during the late 1800s, especially the U.S. Cavalry in the American Southwest from mountain peak to mountain peak.

In Operation On-Target, the heliograph is again used, but this time for fun. Varsity Scout teams from all over the country climb a hill, a mountain, a building, or ascend to any safe high point, carrying with them mirrors—from small handheld ones that can be seen from as far as 30 miles away, to large base-mounted mirrors. It is strongly recommended that plastic mirrors be used instead of glass; picking up broken pieces of glass can cause cuts and problems in transporting the pieces back. Plastic mirrors weigh about half the weight of glass mirrors and, when climbing, every ounce saved helps.

Everyone will feel the excitement when signals are returned from neighboring peaks, the larger mirrors really standing out from the smaller ones. Every team should have at least a 24-by-24-inch mirror on a light tripod; this larger mirror tends to catch the attention of stations on the other peaks and may bring more flashes your way.

Work with another team and prearrange to signal each other at a certain time. Try setting up a code, or use Morse code.

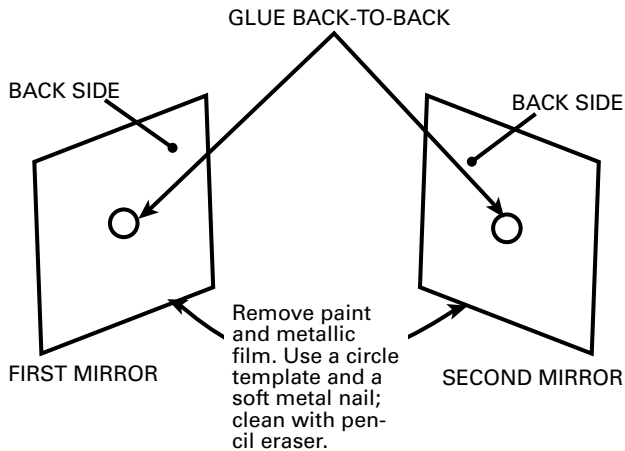


*Today's
heliograph*

AIMING

Learning how to aim a mirror takes a little patience, and knowing where your flashes are going can be critical when you see a reflection across the valley or on a neighboring peak. As you send your signal and receive responses, consider the strides made in technology. When once lives depended on those light beams, now they create fun and excitement for Varsity Scout teams.

TO ASSEMBLE MIRRORS:

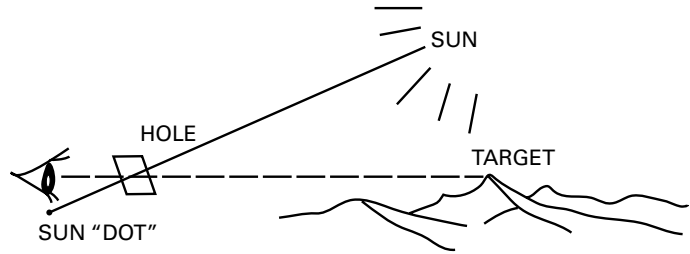


Using a signal mirror is fairly easy, though it may seem complex at first. With practice and use, it becomes second nature and a valuable resource in your ability to survive.

1. Look through the hole at your target.
2. Find the "dot" in the back mirror (usually on your hand, face, or shirt).
3. While looking at your target, arrange the mirror such that the "dot" crosses back and forth over the hole.

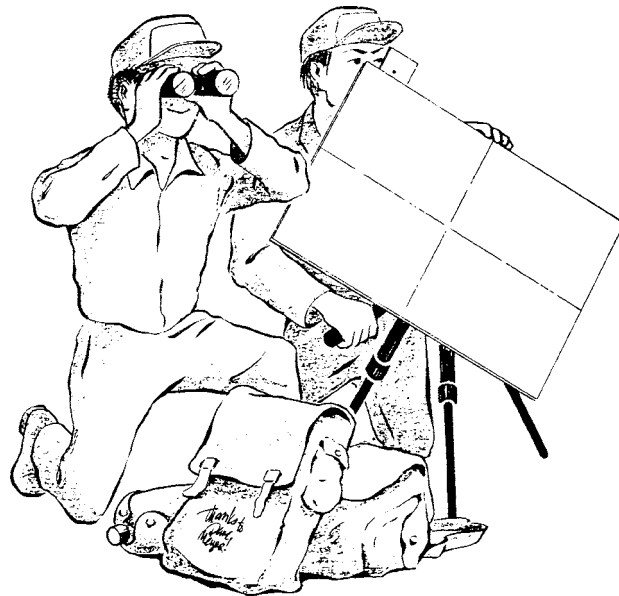
In other words, while looking at your target, align the reflected hole with the real hole, and you're on target.

To check yourself, sight in on a reflector such as a license plate, tail light, or freeway sign. These will really light up.



In a 15- to 20-mile range, a 3" or 4" mirror is sufficiently imposing that you can clearly see it. For greater range and brilliance, use your small mirror as a "sight" by taping it (in the same place) to a corner or edge of a larger mirror.

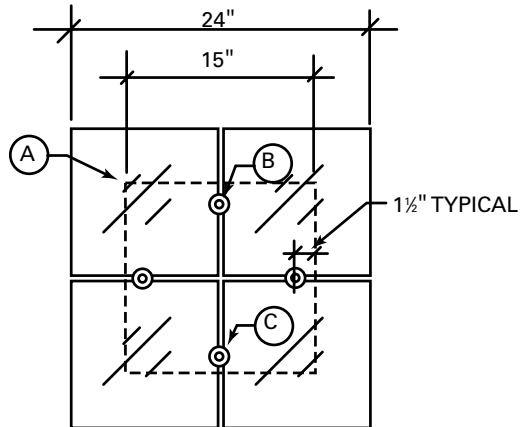
It can be used with Morse code by clamping to a tripod and interrupting the continuous signal with a cardboard deflector at appropriate intervals.



HELPFUL TOOLS YOU CAN MAKE

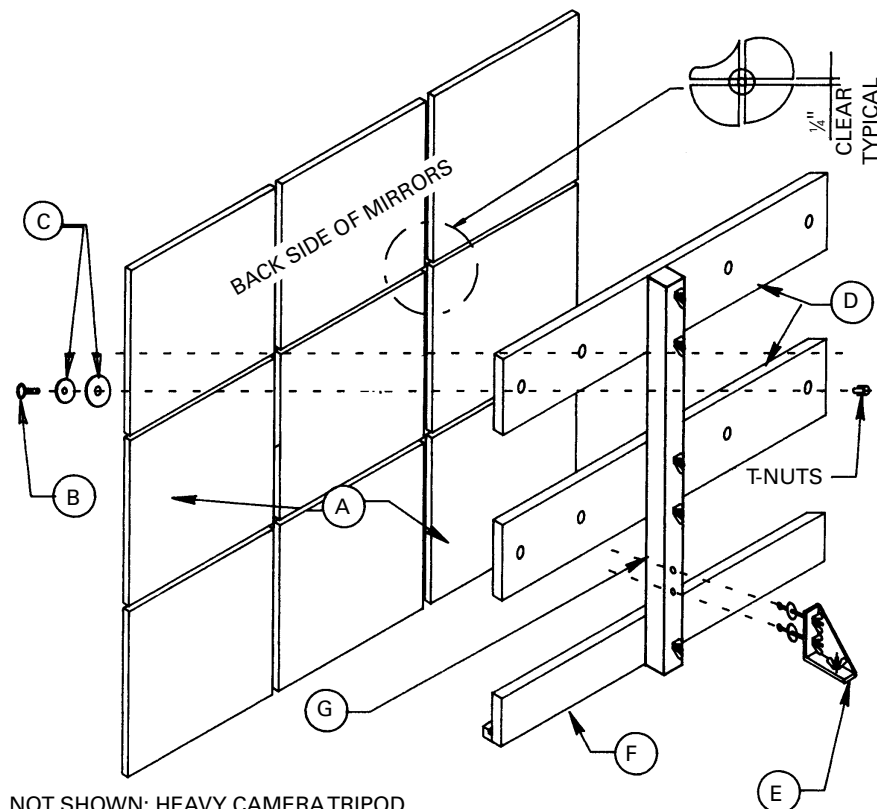
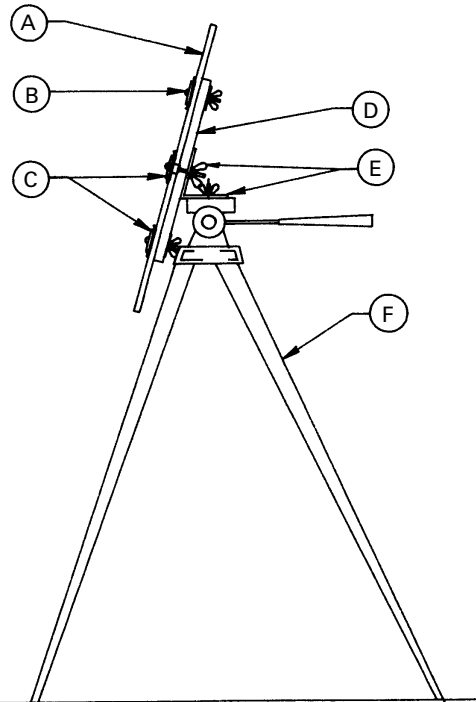
TEAM MIRROR SCHEMATICS

The following pages illustrate two examples of team mirrors. Design your own. Make it lightweight and easy to carry and assemble/disassemble. Share your design with other teams. Remember, large mirrors can make your Operation On-Target adventure more exciting by pulling in more signals.



MIRROR ASSEMBLY INSTRUCTIONS

- A. Four plastic 12" x 12" mirror tiles
- B. Four 1/4" x 1 1/2" dome head bolts with wing nuts (Wing nuts can be replaced with T-nuts, and bolts can be replaced with thumbscrews.)
- C. Four fender washers with glued rubber or cork backing
- D. Plywood or particle board, 3/4" x 15" x 15"
- E. Corner brace, 4" x 4" x 1/8" with one 3/8" x 2 1/2" flathead screw with one fender washer and wing nut
- F. Camera tripod



NOT SHOWN: HEAVY CAMERA TRIPOD

MIRROR REAR PERSPECTIVE

- A. Nine plastic 12" x 12" mirror tiles
- B. Eight 1/4" T-nuts and thumbscrews (may be replaced with dome head bolts and wing nuts)
- C. Eight fender washers with glued rubber or cork backing
- D. Three boards, 3/4" x 5 1/2" x 27", varnished or painted
- E. Corner brace, 4" x 4" x 1/8" with two 3/8" x 2 1/2" flathead screws with fender washers and wing nuts
- F. Board, 3/4" x 3 1/2" x 27", with lip screwed and glued as shown; fasten to 1 1/2" x 1 1/2" board with one 1/4" x 3" flathead screw with wing nut and washer
- G. One 1/2" x 1 1/2" x 27" board with two 1/4" x 3" flathead screws; fender washers and wing nuts in each 3/4" x 5 1/2" board

HOW TO MAKE A HAND SIGNAL MIRROR

Place two mirrors back-to-back with a hole in the middle to see through. The mirrors can be any size and the hole can be placed anywhere.

The back mirror needs only to tell you where the "sun dot" is that comes through the hole. It can be small and thin.

The front mirror needs to be clean, structurally strong, and as big as you want to carry.

Mark the back surface where you want the hole to be. Scrape off a $\frac{1}{8}$ -inch-diameter circle of the paint with the point of a single-edge razor blade or similar device. Try not to scratch the glass. There will still be some glossy stuff on the glass that comes off best with a pencil eraser and elbow grease. Make the edges clean because this is your "aimer."

When you have both mirrors "holed," place them together back-to-back using super-glue to hold them together. Keep glue away from the hole.

How to use the signal mirror:

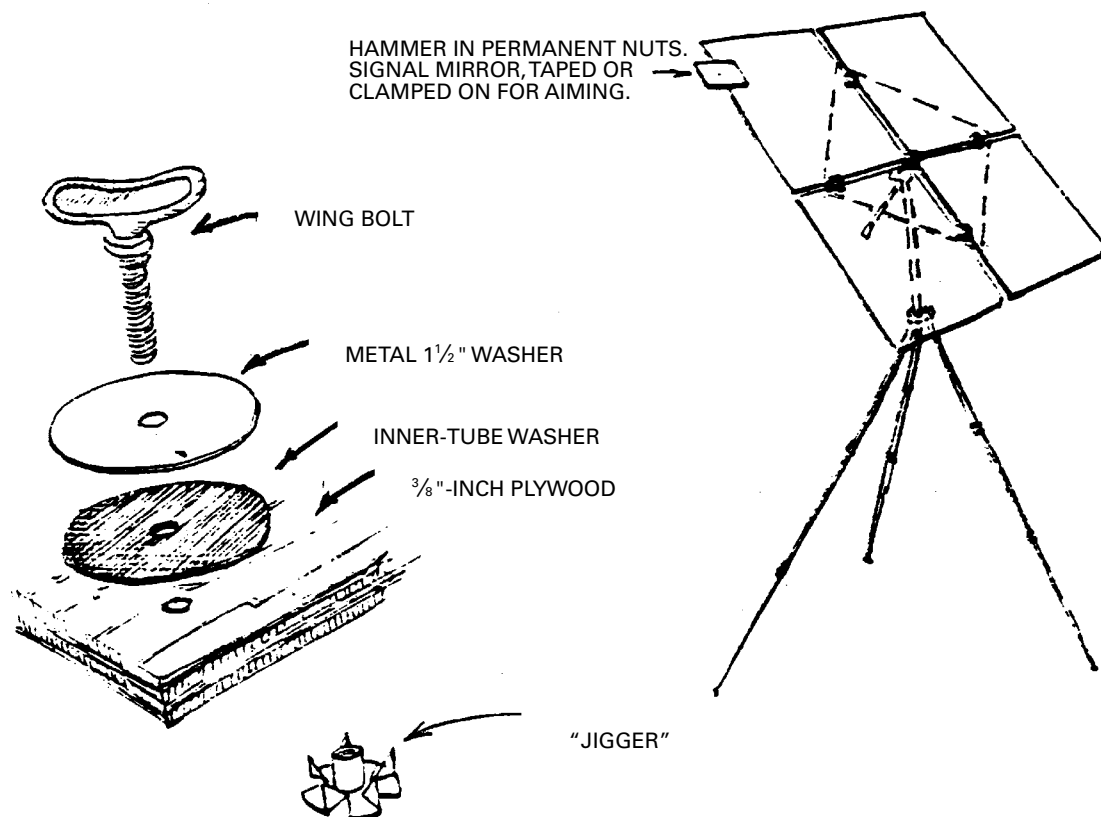
1. Look through the hole at your target.
2. Find the "dot" in the back mirror (usually on your hand, face, or shirt).
3. While looking at your target, position the mirror so that the "dot" crosses back and forth over the hole. In other words, while looking at your target align the reflected hole with the real hole and you're "on target."

A 2-by-2 foot square mirror would accomplish the same function, but it is big and heavy. This one folds up to fit into a backpack. Use standard 1-by-1 foot decorative mirrors. Cut a 1-by-1-foot piece of $\frac{3}{8}$ -inch plywood (if it's thinner, it may warp). Drill five holes: one in the center, the others $1\frac{1}{2}$ inches from each corner. These are to accommodate the little "jiggers" (hammer in permanent nuts, as shown). Use $\frac{1}{4}$ -inch coarse-threaded jiggers with a wing bolt and a $1\frac{1}{2}$ -inch washer plus a homemade rubber washer from an inner tube.

Buy an extra jigger and put it near the center (but offset) and on the other side of the plywood. You will find it will hook up perfectly to a standard camera tripod, which will let you keep the signal on someone you know is there . . . until they notice you. Or send code by interrupting the signal with a hand-held cardboard "shutter."

You may also want to hook a cabinet handle to the back center of the plywood for hand use.

MAKE A GIANT FOLDUP SIGNAL MIRROR



OPERATION ON-TARGET TASK DESCRIPTIONS

There are some responsibilities or tasks that need to be carried out.

TEAM HISTORIAN

Record and report the happenings of the event with full coverage of the locally planned Operation On-Target fireside get-together with parents and chartered organization to show pictures and share the Operation On-Target experience.

TEAM FLAG CHAIRMAN

Create a symbol—like the “Stars and Stripes” is to the United States—to develop your own team esprit de corps. Carry it with you, unfurl it on the peak, and capture the moment on film with your teammates, perhaps in uniform, for all posterity!

TEAM PHOTOGRAPHER

Record the Operation On-Target experience on film to best re-create your feelings or message for your locally planned fireside (approximately two weeks following the event) and perhaps for your own get-together with parents and chartered organization.

TEAM MAP AND GEOGRAPHY EXPERT

Become your team’s “sensor,” knowing such things as how to get them to the peak, where your team will fit in—in the overall operation, your radius of influence, locations of your potential return signals, and what your 360° horizon will look like from on top.

CHOOSING A PEAK

Perhaps the key to your Operation On-Target adventure is the peak or high point from which you choose to signal. Don’t limit yourself to a mountain. A high building might be more appropriate in your area. Use your imagination; signaling from a boat in the middle of a lake (of course, while observing Safety Afloat procedures) could be an exciting On-Target station, as could a small wooded hill, a guard tower (with permission), a bridge, or the top of a ski run. Look around, be open-minded, and choose somewhere fun.

TEAM SKILL OR FITNESS LEVEL

A peak should be chosen that all members of the team can reach or a large team could be split, each half choosing its own peak with the level of difficulty acceptable to each group. The team Coach should be aware of all difficulties and dangers associated with the peak chosen by the team, and should also be aware of and considerate of the limits of all team members.

SOLITUDE

Close, easy-to-get-to peaks will be chosen by more than one team. A peak can be used by several teams and can add to the excitement of Operation On-Target with the camaraderie or competition with other teams. However, if your team wants to be by itself, you will probably want to choose a peak that is more inaccessible.

WEATHER

Even though Operation On-Target occurs in the summer, high mountain peaks have been known to have snowstorms all year round. If this type of peak is chosen, the team must be prepared for all types of weather.

VIEW

If you are choosing a secluded peak, don’t get so secluded that you don’t see any other mirror flashes. Make sure that other teams will be close enough so that they can see your mirrors.

FUN

Make Operation On-Target the center of your activity, but don’t limit yourself to just flashing mirrors. Plan other activities that all can join in on such as hiking, fishing, rappelling, and orienteering, or have your team set up a schedule or list of activities.

Be prepared for the activity. Review first aid for hypothermia and mountain sickness, and take along lots of sunscreen (factor 20 or higher). Give yourself lots of time to reach your stations, and don’t push your team in a low-oxygen, high-altitude area.

Check with your local U.S. Geological Survey office or state natural resource organizations to find out about peaks, mountains, or hilltops in your area.

ON-TARGET WITH HAM RADIO OPERATORS

WHAT DOES THE HAM RADIO OPERATOR DO?

When you are on a peak scanning the horizon, there is a lot of country to see. It can be pretty difficult to pick out any one tiny mirror flash if you don't know where to look. Your radio operator will be in contact with other teams all around you to help coordinate their locations with your team. This person will also be able to confirm your contact; after all, you want to know that the other guys saw you, too.

HOW DO WE FIND A HAM RADIO OPERATOR?

Many of you are probably already aware of hams in your neighborhood. If you are not, here are some suggestions on how to find them. The first clue is the antenna. Many hams have huge antennas on their vehicles. Another thing to look for is a "call sign" license plate. A ham station call will have three to five letters with one number in the middle somewhere, such as N7CES or WA7UFS. Many hams are very public service-oriented, so when you see one, don't hesitate to approach a ham operator and explain what Operation On-Target is, and ask if he or she would like to help. (It might not be a bad idea to approach the ham in uniform to help make a good impression.)

It would be a good idea to try to contact a ham as soon as possible. There are a limited number of them around, and there always seems to be other public service events scheduled that request their services.

When you do find a ham, you might want to invite the ham to introduce your team to amateur radio. Most hams are proud of their stations and their hobby and love to show them off. It also provides an opportunity for you to get better acquainted.

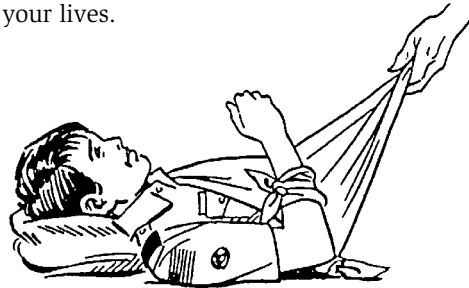
Check with your local council for radio frequency details.

SAFETY

Every year there are fatalities across the United States involving climbers and hikers. Many of the accidents are from just plain carelessness; some are from individuals not recognizing hazardous situations when they get into them.

Some basic mountaineering skills and some good common sense can go a long way in keeping you and your team safe in a mountain setting.

Don't overestimate your potential or your knowledge of mountaineering. If the areas you're planning to visit require special skills unknown by you and your team, or special equipment you don't have, then don't go. Pick a safer environment. Don't gamble with your lives.



Following are some mountaineering safety tips. They are by no means the only safety tips you need to know.

- 1. Snow pack.** Glaciers or snow fields hold their own kind of hidden dangers. Moats are voids formed between the hidden rocks underneath and the snow pack. If you have to cross large areas of snow pack, use a rope or, at the very least, an ice pick.
- 2. Rock climbing.** Climbing cliffs or rock faces is a learned skill; it's not one that comes naturally. Certain types of rock should not be climbed at all. Learning how to climb, as well as what to climb, requires time-consuming training and special equipment. Many people have become trapped on cliffs because it appears easy to climb, only to discover it's not so easy to descend.
- 3. Sliding.** Sliding down shale, smooth rock, snow, or ice may seem like a lot of fun, but most natural slides end at cliffs or in a large jumble of jagged boulders. Be careful.
- 4. Never hike at night or alone.** Always hike with a buddy.
- 5. Be especially careful with fire.**
- 6. Never split up in the backcountry;** stay together.
- 7. Watch weather carefully,** being especially careful not to get caught in a deep canyon during a rainstorm, or on a ridge during a lightning storm, or at a high altitude by a snowstorm.

8. Know the symptoms of and treatment for hypothermia.

9. Be aware of the consequences of drinking contaminated water. Become familiar with Giardia and the illness it causes.

10. Don't exhaust yourself or weaken members of your team by trying to travel too far or too fast.

11. If you get lost, don't panic. Sit down and relax for a few minutes while you carefully check out your surroundings and your compass, then plan your next move with confidence, or wait for help.

12. Stay clear of wild animals. A healthy respect can prevent potentially dangerous confrontations.

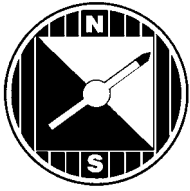
Although well-publicized when they occur, rattlesnake bites are not common, and death from a rattlesnake bite is extremely rare. Complications from bee stings are much more common. However, if one of your fellow team members is bitten by a snake, the best treatment is to get medical attention as soon as possible, keeping the victim calm in the process. Both tourniquets and cutting are not recommended unless you know exactly what you are doing.

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ORIENTEERING

BACKGROUND



Map reading and use of the compass are the basic skills of orienteering. Now comes the opportunity to test those skills by traveling cross-country while competing against other teams or individuals.

Orienteering is rapidly becoming an exciting competitive sport with demanding challenges for the best of athletes. Much like chess, it is a thinking person's sport. As the skills in orienteering are perfected, the Varsity Scout team should seek out locally sponsored orienteering events and enter the competition. Many communities have local orienteering clubs that would welcome your team's participation.

The Orienteering program feature contains an introduction to orienteering, training, techniques, laying out a course, training games, and resources to use.

You will find sessions outlining skills instruction and special activities and events to reinforce the skills learning.

Orienteering can be done on bicycles, at night, on skis, as a relay, or in the downtown area of a metropolitan city. Varsity Scouts will learn the new meanings of "saddle" and "spur" as they participate in this challenging sport.

PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with help from a team committee member.

ADVANCEMENT

- Review each Varsity Scout's advancement status.
- Conduct a merit badge clinic for Orienteering.
- Monitor the team advancement chart regularly.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team's annual special high-adventure event (Philmont, Florida Sea Base, etc.).
- Conduct an orienteering activity.

PERSONAL DEVELOPMENT

- Have a member of a historical association, such as Daughters of the American Revolution, make a presentation on the early leaders of the community. Hold the team meeting at a historical site or in a public meeting place.
- Hold a family night progressive dinner—one home for appetizers, another for the main courses, a third for dessert. Consider having an outdoor barbecue if weather permits.

SERVICE

- Plant food for wildlife. Planting shrubs, trees, vines, and grains will help attract wildlife to rural and sub-urban areas. Get advice from the soil conservation district office or state conservation department.

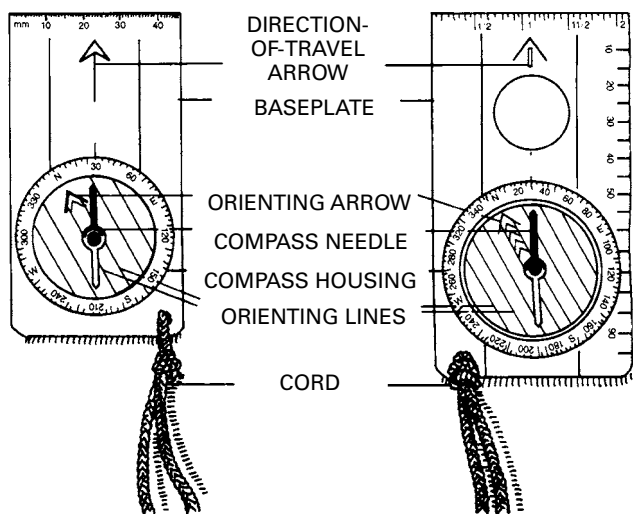
SPECIAL PROGRAMS AND EVENTS

- Contact several other teams to plan an orienteering meet.
- Plan a family outing that includes the opportunity to involve family members as members of an orienteering team. Set up and run a course that will not require a lot of expertise.

ORIENTEERING AT A GLANCE

So far in your Scouting experience you have learned some of the basics of orienteering. In your Tenderfoot through First Class requirements, you learned how to read a map and take a bearing on a compass. If you have earned the Orienteering merit badge, you refined those skills. Now you are going to be challenged to perfect those skills and be able to travel cross-country using only a map and compass. By perfecting your ability you will be able to compete with other individuals or teams.

As you perfect your skills, enter in some locally sponsored orienteering events. If none are available, organize one. Check for local clubs; some major corporations have employee clubs that have orienteering events. If you have a military unit that could help, use them as a resource. Colleges and universities often have clubs. Also use your skills to help younger Scouts who are just starting to "get their bearings."



BLACK AND WHITE ORIENTEERING MAP SYMBOLS



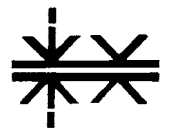
Jeep trail



Footpath



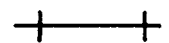
Path junction; distinct/indistinct



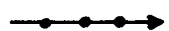
Underpass; with path/without path



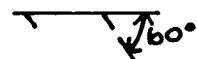
Railroad



Utility line, aerial lift; crossmarks show position of poles or pylons



Stone wall



Fence; crossable



Fence; uncrossable



Cairn, boundary marker



Blazed boundary



Buildings (show shape of building)



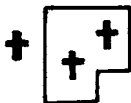
Ruins, foundations (show shape of ruin)



Shelter



Tower, hunters' platform



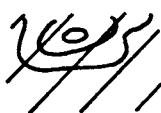
Gravestone, cemetery



Firing range



Other obvious object



Private area (show landmark features)



Built-up area (show major roads and landmark features)



Prohibited area



North line; with north arrow

HYDROGRAPHIC FEATURES



Lake, pond



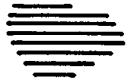
Small pond



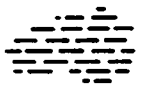
Water hole



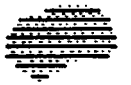
Uncrossable swamp; wooded



Marsh; wooded



Wet area; marshy but seasonally dry, wooded



Open marsh (combine swamp/marsh symbols with any clearing symbol)



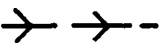
River; with flow arrow



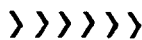
Uncrossable stream



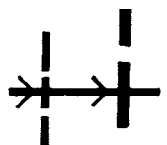
Crossable stream



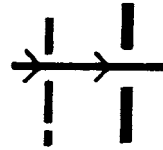
Intermittent stream, ditch; seasonally dry



Drainage bed; seasonally wet



Crossings; with bridges



Crossings; without bridges



Footbridge



Well



Springs

LAND FORM FEATURES



Contours



Intermediate form contour



Contour; with clarifying slopemarks, pointing downhill



Small knoll, high point



Depression



Small pit



Ravine (difficult to cross)/gullies

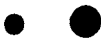


Gravel pit (dots show extent of face)

ROCK FEATURES



Cliff (tags show extent of face)



Boulder (obvious); small/landmark size

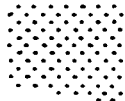


Boulder field (difficult running)

VEGETATION



Field, clearing



Semi-open area; occasional bushes



Dense vegetation (less than 50 percent of normal speed, forced to walk)



Distinct vegetation; boundary (along different wood types, firebreaks, cuts, small openings, etc.)

SELECTED CONTROL DESCRIPTIONS

This is only a partial list of the most frequently used control codes. The symbols show specific numbers for each, based on the various categories they appear under.

FINNISH BASIC MAP	INTERNATIONAL "O" MAP	LOCATION IN THE TERRAIN
----------------------	--------------------------	----------------------------

TERRAIN FORMS



The knoll



The knoll (1.5m), east foot



The hill



The depression (0.3m)



The depression, east part



The saddle



The pass

FINNISH BASIC
MAP

INTERNATIONAL
"O" MAP

LOCATION IN THE
TERRAIN



The terrace



The spur



The re-entrant



The re-entrant, upper end



The cliff foot



On the cliff, south end

HYDROGRAPHIC FEATURES



The pond, west edge



The spring, west edge

FINNISH BASIC
MAP

INTERNATIONAL
"O" MAP

LOCATION IN THE
TERRAIN



The stream bend



The stream junction



The ditch end

MARSHES



The marsh (0.6m)



The marsh, northwest part



The solid ground, northwest tip

FINNISH BASIC
MAP

INTERNATIONAL
"O" MAP

LOCATION IN THE
TERRAIN

OPEN TERRAIN AND FORESTS



The field



The field, southeast corner

SURFACE ROCKS, STONES, ETC.



The boulder (2m), west side



The eastern boulder (2.8m), east side

ORIENTEERING TECHNIQUES

Most techniques can be mastered by simply practicing. The following is a skill level chart that indicates where you should be at a beginning stage and more advanced stages of orienteering. Your goal should be to master these areas.

Techniques and their level classification:

B	Course plotting	B	Handrails	M	High approach
M	Traffic light	B	Route choice	M	Ground cover/distance relationships
B	Thumbing	M	Rough map reading	B	Precision compass
M	Green light selection	B	Control extension	B	Mapping problems
B	Control cards	M	Check-off points	M	Precision map reading
B	Map skimming	B	Aiming off	B	Misses
B	Reading the map	M	Contouring	B	Control finding
B	Collecting features	B	Attack point	M	Night orienteering
M	Distance judging	M	Climb distance relationships		

You need to become familiar with these terms and techniques in order to become an expert in the field of orienteering.

TRAINING TECHNIQUES

Because so many skills are required for orienteering, there is a wide variety of ways you can train. As the runner, you must constantly think on your feet; there are no timeouts or huddles to figure out what you are doing. From the start of the course until the end, all the speed and endurance you can muster will be the only way to stay in the competition. Below is a chart that contains techniques that can be worked on while playing a series of games. The number 1 indicates that the game has intermediate training significance and the number 2 indicates maximum training significance.

	Terrain Memory	Map Reading	Map Memory	Distance Judging (Pacing)	Rough Compass	Precision Compass	Route Choice	Control Finding	Attack Point	Running	Course Setting
Follow the Leader	2	2	2								
Bergvik Runs							2				
Map-Memory Chase			2								
Swapped Courses		1		1	1		1				1
Route Orienteering		2		1						1	
Compass Pacing Lines				2		2					
Line Orienteering		2	1								
Score Orienteering		1					1	1	1	1	
Control Picking		1						2	1		
Rough Orienteering					2		1			1	
Assigned Routes Orienteering		1					2				
Blank Map Orienteering				2		2					
Map Memory Star Orienteering			2							1	
Control Plotting			2							1	

TRAINING GAMES

FOLLOW THE LEADER

Unfamiliar terrain is a must for this exercise. The game can be practiced in two ways:

- 1. With a map.** All runners in a group of two to four team members have maps. Everybody should be aware of the starting point. One elected runner chooses a point some 1,000 meters away without telling the rest of the group where it is. It should not be too difficult a point. The elected runner leads (avoiding use of the compass) the other members to the point. As the other runners follow the leader, they try to find his route on their maps. Now and then the leader stops, at which time the rest of the group should be able to tell the leader their position and how they got there. When the first point is reached, a new leader takes over. This is good practice in map reading and terrain memorization; it is equivalent to route orienteering.
- 2. Without a map.** Only the leader has a map. The chosen point must be very easy and the route short (100 to 150 meters), following handrail type features. After the map man has reached the chosen point, the rest of the runners should try to trace the route they ran and indicate their present position on the map. This exercise helps develop both map reading and terrain memorization.

BERGVIK RUNS

This practice game, which got its name from the Swedish club that invented the game, is suitable for groups of two to four runners of about equal ability. Together, they decide on a course of suitable length and difficulty, with several controls. The runners start out on each leg at one-minute intervals (they might also assign different routes for each other before the start). As the controls are reached, the runners wait until all have reached the point; the first runner can time the later arrivals. They then discuss the previous leg, plan the next leg, and start out again in a new order.

Others may choose to rejoin after a couple of controls. In this case, each runner should carry some small streamers. When each runner arrives at a control, he hangs up one of the streamers, unless he finds that all the other runners have already hung theirs in place ahead of him. In this case, he takes down all the streamers.

At the predetermined waiting point, the runners check to be sure that all the streamers have been picked up. If not, all runners go back to the disputed control to determine the correct point. After analyzing the previous legs, the streamers are then redistributed and the runners head out again for a new set of controls. Bergvik runs simulate a regular orienteering run very well and also give an immediate opportunity to compare routes. They also add some often welcome competitive spice to a group workout.

MAP-MEMORY CHASE

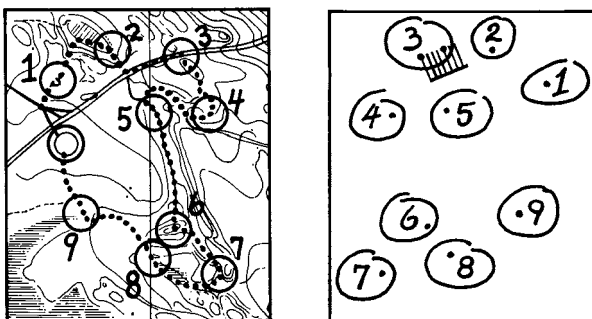
This exercise is done in groups of two, with runners of about equal skill. Runner A selects a point on the map that is easy to reach and is not more than 200 meters away. Runner B is allowed to study the leg for about half a minute. He then tries to reach that point from memory. Runner A follows after him with the map, checks the route, and stops runner B if he is running away from the control. The runners rotate functions after each leg. This develops map memory skills for runner B and map reading skills for runner A.

SWAPPED COURSES

This type of training is normally done by two persons. From the common starting point, each runner goes out and sets a short (half-length) course of appropriate difficulty in a section of the area that is reserved for him. The participants return to the start area before a determined time. After some rest, they swap courses and run the other person's course as a regular training orienteering meet. At the same time they pick up the streamers or flags that marked the controls.

This game simulates a regular training orienteering meet or a run on a course with permanent controls, but also gives experience in setting courses. No timing is required.

Several persons may participate if the area is split so that each person has an area. At the restart, each runner goes out to all controls except his own. The markers must be retrieved after all runners are back.



Route Orienteering. At left, an example of a route orienteering course, though for the purposes of this exercise no course is drawn on the participants' maps—streamers show the way. At right, the back side of a corrected map after the course is completed. All controls rate a perfect score, except number 3, which is 4mm off.

ROUTE ORIENTEERING

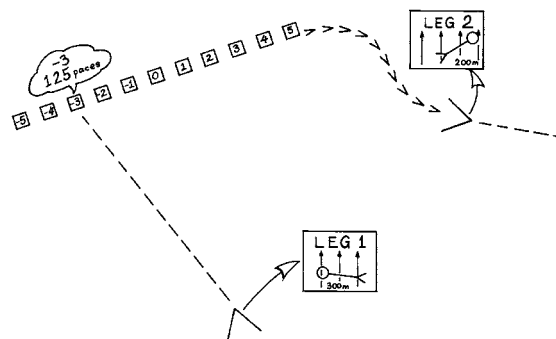
This is a variation of orienteering that will give you lots of practice in map reading and distance judging. Route orienteering can be made suitable for all levels of orienteering proficiency by varying the route, but it is especially good for beginners since the participants follow streamers all the way and it is difficult to get lost.

Use an area that is quite detailed. Place streamers along a route that can be followed easily by map reading. Compass bearings should not be required. Be aware that hanging out streamers is very time consuming, as is taking them down again, so don't plan a long course.

Place control markers at well-defined features along the route. Each participant should carry a pencil or pen, and at least one safety pin (more is better), to use to mark the position of each control on his map; a small pinhole at the control point will do this without ruining the map. On the back side of the map, he then circles the pinhole and writes the control number in the circle. At a beginner's event, there should be helpers stationed at each control to supervise.

At the finish, each runner's map is examined and the pinholes measured in millimeters (remember, a millimeter is only .0394 of an inch) against the correct location. For each full millimeter error, a time penalty is added to the final running time. This penalty might be 10 to 60 seconds per millimeter, depending on the difficulty of the course.

On advanced courses, pinpointing objects away from the streamer route might be part of the exercise. In this case, the feature is best shown to the participants by use of a sighting device.



Compass Pacing Course. Part of a suggested course for the compass pacing training exercise. This exercise helps develop skills in taking bearings, as well as compass and pacing skills. A permanent compass pacing practice course, if it can be arranged, is a great boon to runners—wayfarer and elite alike.

COMPASS PACING LINES

This is an exercise that will help reinforce compass skills, and can also be used to correct pacing technique.

The organizer instructs the participants at the starting point to set their compasses to a certain degree reading—or better yet to take a bearing from a rough sketch map with just the start and destination points shown. The organizer should also indicate how far the runner should proceed at that bearing. In that direction, some 50 to 300 meters away, a line of streamers is set up perpendicular to the bearing. Numbered poster board pieces are placed on the ground, every 5 meters, under the streamers. (Control cards are fine, but if it's windy, whatever is used should be weighted down.) At the correct point the sign should read 0. The boards to the left of the 0 sign are numbered -5, -10, etc., and to the right, +5, +10, etc. (A good rule of thumb: In addition to the 0 number, you need at least one numbered card location for each 10 meters of distance from the starting point to the streamer line.) It is important that the placement of the 0 sign be determined with highest possible accuracy using a sighting compass.

The participants are to read and record the number on the sign nearest them when they come to the line, and then follow the streamers in one particular direction, e.g., to the right. At the end of the streamers, a new compass bearing is given and the exercise begins again. If the exercise is also used as a pacing check, the number of paces to the streamer lines should be recorded.

Afterward, the participants can study the results to find out if they are making consistent compass errors and/or how good their pacing is. The course can be run several times at different speeds to further check the runners' accuracy.

This exercise can be made competitive by adding time penalties based on how far off the runner was from the 0 point. But, in this case, the cards are numbered consecutively with only the organizer knowing the 0 point. The value of this exercise can be increased by arranging it so that the different legs are run through different terrain types—open woods, dense bush, uphill, downhill, along a hillside, etc.

LINE ORIENTEERING

This exercise is primarily a map reading practice.

The route that the runners have to follow is shown as a line on the master map (everyone should be sure to copy the course very carefully). Along this route are placed unmarked, easily visible controls. The participants start out in one- to three-minute intervals and try to follow the given route closely in an effort to spot all the controls, carefully marking each on the map. Missed controls will result in penalty time.

The route should mainly follow terrain features, so map reading skills will be used. Straight lines, where a compass must be used, may also be incorporated. For beginners, the route should follow big handrail type features, but if line orienteering is set up for experienced runners, the course should utilize topographic features.

SCORE ORIENTEERING

Score orienteering is also a good training event—with emphasis on route choice. A special advantage is that the event can be run in a relatively short time period, perhaps one hour.

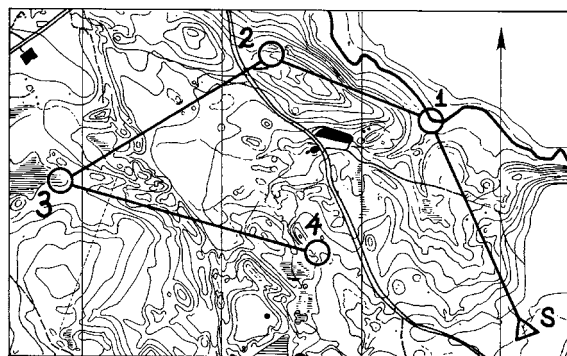
CONTROL PICKING

The idea here is to set a course that offers practice in pinpointing a control from an attack point.

Use an area with several small features. The course should be set with no leg exceeding 200 meters and with no leg crossing or being close to any big features. The previous control should serve as the attack point for the next one.

The time interval between starters must be generous so that they will not be in contact with each other on the course. Otherwise, the exercise will be spoiled.

With proper course setting on a good, detailed map, this exercise can be run without a compass to test the runner's map reading ability.



Rough Orienteering. The markers for this section of a rough orienteering training course are placed at features that normally might be used as attack points.

ROUGH ORIENTEERING

During this exercise, the runners will practice the technique of getting themselves to an attack point as fast as possible, using either rough compass or rough map reading.

The course is laid out with long legs and easy controls placed at big features. The legs must be designed so that either a straight compass bearing or routes along handrails appear to be the best choices. The controls should be placed very obviously so that no time is lost locating the marker when the feature is reached.

This exercise will give the runners quite a workout on a fairly easy course. Such a course is similar to a ski orienteering course with easy controls, long legs, and navigation along trails and other handrails.

ASSIGNED ROUTES ORIENTEERING

This exercise offers opportunities to compare different route choices between controls. A course of one-half or one-third normal length is set—featuring long legs only; few, and very easy, controls (no time should be spent on finding the markers); and a common start/finish area. Each leg must have two (or possibly three) decent route choices—the routes to be marked on the runners' maps.

The course is first run using the best routes; then, after some rest, completed again via the second-best alternatives. A lively comparison and discussion of the time differences between the runs follow. This will be more interesting if timers are stationed at each control so that the times for each leg can be compared.

BLANK MAP ORIENTEERING

This is an exercise for practicing compass running and pacing skills. The organizer lays out an easy course using big control features. The legs must be short (less than 300 meters), especially for the less advanced groups. Put a blank paper over the area map, trace off the course and the north lines (or use a lined paper). Also, indicate the north side of the map and the scale. This will be the map master to be duplicated. The control descriptions may also be put directly on this map master.

Another way to transfer a course to blank paper (or maps) is to place the map showing the set course over a paper pad, and then put pinholes through the controls to the pad below. Draw the course on the blank sheets, using the holes for guidance.

A variation of this exercise is to have maps that are black except for small areas around the controls where the actual map is shown. This "window orienteering" encourages use of attack points and rough compass reading.

The illustration on the following page shows clearly how these two rather unorthodox maps are done.

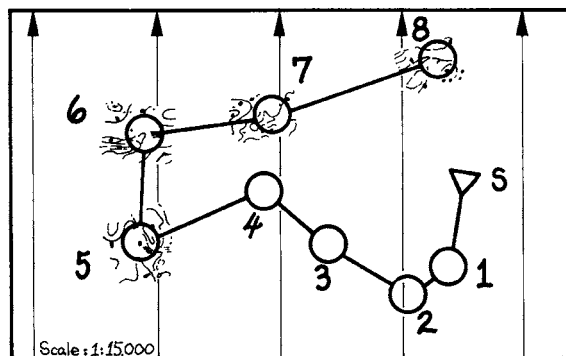
MAP MEMORY STAR ORIENTEERING

The purpose of this exercise is to practice and improve map memory techniques. A starting location is selected in an area from which many handrail type features lead out. Keeping the starting point in the center, put out a number of very easy controls. Select points that are near handrail features. The only map in use is posted at the start. After the start is signaled, the runner studies the master map and tries to memorize the route to his first control. He then runs out to find the marker. This is a difficult task, so the legs must be very easy and quite short. The participants have to return to the start each time they need to look at the map again.

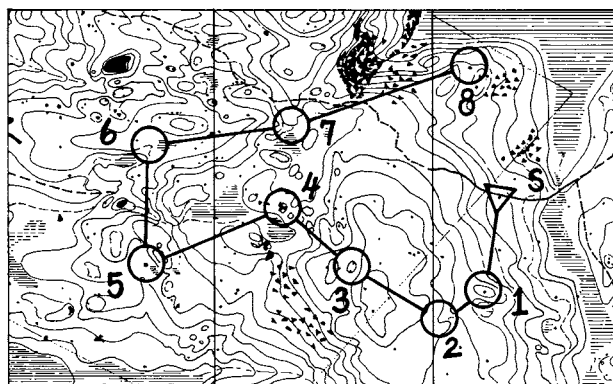
If the participants do not outnumber the controls, a mass start can be used with a different first control for every runner. The runners can then continue to the next marker in a clockwise order. With many participants, a regular staggered start must be used, with generous time spacings.

Start: The boulder

1. The knoll
2. The re-entrant, upper end
3. The depression
4. The knoll
5. The boulder (2m), west side
6. The re-entrant
7. The boulder (2½m), east side
8. The pit (0.4m)



Combined Blank Map and Window Orienteering. A section of a good course for blank map and window orienteering combined. Achieve the "windows" by cutting holes in a plain sheet of paper covering the master map. Draw in the full course and north/south lines before copying, as well as any necessary slope or other terrain clarifications indicated. The full master map is shown below.



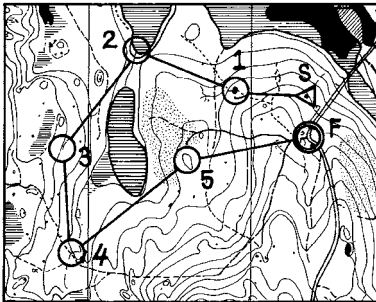
CONTROL PLOTTING

If done indoors, this exercise offers good training in map memory; if done outdoors, it also gives good running exercise.

A course of appropriate difficulty with approximately 10 controls is drawn on a number of master maps. The master maps are placed some distance from the start area. The participants are to copy the course on their

own maps, which are kept at the starting location the whole time—requiring them to run back and forth between the start and the master until all the controls are drawn in.

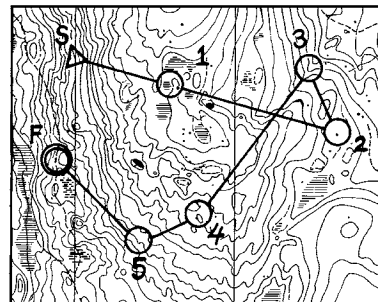
If the exercise is done indoors, it can be made quite exciting by conducting a relay competition. Outdoors, if the master maps are placed some 100 to 300 meters away from the start (and possibly up a hill), the runners will get a lot of exercise in a short period of time.



Start: The building

1. The clearing
2. The swamp, south tip
3. The trail end
4. The trail stream crossing
5. The knoll

Finish: The road-trail junction



Start: The re-entrant

1. The marsh, east edge
2. The boulder
3. The re-entrant, lower part
4. The knoll, north foot
5. The spur

Finish: The northern trail bend

Control Plotting. It is not necessary to give too much thought as to how to connect the controls for these two control plotting exercise courses. It is, however, very important that the control features be selected with an eye to the proper degree of difficulty for the participants' skill level—as is true for most exercises. Compare the course on the left, intended for novices, with the one on the right, for experts.

GLOSSARY OF ORIENTEERING TERMS

Aiming off. Plotting a bearing near the precise target in a chosen direction to avoid any false turns near the mark.

Attack point. An easy-to-find feature on the map from which a runner begins to navigate carefully to a control.

Bearing. A direction in which you are traveling, usually measured in degrees from north and determined with a map and compass.

Collecting feature. A distinct feature that is relatively easy to find and recognize.

Control. A prism-shaped marker, usually orange and white, placed in the field prior to an orienteering event. It corresponds to a known map point, and is to be located by participants during the event.

Control extension. Plotting a course to a larger adjacent feature rather than to the easy-to-miss smaller actual target.

Handrail. A feature running parallel to one's direction of travel; serves as a navigational aid.

Knoll. A small hill shown by a single, closed contour.

Meridian. Line running through true north and true south on a map or terrain.

Re-entrant. In orienteering, an elongated, sloping valley.

Saddle. A low point on a ridge connecting two summits.

Spur. A narrow, sloping ridge, jutting out from a main ridge.

ORIENTEERING COURSES

Orienteering courses are distinguished by an internationally recognized system of colors. The various colors designate the level of difficulty of the courses, from beginner to expert. Below is a chart that gives a description of a course. Note that the courses are color coded. The color codes may vary somewhat in certain parts of the country because of the terrain you are in. Remember that you need to be in good physical condition for the higher levels of challenge.

Level of Difficulty	Beginner or Wayfarer	Advanced Beginner	Intermediate	Advanced Intermediate	Elite or Expert
Course Color	White	Yellow	Orange	Red	Blue
Classes commonly using the course	Novice men and women	Boys and girls (14 years and under) Recreation classes of all ages	Girls (15 to 18 years) Men (50 and up) Women (35 and up)	Elite women (19 years and up) Men (35 and up) Boys (15 to 20)	Elite senior men (21 years and up)
Average length of course	Up to 3 km	3½ to 4¼ km	3¼ to 4¼ km	5 to 7 km	7 to 12 km
Average number of controls	4 to 8	6 to 8	6 to 8	6 to 10	8 to 15
Difficulty of control placement	Easy, obvious locations, near paths and roads	Near large map features, less obvious than white course	Varied difficulty, some in remote locations, some fairly accessible	Difficult locations along long legs between controls	Difficult locations, low to ground, at small map features

RESOURCES

Information about orienteering can be obtained through brochures from local and national organizations, books, and films. The principal organization in this country is the United States Orienteering Federation, P.O. Box 1444, Forest Park, GA 30051; in Canada, it's the Canadian Orienteering Federation, Box 62052, Courant Glen P.O., Orkans, Ontario, Canada K1C 2R9.

BOOKS ON ORIENTEERING AND RELATED TOPICS

Be Expert With Map and Compass, Bjorn Kjellstrom. Scribner, 1976. An excellent general handbook.

Orienteering, John Disley. Stackpole, 1973. A British title now popular in North America.

Competitive Orienteering, Hellman, Kaill, Rystedt, and Gustavsson. Canadian Orienteering Service, 1971. As the title suggests, this is intended for advanced runners.

Introduction to Orienteering, Carlson, Lee, Peppre, and Peepre. Canadian Orienteering Service, 1971. As the title suggests, this is intended for advanced runners.

Teaching Orienteering, James Gilchrist. Canadian Orienteering Service, 1975. Another helpful instructor's manual.

Orienteering Techniques, Bertil Norman. British Orienteering Federation, 1975. More useful guidance on orienteering basics.

Course Planning, Sue Harvey. British Orienteering Federation, 1973. An English translation of a well-known Swedish title on this important aspect of orienteering.

The Spur Book of Map and Compass, Terry Brown and Rob Hunter. Spur Books, 1975. A truly pocket-sized British title.

Ski Orienteering, Bjorn Kellstrom. Orienteering Service/USA, 1974. A helpful and inexpensive booklet on this specialty.

Mapmaking for Orienteers, Robin Harvey. British Orienteering Federation, 1981. Good guide on map making.

Drawing Specifications for International Orienteering Maps, International Orienteering Federation, 1982. Rules for orienteering mapmakers.

White Mountain Guide, Appalachian Mountain Club, 1976. Contains new declination grids for orienteering.

The New Aerobics, Kenneth Cooper. Bantam Books, 1970. A good review of these excellent training exercises.

Caldwell on Cross-Country, John Caldwell. Stephen Greene Press, 1975. The excellent material on cross-country training here applies equally well to competitive orienteering.

Jogging: A Complete Physical Fitness Program for All Ages, W. E. Harris. Grosset 1973. Another good training manual.

TOPOGRAPHIC MAPS IN THE UNITED STATES

Follow these steps to obtain topographic maps from the United States Geological Survey:

1. Request an index of topographic maps for your state from the Branch of Distribution, United States Geological Survey, 12201 Sunrise Valley Drive, Reston, VA 20192.
2. Upon receipt of the index, locate the particular quadrangle of interest and contact the proper regional office.

Eastern region: USGS, 12201 Sunrise Valley Drive, Reston, VA 20192

Central region: USGS, Box 25046, Denver Federal Center, Denver, CO 80225

Western region: USGS, 345 Middlefield Road, Menlo Park, CA 94025

OTHER MAP AND CHART INFORMATION

National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092

SUPPLIES

A&E Orienteering
74 Decorah Drive
St. Louis, MO 63146

Berman's Orienteering Supply
23 Fayette Street
Cambridge, MA 02139-0111

Silva Orienteering Services
P.O. Box 1604
Binghamton, NY 13902

AERIAL PHOTOS

National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092

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ROCK CLIMBING AND RAPPELLING

BACKGROUND



With a bit of apprehension, the Varsity Scout leans out over the sheer face of a 100-foot cliff. While holding onto a rope not much thicker than his little finger, he descends the face of the cliff. After reaching the bottom, he hurries to his left and returns to the top of the cliff—not by going up a set of steps, but rather by climbing the wall he just came down. Sound exciting? Count on it!

The Rock Climbing and Rappelling chapter introduces the team to the sport of rappelling and rock climbing. Using a qualified consultant, the team learns about basic equipment, clothing, and knots that don't slip.

After learning the basics, the team will practice on climbing walls and towers. In some parts of the country, these practice sessions will be carried out on the sides of buildings and from high-rise rooftops. When carrying out the ultimate adventure, the team learns an entirely new meaning of "hanging out"!

PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with help from a team committee member.

ADVANCEMENT

- Review each Varsity Scout's advancement status.
- Conduct a Geology merit badge clinic.
- Monitor the team advancement chart regularly.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team's annual special high-adventure event (Philmont, Florida Sea Base, etc.).
- Conduct a rappelling activity.

PERSONAL DEVELOPMENT

- Conduct a forum on the topic of leadership.
- Carry out a physical fitness program for the team. Concentrate the program on those muscles needed for rappelling.
- Arrange for a certified instructor to demonstrate equipment safety and correct ways to climb and rappel.

SERVICE

- Conduct a service project for the local council.
- Assist a Webelos Scout den in earning activity badges.
- Carry out a cleanup effort as a part of the rappelling activity.

SPECIAL PROGRAMS AND EVENTS

- Invite a member of a climbing club to share his or her experiences with the team.
- Visit a museum with a geology display. Learn how handholds were formed.

BASIC EQUIPMENT

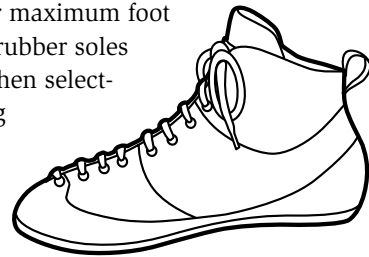
WHAT TO WEAR

CLOTHING

The first rule for choosing clothing for climbing and rappelling is that it should allow you to move freely and easily. However, it shouldn't be so loose or baggy that it gets in your way or can get caught in equipment. Thick, karate-style pants or tights are preferred by most climbers. Boy Scout trousers are also a good choice. While jeans are perhaps the most durable pants for climbing, they can restrict leg movement and are not advised for most climbing or rappelling.

SHOES

Hiking boots or high-top tennis shoes are suitable for rappelling, but more specialized shoes are helpful for climbing. Climbing shoes are designed for maximum foot control, with smooth rubber soles for better gripping. When selecting your own climbing boots, you'll need to have them fit as snugly as possible. This keeps your foot from moving in the shoe and will let you stand on smaller holds.



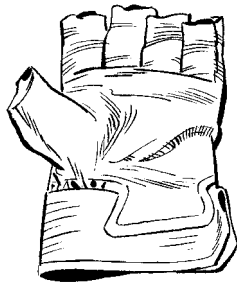
General-purpose shoe



Edging shoe

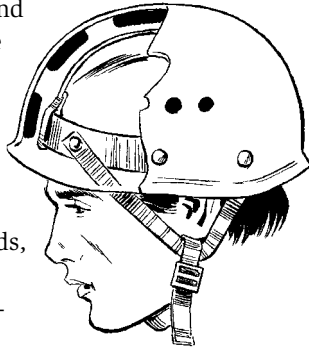
GLOVES

Rappelling/climbing gloves should be made of tough, durable leather with double-leather palms. For climbing, fingerless gloves are preferred.



HELMETS

A climbing helmet is recommended for all rappelling and climbing activities. Because cliffs are in a constant state of erosion, helmets are used primarily for protection from falling objects. Climbing helmets usually have small brims, headbands, and chin straps, and some sort of padding and suspension system inside.



WHAT TO USE

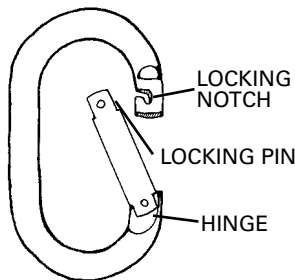
HARNESSES

There are two types of harnesses: the seat harness and the full-body harness. The seat harness is the more popular type of rock-climbing harness, but the full-body harness prevents a climber or rappeller from turning upside down. Your local climbing store will have several options. Try to pick a harness that is comfortable and easy to adjust.

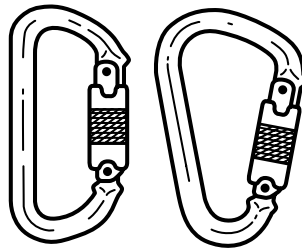
You can make an improvised harness for short-term use or for emergency situations. Directions for a knotted leg-loop harness and a tied-seat harness using a water knot are included in this chapter.

CARABINERS

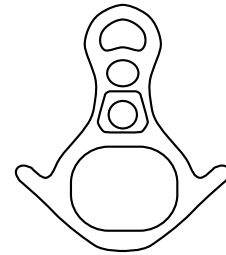
The carabiner is an aluminum snap link used for hooking into belay anchors and descending devices. They come in many styles, but the oval and the “D” are the most common. Carabiners come with either locking or nonlocking gates. Double-locking carabiners that require two motions to open their gate are used where maximum safety is needed, such as on harness and top-rope anchors. Double-locking carabiners prevent gates from opening accidentally.



Carabiner



Locking carabiner



Rescue figure eight

DESCENDERS

A descender is a mechanical device that, when rigged properly to the rope and harness, allows you to safely descend the rope. Descenders use friction to control the rate of descent. There are many types of descending devices; it is important to know the proper use of the device you choose.

CHOCKS

Chocks are used as anchors in cracks. When attached to the climbing rope, chocks protect you in case of a fall. There are three types of chocks: wedging, passive camming, and active camming.

ROPE

The climbing rope is the lifeline in both climbing and rappelling. Climbing ropes have a kernmantle construction, which is a core of continuous fibers surrounded by a sheath of braided fibers. The core is made up of fibers twisted into strands. These twists give the rope some of its dynamic (stretching) qualities. This stretch will help reduce the force of the shock involved in a fall for both the climber and the belayer. A kernmantle rope with a minimum diameter of at least 10.5 mm is recommended.

Since the rope is the lifeline for a climber, caring for it is serious business. Keep it clean and out of the sun. Store it in a clean, cool, dark, dry place. Keeping it in a rope bag is advised. Ropes should be carefully checked before each use. Keep a record about each piece of rope. When to retire a rope depends on its use, how many hard falls (more than 6 feet) it has taken, and how well it has been taken care of. No rope should be used for more than four years.

WEBBING

Webbing is woven from continuous strands of nylon. There are two basic types of webbing: flat and tubular.

Tubular webbing is shaped like a tube and is commonly used for slings, harnesses, and tie-ins. One-inch tubular webbing is the most common webbing used in rappelling and rock climbing. It has an approximate breaking strength of about 3,500 pounds. Webbing stretches but not as much as dynamic rope.

KNOTS

As you moved up the ranks from Tenderfoot Scout to First Class Scout, you learned some of the basic knots of Scouting. In climbing, you'll use many of these knots plus a few new ones.

FIGURE EIGHT

The figure-eight knot is known as an end knot. As such, it may be tied in either the end or the standing part of the rope to check it from sliding through a block, hole, or part of another knot. It may be used temporarily to stop fraying when a rope is not whipped. The figure eight is often used in such places as the end of a string when tying a package with a slipknot or in the end of a rope forming a lariat loop.

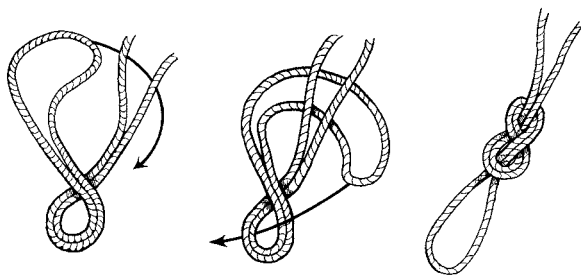


Figure eight on a bight

FIGURE EIGHT ON A BIGHT

Much used by mountain climbers, the figure eight on a bight makes a nonslip loop in any part of the rope. It can be tied quickly and easily in difficult situations. This knot can be used to construct loops and can be used in conjunction with carabiners to hook a rappel rope to a cable or a belay rope to a climbing harness.

FIGURE EIGHT FOLLOW-THROUGH

The figure eight follow-through is similar to the figure eight on a bight, differing only in the way in which it is tied. The figure eight on a bight must be tied in a rope *before* it is attached to a carabiner, while the figure eight follow-through is tied directly to a harness. The end of the rope can be passed through a carabiner, an anchor sling, or a harness before the knot is tied.

Begin by tying a simple figure-eight knot in a rope (steps 1-4 in the illustration). Run the end of the rope through the climbing harness or the hardware to which you want to attach the rope (step 5), then trace the end of the rope back through the figure-eight knot to form a figure-eight follow-through (the "follow-through," steps 6-8). Leave enough tail for a safety knot (step 9).

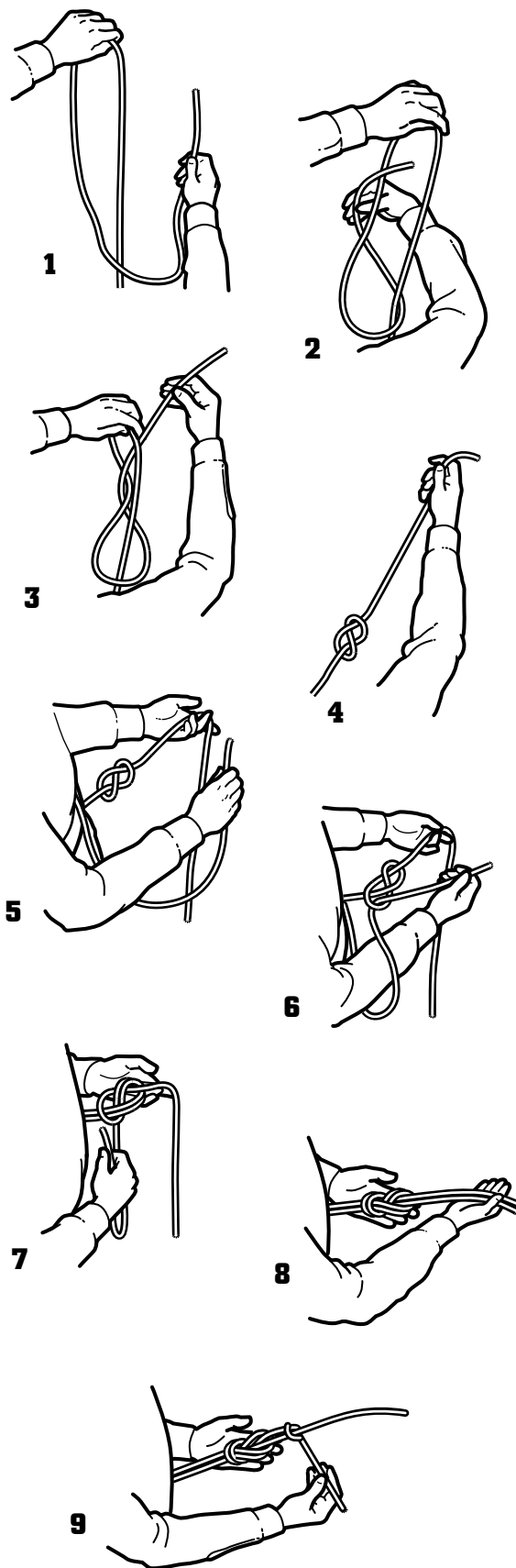
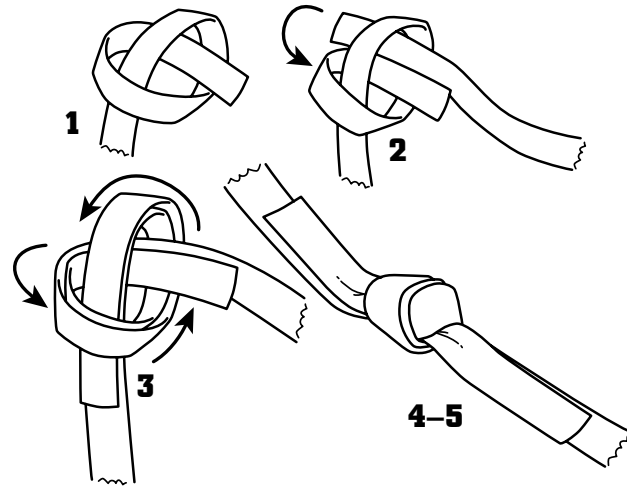
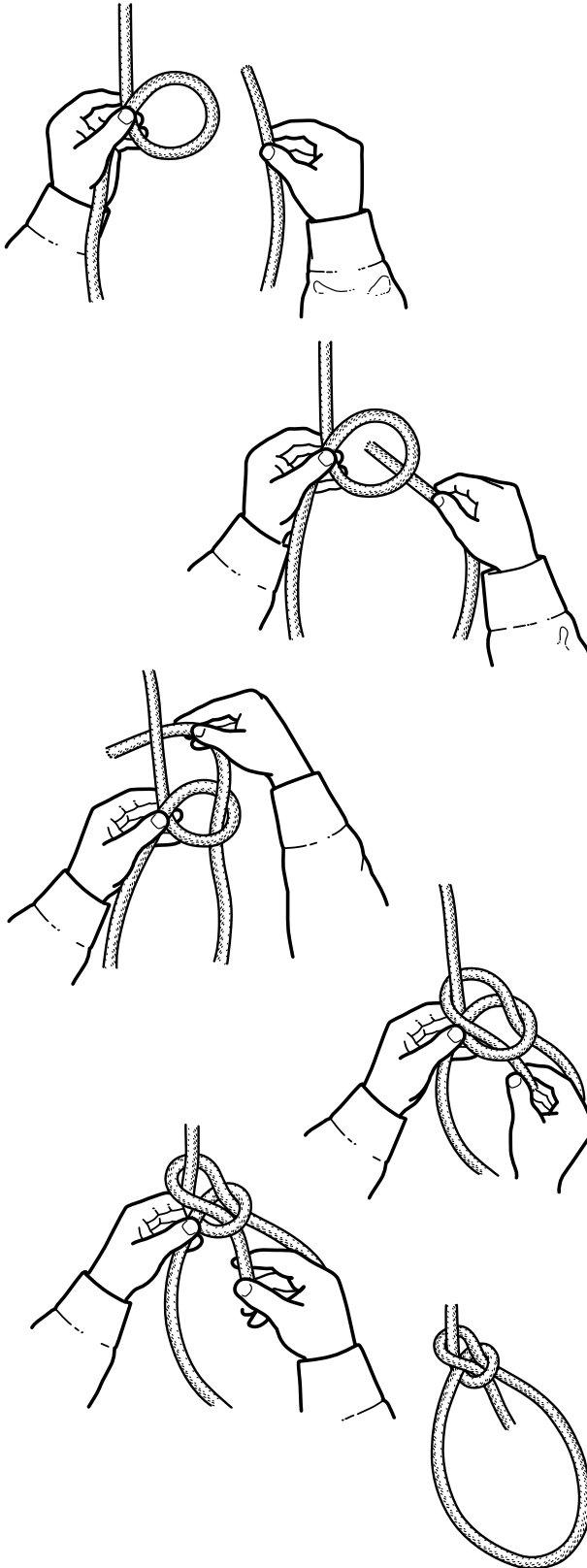


Figure eight follow-through

BOWLINE ON A COIL

The bowline on a coil is used to fasten the belay rope and rappel rope to an anchor such as a large rock or tree.

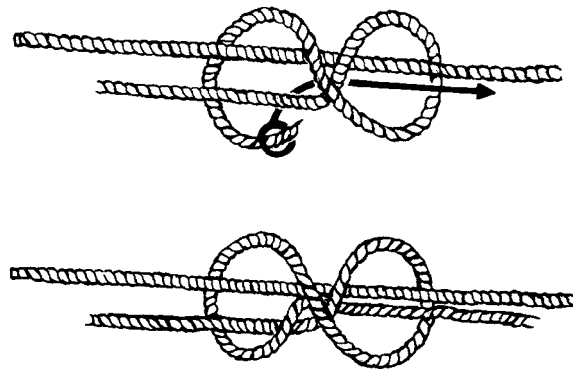


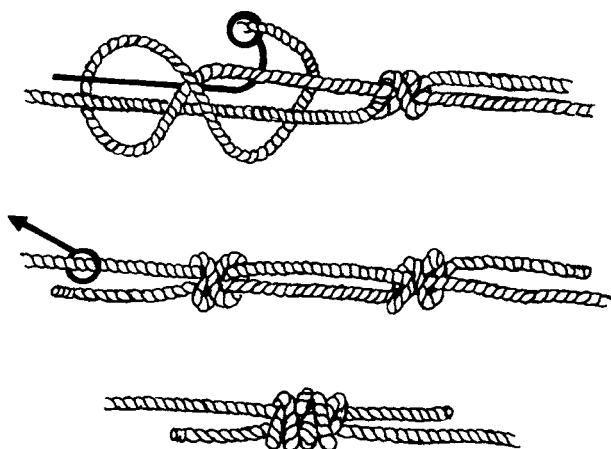
WATER KNOT (RING BEND)

To tie this knot, make an overhand knot on one end of the length of webbing. Make sure not to twist the webbing; it must lie flat for maximum strength. Now get rid of any twists in the rest of the webbing, and thread the other end back through the overhand knot. Tighten the knot, making sure to leave a tail of at least 6 inches.

DOUBLE FISHERMAN'S KNOT (GRAPEVINE KNOT)

Loop 11 inches of one cord end around the other end. Now loop the cord around again. Finally, thread the cord's end under these two loops, and pull tight. Leave a tail of at least 2 inches on both ends of the knot. (When under load, the knot will slip slightly; the 2-inch tail allows for this.) Repeat this procedure with the other cord end. When this is done, pull the two knots together, making any necessary length adjustments.

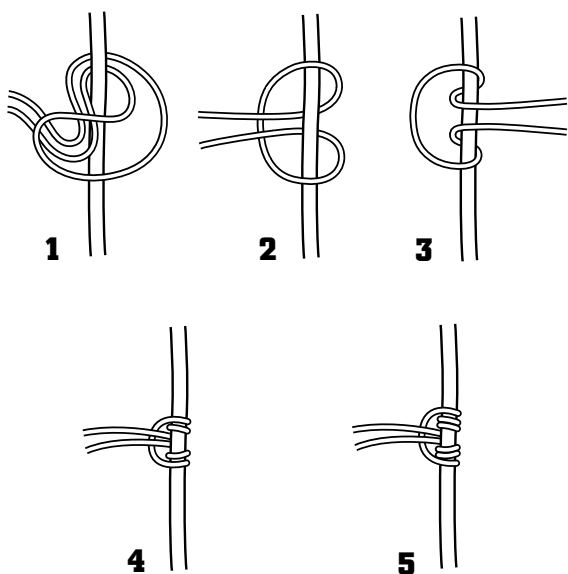




Lay about 2 feet of the ends of two ropes alongside each other, ends opposite. Loosely loop one rope end twice around the other, then thread the end of that rope through the loops. Repeat the procedure with the second rope and slide the two knots together so that the flat slides lie parallel against each other.

PRUSIK KNOT

The Prusik knot can be used to ascend a rope. To tie the knot, you need at least a 2-foot-long loop of accessory cord. Wrap the loop several times around the rope, taking care that each wrap goes through the previous one. Three wraps are preferred.



Follow steps 1–4 for tying a Prusik knot. Additional wraps can be added to increase friction (step 5).

CLIMBING HARNESS

KNOTTED LEG-LOOP HARNESS

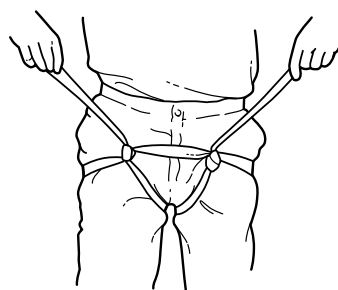
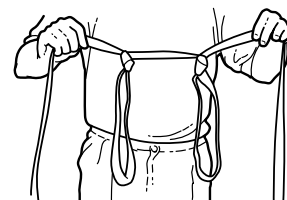
The knotted leg-loop harness is the most accepted seat-sling method used by rappelling and rock-climbing facilitators and instructors. It is preferred over the tied-seat harness because it has better safety features.

Note: Learning to tie the knotted leg-loop seat sling from these instructions and diagrams may be very difficult and confusing without firsthand experience and assistance from a rappelling or rock-climbing facilitator or instructor.

Form the knotted leg-loop harness using a piece of webbing 24 to 30 feet long.

STEP 1

- Holding one end of the webbing, measure off a length that stretches from your nose to your outstretched hand. Keep that length marked with one hand while you tie the first leg loop.
- Form the first leg loop. Just beyond the measured piece, wrap the webbing around your thigh to size it to your leg. Add another 4 to 6 inches to allow for a knot, and form a leg loop with an overhand-on-a-bight knot.
- Move about 6 inches further along the webbing and repeat step 1b to form a second leg loop.



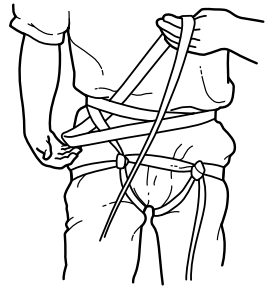
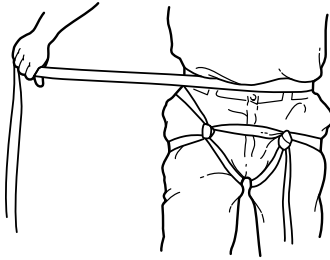
STEP 2

With the shorter, measured piece of webbing on your left side, put on the leg loops as you would a pair of pants. Pull the loops all the way to your crotch with the knots toward the

front. For the sake of comfort, be sure there are no twists in the webbing. Each loop must be snug, but not tight enough to restrict circulation. You should be able to easily slip two fingers between a leg loop and your leg.

STEP 3

Let the shorter, measured piece of webbing hang down on your left side. Bring the longer piece of webbing clockwise, behind your back, and wrap it several times around your waist. Bring the end of it across your belly to your right side.

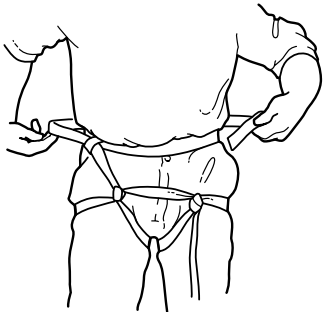
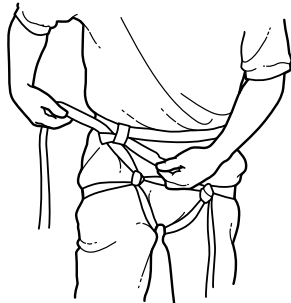


STEP 4

Tuck the webbing end up and behind the wraps of webbing on your right hip, leaving enough slack to form a bend.

STEP 5

Pass the webbing end through the bend to form an overhand knot. Work any slack out of the webbing so that the harness fits snugly around your waist and the overhand knot is secure.

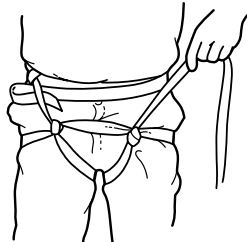


STEP 6

Wrap the remainder of the longer piece of webbing a final time around your waist, going clockwise, as before. To keep it out of the way, tuck the end behind the webbing above the right leg loop. (You will need it in a moment to finish tying a water knot.)

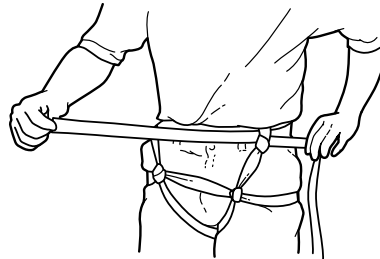
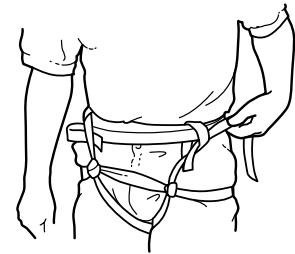
STEP 7

Turn your attention to the shorter, measured length of webbing on your left side.



STEP 8

With the measured length of webbing, tie a loose overhand knot ($\frac{1}{2}$ of a water knot) around the wraps of webbing on your left hip.

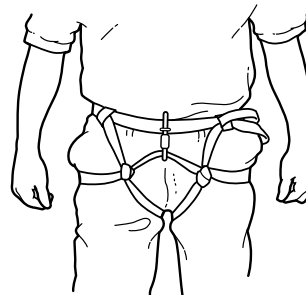
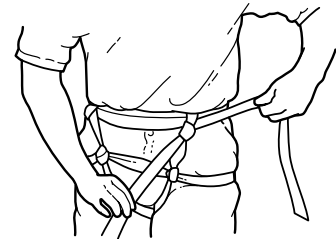


STEP 9

Retrieve the other end of the webbing and use it to trace back through the loose overhand knot, thus completing a water knot.

STEP 10

Tighten the water knot. Check the harness to be sure it fits securely and that there are no unnecessary twists in the webbing. Wrap any remaining length of webbing around your waist and tuck the end under the previous wraps.



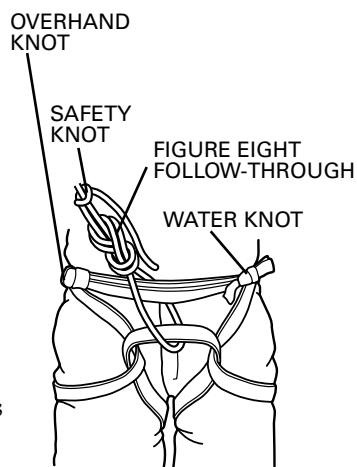
STEP 11

Use a locking carabiner (double-locking preferred) to clip together all the webbing between the knots in front of your body.

TIED SWISS SEAT

A 30-foot length of 1-inch tubular webbing can be used to tie a reliable and comfortable seat harness. A tied harness such as the Swiss seat, and the knotted leg-loop harness, as shown in the illustrations, are acceptable for BSA climbing/rappelling activities. Other forms of tied harnesses are not acceptable and should not be used during BSA activities.

Tie the seat harness using a piece of webbing 24 to 30 feet long.



STEP 1

Drape the center of the webbing behind your neck.

STEP 2

Step over the ends of the webbing and bring them around the sides of your hips, taking care not to allow any portions of the webbing to twist. Pull the webbing snug.

STEP 3

Pass the webbing ends behind and then through the lengths of webbing against your lower torso.

STEP 4

Slip the webbing off your neck.

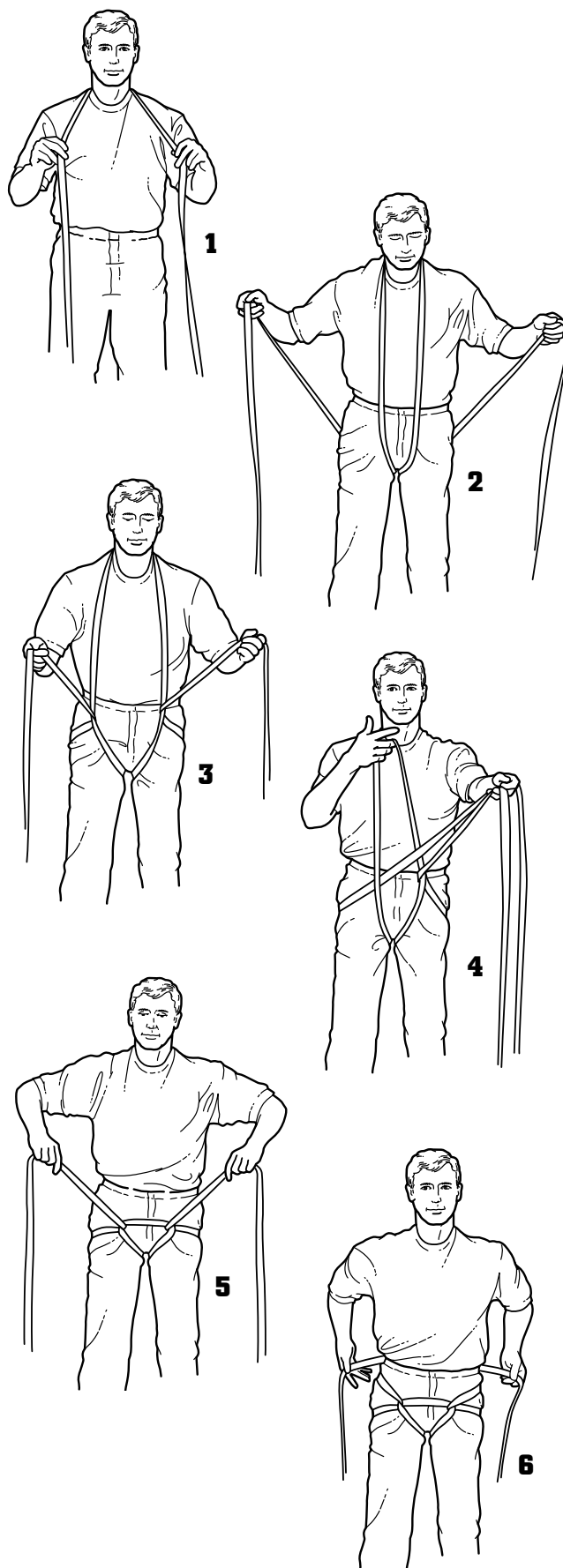
STEP 5

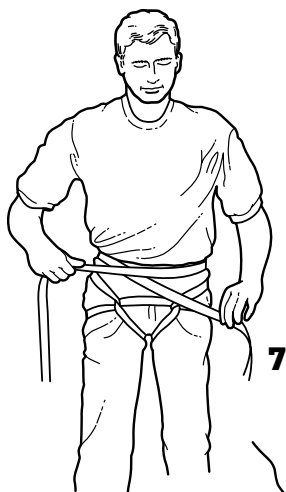
As you pull out the slack, the bend that had been around your neck will become the horizontal band between the loops of webbing that have formed around your legs.

STEP 6

Going first behind your back, wrap the remaining lengths of webbing around your waist in this fashion:

- The piece originally in your right hand goes clockwise.
- The piece originally in your left hand goes counterclockwise.



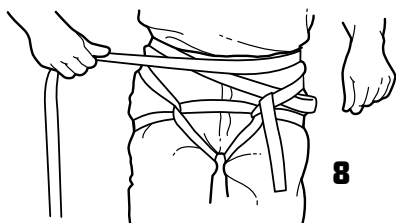


STEP 7

Continue wrapping until only about 3 feet remain at each end of webbing. Keep the webbing flat and snug against your body.

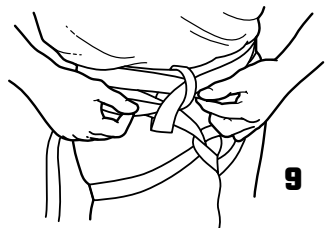
STEP 8

Tuck the end of the counterclockwise webbing beneath the sling on your left hip. (You will need it in a moment to finish tying a water knot.)



STEP 9

With the end of the clockwise webbing, tie a loose overhand knot ($\frac{1}{2}$ of a water knot) around the wraps of webbing on your right hip.

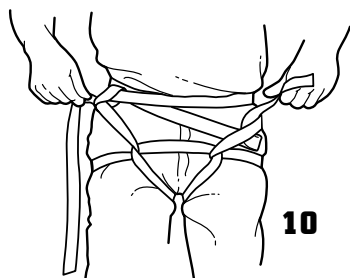


STEP 10

Retrieve the other end of the webbing and use it to trace back through the loose overhand knot, thus completing a water knot.

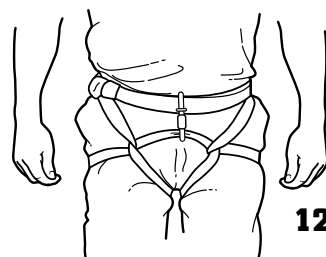
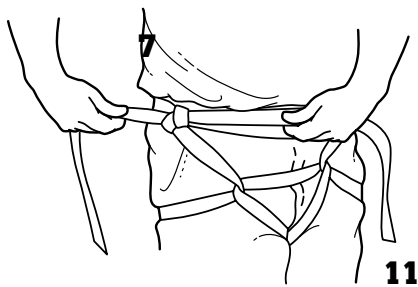
STEP 11

Tighten the water knot. Check the harness to be sure it fits securely and that there are no unnecessary twists in the webbing. Wrap any remaining length of webbing around your waist and tuck the end under the previous wraps.



STEP 12

Use a locking carabiner (double-locking preferred) to clip together all the webbing between the knots in front of your body.



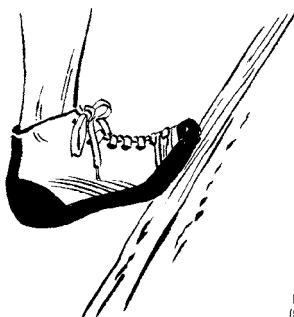
ROCK CLIMBING

Rock has two distinctive features: faces and cracks. *Faces* are unbroken slabs of rock, while *cracks* split the slabs in two. Climbers use these features to define the two types of climbing: face climbing and crack climbing.

There are three basic variations of *face climbing*: friction, edging, and pocket climbing. *Friction climbing* uses the rubber on the soles of climbing boots. The grainy texture creates friction on smooth rocks. Friction climbing is easiest on grainy, granular rock such as granite. *Edging* simply means climbing on the edge of a rock outcropping. Limestone rock offers the best opportunity for *pocket climbing*.

Crack climbing offers another type of adventure. Different types of cracks call for different techniques. Chimneys, the largest types of cracks, require use of the entire body to move upward. Other cracks basically are defined by what body part will fit, e.g., fist cracks will accept a fist.

Cracks will not automatically fit any one description and may be shaped differently. Therefore, each crack climb will offer many different opportunities.



Friction climbing



Edging



Crack climbing

TYPES OF ROCK-CLIMBING

There are six basic types of rock climbing: bouldering, top-roping, free climbing, aid climbing, multiday climbing, and soloing. Begin by learning the safest kinds—bouldering and top-roping.

BOULDERING

Bouldering is simply climbing horizontally on large boulders and never ascending more than shoulder height. Most of these boulders are small enough that you can exit simply by jumping off.

Bouldering equipment requires only climbing shoes. For safety, each boulderer needs at least two spotters.



TOP-ROPING

As the name implies, *top-roping* requires the use of a rope and an anchor to assist with the climb. Set a top-rope by tying the rope into the anchor in the rock above where you are going to climb. This keeps you from falling any distance as your partner on belay will stop the rope. The height of a top-rope climb is limited by the length of the rope, normally no higher than 150 feet.



OTHER GAMES

Lead climbing and aid climbing are inherently more dangerous than bouldering and top-roping. These types of climbs should be undertaken only under the supervision of an instructor who has received instructor training in that specific activity from a nationally or regionally recognized organization.

RAPPELLING

Rappelling is the controlled descent on a rope by the use of a descender device, most often a figure eight. To conduct a safe rappel, follow these guidelines.

First, use a sit harness. A diaper-sling rappel seat tied with 1-inch nylon webbing or a seat harness also may be used. A

single climbing rope with a figure eight and belay, as well as an independent safety line clipped or tied to the participant's harness with a figure eight on a bight and belayed separately (in case the rappeller lets go of the rope), is used for all rappelling activities (preferably different colored ropes are used). New slings are always used on the rappel anchor.

A braking system is established with a figure eight. This system will create enough friction on the rope to prevent the rappeller from descending too quickly. A slow descent enables the rappeller to develop the proper technique, be observed for any problem that may develop, and gain confidence, as well as protect the rope.

The braking system is attached to the harness or diaper sling with one locking or nonlocking carabiner. The gates of nonlocking carabiners must be reversed to prevent an accidental failure of the system. The belay rope is tied around the waist of the rappeller with a bowline on two or three coils.

Rappelling participants should:

1. Maintain a stance of shoulder width
2. Keep knees flexed



3. Keep feet 24 to 36 inches apart for balance
4. Lean back
5. Become perpendicular to the rock
6. Walk backward, avoiding a speedy or bouncing descent that may place a sudden strain on the anchor(s)

All beginning rappellers should use leather-palmed and -knuckled gloves. A rappeller should grip only with the braking hand; the guiding hand is used only to maintain balance. The rappeller must never release his grip on the rope with his braking hand.

Onlookers may offer reassurance and encouragement on a rappeller's first attempt. However, make sure that observers are kept away from the immediate area below the rappel where they will not be struck by a falling rock or equipment.

BELAYING

The purpose of a belay is to reduce the length of a fall and minimize its consequences. Use these guidelines in belaying a climber or rappeller.

1. Have a secure anchor that is backed up.
2. There should be no slack between the belayer and his anchor point(s).
3. The anchor must be placed in line with the belayer and the direction of pull.
4. The belaying rope must never run tautly across the anchor rope or sling. This can cause a nylon rope or sling to melt from the intense heat generated by the moving rope.
5. Each point of the anchor should be rigged independently so failure at one point will not cause collapse of the system.
6. The climbing rope, as well as the belayer, is tied into at least two anchor points.
7. A top belayer uses the sitting hip belay with feet firmly braced; a bottom belayer uses the standing hip belay and is secured to an anchor placed low enough and far enough from the ascent that the belayer can comfortably observe the climber.
8. The rope must be kept on muscle, fat, or the hip-bone. Do not allow it to ride up over the spine.

9. The hand of a belayer holding the rope going to the climber is referred to as the feeling hand, as it feels the progress of the climber. The hand grasping the rope after it passes around the hips is known as the braking hand.
10. The braking hand must never be removed from the rope until the climber says, “off belay.”
11. Holding a fall is entirely up to the belayer. The belayer needs to know how the climber/rappeller is progressing and anticipate potential problems. The belayer must know precisely how to react to hold a fall.
12. No one is permitted to talk with the belayer except a rock-climbing instructor and the person being belayed. This will avoid confusing and/or flustering the belayer and will enable the belayer to devote full attention to the task at hand.

SITTING HIP BELAY

The sitting hip belay is used by a top belayer. The belayer’s feet are firmly placed on the ground. The bowline on a coil is used to anchor the belay rope.

The belayer is attached to the anchor rope by clipping a small figure-eight loop to the front of the harness. This method prevents the belayer from slipping out of the large belay loop. Use a locking carabiner to clip in.

Make sure the belayer is securely seated. A standing belayer could be pulled off his feet by a fall. If the standing belay method is used, brace the legs as well as possible against the direction of pull. Remember: The leg on the side of the rope going to the climber is the more important one. Brace this leg straight so you are using leg bones instead of muscles.

The belayer should be facing the cliff’s edge, *sitting*, in a position so as to minimize any twisting action caused by a fall. The body should be braced in the direction of the fall. The belayer should be sitting as close to the belay anchor as practical to reduce stretch in the belay rope.

Keep the anchor rope taut. A slack anchor rope will allow a falling climber to pull the belayer readily forward, which can startle the belayer.

The guiding hand on the side of the rope going to the climber aids in taking the rope in and letting it out and feeling what the climber is doing.

The rope that runs around the hip and over the belay anchor is handled by the holding hand, which stops the falls. The holding hand never releases the rope.

The belay rope should pass *over* the anchor rope to ensure that the belay rope cannot slip under the belayer. (Note: If the climber is below the belayer, the rope runs

over the belayer’s tie-in. If the climber is above the belayer, the rope runs under the belayer’s tie-in. This is primarily a result of the direction of the pull in case of a fall. This also applies to any standing belay methods used.) The belayer should be positioned so that the rope passes over trouser-protected hips rather than the vulnerable waist. The belayer should use a leather or canvas pad on the back, if available, for protection against friction burns from rope. An inexperienced belayer should wear gloves to ensure the safety of both climber and belayer. These will prevent rope burns.

Keep communications clear at all times. The belayer should know what the climber is doing, where the climber is, where the rope is, and what the rope is doing in respect to tension or slack.

SELECTION OF ANCHOR POINTS

To select anchor points for the top anchor belay system, top anchor rappel system, and the bottom belay system, follow these guidelines.

Anchoring is the process of attaching oneself to a fixed point, commonly a tree or boulder, independent of other ropes. When selecting a tree for an anchor system, the tree should not be any smaller than 6 inches in diameter at the point of attachment and should be firmly rooted. Use a second tree as an anchor safety backup, or select a different anchor point. At least three anchor points should be established for each belay and each one should be strong enough to hold the entire load if the primary anchor fails. Different types of anchors should be used for each anchor point.

The anchor point should not be next to the edge of the cliff. Choose an anchor point at least 10 to 20 feet from the cliff’s edge.

If using a tree as an anchor point, the tree’s *root system* should not be unsafely exposed. Also, if using a tree for an anchor point, make sure that the tree is living. In the winter, check to see if the trees have small buds on them. If so, then the tree is alive.

If using a boulder as an anchor point, it should be large enough (at least 2,000 pounds) that it will not budge or roll. Make sure the rope or webbing cannot be pulled off or under the boulder if a strong force must be held. Check the boulder for sharp edges, burrs, ridges, or spikes, and pad the rope or webbing if possible to protect them from abrasion. In many cases, 1-inch tubular webbing is used to wrap around boulders and then the rope is clipped into the webbing with carabiners. This ensures more adequate strength, and because of the webbing’s flat construction and increased surface area, it will hold quite securely. On some boulders or rock protrusions, a rope, because of its rounded construction, could roll off.

Always use an anchor point for the belay system that is separate from the one used for the rappel system. The anchor point used in setting up a rappel system should be in direct line with the rappel sight, and the belay anchor system should be at a slight angle to the rappel rope to keep the belay rope from rubbing the rappel rope. This also keeps the two ropes from becoming tangled or twisted.

The anchor point used in setting up a belay system for a climb should be in direct line with the climbing route. This will eliminate a pendulum effect in case of a fall.

Anchors should be checked and double-checked by all individuals present and periodically checked during periods of use. Anyone, including experts, can make errors and the effort is for everyone's safety. When selecting an anchor, it usually is better to find a natural anchor (such as a tree, rock, etc.) rather than placing an artificial anchor (a chock, nut, or spring-loaded camming device). *Remember:* It does not matter how strong the rope is or how well the knots are tied if the anchor is not sufficiently strong.

SELECTING A SUITABLE CLIMBING SITE

Once you have mastered the basics, you can begin selecting the locations of your climbs. Make sure to get the assistance of a rock-climbing authority—someone with extensive, safe rock-climbing training. The consultant teaching this program should qualify.

The site you choose should have rock that is not unduly fractured, brittle, loose, slippery, or crumbly. Soft sandstone is best avoided. Easily dislodged rock may present a hazard to observers at the base of a rock face, as well as to climbers.

Specific sites should be sought and designated by a rock-climbing authority for climbing and rappelling—don't select just any area that "looks good." Both the climb and the rappel should be challenging but within the capabilities of beginning Scout climbers.

The incline for climbing should be a 40- to 80-degree slope, depending on the rock and available holds. The ideal slope is usually between 60 and 70 degrees. The climb should be 30 to 60 vertical feet, depending on the number of participants. The greater the number of climbers, the lower the climb should be. Two or three adjacent climbs of varying difficulty are preferable to just one. The climbing site must have sufficient handholds and footholds—preferably a variety of cracks, ledges, protrusions, ribs, etc. Extensive smooth surfaces will not do. Low-angle (40 to 50 degrees) slabs are generally good for friction-climbing practice, depending on the experience

and skill of the participants. Even lower slabs allow balance-climbing practice (without using the hands), using only boot soles and good balance to ascend.

The rappelling site should have a 60- to 85-degree slope; a 70- to 80-degree slope is generally best. It should have a reasonable constant slope from bottom to top, without any large ledges or benches, so that there will be continuous tension on the rappel rope and so that participants can be readily observed throughout the activity. To achieve a feeling of adventure and accomplishment, the rappel should be at least 30 vertical feet. A longer rappel requires little additional time so it can be considerably longer than the climb—one rope length is the maximum that should be attempted by beginning climbers. If you are using 120-foot ropes, the maximum rappel length will be about 90 feet using a single rappel rope with a figure eight.

Both climbing and rappelling sites preferably face north or east, and should be out of direct sunlight in warm or arid regions. The sites should be readily accessible to the camp should any emergency arise. A safe path must be established from the top of the climb to the rappelling site. The path should not run next to the edge of a cliff. However, if it must, a safety rope should be set up for climbers to clip into as they walk along it.

There must be sufficient level space above each climb and each rappel to accommodate at least three people comfortably—a belayer (staff member) and two climbers. There must be a good place for a belayer to conduct a firm belay for climbers and rappellers—one where the belayer's feet can be braced against the direction of a possible fall and where he is protected from potential falling rock.

Both the climb and rappel must have good places for anchors—preferably large trees (ones that will not budge) or solid rock projections. If artificial protection must be placed, use $\frac{3}{8}$ -inch-diameter expansion-type bolts (at least $2\frac{1}{2}$ inches long, depending on the type of rock), with hangers, placed by your rock-climbing authority. They should be driven into solid rock, not a flake or projection, at a 90-degree angle to the surface. The hangers should have some play; they should not be tight against the rock. The direction of pull on hangers should be parallel to the rock surface.

The site must permit the climbers to be observed throughout the climb from below, and preferably from above as well. Rappellers must be continually observed throughout the rappel, preferably from the bottom. The staff observer and participants should be located far enough out from the base of the rock to be well removed from the line of fall of rocks or climbing equipment. The lower rappel observer is prepared to grab the rappel rope to control descent speed.

CALL SYSTEMS

Safety at climbing/rappelling areas is impossible without good communication. Climbers, rappellers, and belayers have developed a standard set of signals to exchange information with one another. Participants should be introduced to these signals and should use them throughout BSA climbing/rappelling activities.

HEARING-IMPAIRED PARTICIPANTS

Climbing instructors may have opportunities to work with participants who are hearing-impaired. Instructors should meet ahead of time with the adult leaders of those participants to develop appropriate strategies for ensuring safe communications during climbing and rappelling.

Limit talking in climbing areas to essential exchanges of information. Noise and the distractions of casual conversations can confuse belayers and those on belay. Participants waiting their turn should curtail visiting and avoid horseplay. If chattering becomes an issue, instructors should suspend climbing and rappelling activities until the situation has been remedied. If the day is too windy or the area too noisy for climbers and

belayers to hear one another clearly, climbing and rappelling should be postponed or moved to another site.

ROCK!

A shout of “Rock!” is perhaps the most important of climbing’s signals. It warns everyone that there is immediate danger from something falling—a rock, a carabiner, an article of clothing, etc. Yells of “Rock! Rock! Rock!” warn of more danger than a single shout. Those hearing the warning should not look up, but must immediately protect themselves in the most efficient way—taking refuge under a ledge, moving quickly to the left or right, or becoming “small” under one’s climbing helmet.

The signals between a belayer and a climber or rappeller are clear commands and answers of just a word or two. Each command is always followed by a response of acknowledgment to ensure that the command was heard and correctly understood. Each word should be enunciated loudly and slowly, especially if the wind is blowing, distance is a factor, or a ledge or overhang prevents a belayer and a climber or rappeller from seeing one another. Several participants climbing or rappelling in close proximity should use names to be sure the right person is getting the message. When in doubt, repeat signals and responses.

SIGNALS FOR BELAYING CLIMBERS

Generally accepted signals exchanged between a climber and a belayer include the following, listed in a normal sequence.

CLIMBER	BELAYER	MEANING
“On belay?”	→	“Is the belay ready?”
	“Belay on.”	→ “Your belay is ready.”
“Climbing.”	→	“Here I come.”
	“Climb” or “Climb on.”	→ “Come ahead.”
“Slack.”	→	“I need some slack in the rope.”
“Up rope.”	→	“Take in the loose rope.”
“Falling!”	→	“I’m falling! Brake the rope!”
“Tension.”	→	“Hold the rope tightly in case I fall.”
	“Got you.”	→ “There’s tension on the rope.”
“Ready to lower.”	→	“Lower me down the route.”
	“Lowering”	→ “I’m letting you down now.”
“Rock!”	→ “Rock!”	→ “Look out for falling objects.”
“Rope!”	→ “Rope!”	→ “Rope being thrown down.”
“Off belay.”	→	“I’m in a safe place and no longer need a belay.”
	“Off belay.”	→ “I’m no longer belaying you.”

SIGNALS FOR BELAYING RAPPELLERS

The verbal signals used by rappellers are a little different from those of climbers, but the basic information they share is the same.

RAPPELLER	BELAYER	MEANING
"On belay?"	→	"Is the belay ready?"
	"Belay on."	→ "I'm ready to belay."
"Rappelling."	→	"Your belay is in effect."
	"Rappel on."	→ "Go ahead."
"Falling!"	→	"I'm falling! Brake the rope!"
"Off belay."	→	"I am done rappelling and am in a safe place."
	"Belay off."	→ "I'm no longer belaying you."
"Off rappel" or "Off rope."	→	"The rope is free of hardware and is ready for the next rappeller."

BELAY ON

An information call given by the climber. The call means the climber is hooked onto the belay rope and the climber is making the belayer aware of this.

ON BELAY

An information call given by the belayer. The call means the belayer is ready and able to provide a safe belay for the climber. The call requires no answer.

UP ROPE OR TAKE UP SLACK

A call given by the climber to notify the belayer to take up the rope. It is important to the climber that no slack develop in the belay rope. The call requires no answer, just action on the part of the belayer.

READY

Sometimes the first call given by the climber to the belayer when he is ready to start climbing. If he does not receive an answer from the belayer, it may be because the belayer is not ready or has not heard the climber. The climber should not start to climb until the belayer does answer. Means the same as "Ready to climb."

CLIMBING

A call given by the climber to notify the belayer that the climber is starting to climb. The climber should not start climbing until the belayer answers back with the command "Climb."

CLIMB

A call given by the belayer to notify the climber he may start climbing. The call requires no answer and the actual climbing begins following this call.

SLACK

A call given by the climber to notify the belayer to let out rope. Slack may be required to make a traverse, negotiate a tricky move, or untangle the belay rope. The call requires no answer, just action on the part of the belayer. (Only a small amount of rope should be let out at one time.)

TENSION

A call given by the climber to notify the belayer to take up as much of the belay rope as his strength will allow. This may be required for a rest stop, a tricky move, or just for the climber's confidence. The call requires no answer, just action on the part of the belayer.

ROCK

A warning call given by anyone: climber, belayer, or bystander. The call means something (rock, log, piton, etc.) is falling and people below are possibly in danger of being struck.

FALLING

A warning call given by the climber to notify the belayer that the climber is falling or that a fall is imminent. The call is given since in many circumstances the belayer cannot feel the fall. The call requires no answer, just a safe belay catch. (The exact wording may vary depending upon the climber's mental attitude at the time.)

OFF BELAY

A call given by the climber to notify the belayer that the climb has been completed and the climber is on safe ground and no longer needs the assistance of the belayer or the belay system.

BELAY OFF

A call given by the belayer to the climber acknowledging the climber's command "Off belay." At this time the belayer will release the belay rope and step away from it. This call is telling the climber that the belayer is no longer on the belay rope.

READY TO CLIMB

Sometimes the first call given by the climber to the belayer when he is ready to start climbing. If he does not receive an answer from the belayer, it may be because the belayer is not ready or has not heard the climber. The climber should not start to climb until the belayer does answer. Means the same as "Ready."

THAT'S ME

A call given to the belayer from the climber to inform the belayer that all slack has been taken out of the belay rope and the belayer is now tugging at the climber.

READY TO RAPPEL

This is usually a first call given to the belayer by the rappeller, informing the belayer that the rappeller is hooked up to the belay rope and the rappel rope, and is now ready to rappel.

RAPPELLING

A call given to the belayer from the rappeller that he is starting the rappel. Very similar to "Ready to rappel."

RAPPEL

A call given to the rappeller from the belayer, informing the rappeller that he is ready to belay him during the rappel. In other words, the belayer is giving the rappeller the go-ahead to rappel.

ROPED CLIMBING AND RAPPELLING RULES

EQUIPMENT CARE

- Keep oils, spirits, gasoline, and lacquer thinners away from synthetic ropes. (Lacquer or lacquer thinner will destroy a nylon rope in minutes.)
- Keep rope away from cigarettes and open flames and, when stored, from direct sunlight.
- Keep rope coiled when not in use.
- Keep ends of rope and webbing burnt to prevent fraying.
- Inspect ropes and slings for damage after each use by carefully feeling the entire length of the rope.
- Remove all tight knots after using and before storing.
- Periodically wash dirty slings and ropes with mild detergents and lukewarm water.
- Keep ropes reasonably dry, if possible. Dry before storing.
- Uncoil wet ropes before drying them.
- Do not store a rope near radiators or other sources of heat, or in a dirty car trunk.
- Never use a climbing rope as a car tow rope. (Once so used, the rope must be retired by cutting it into lengths of 12 feet or less.)
- Do not hang a rope over sharp nails.
- Never step on a rope.
- Never drag a rope or webbing along the ground. (Small rock crystals and fragments can damage the rope and make it unusable.)
- Do not allow a rope to run over sharp edges, if possible, especially if it is under a heavy load. (A canvas shield laid over the edge protects the rope from rubbing against the rough edge.)
- Do not leave a rope stretched or under tension for any extended period.
- Completely examine a rope immediately after it has held a fall.
- Examine ropes at regular intervals. If puffs of fibers are observed at any point along the line, retire the rope.
- Examine a rope immediately after it has been hit by a falling rock, no matter how small. If a sudden strain has been placed upon the rope while passing over a sharp edge, examine it carefully.

- Don't allow nylon rope, or any nylon equipment, to run or rub over another piece of nylon rope or equipment. (With the weight being placed on the ropes, it is just a matter of seconds before one rope will melt through the other as a result of friction heat.)
- Don't allow nylon webbing or rope to remain in direct sunlight for unnecessarily long periods. (Ultraviolet rays can break down the strength of the rope or webbing. This is most critical for webbing because of its large amount of surface area.)
- Do not drop or throw carabiners, figure eights, brake-bars, ascending rings, helmets, etc., against a rock surface. Do not pull them back up on a rope, as this subjects them to banging against the rock face. (This weakens them and they can suffer internal cracks not visible on the outside. Treat them with care even though they are made out of metal.)
- Retire a rope after three hard falls (at least 6 feet), or when its condition warrants, or after four years, whichever comes first.
- Always use separate anchors for the belay rope and the rappel rope.
- Always have an extra rope anchored and out of the way at the rappel site in case of an emergency.
- Never leave ropes hanging unsupervised.
- Coil and whip any rope not being used and put it in a safe place.
- Use double carabiners on running belays from top anchors to reduce the sheer (tension) on the rope.
- Use a gloved brake hand on rappels and belays.
- Never wear loose clothing, hanging straps, or strings, and keep long hair up and out of the way of the figure eight. (Such things can become lodged in the figure eight during a rappel, requiring rescue operations.)
- Always climb with at least two other people.
- Only climb with a top-rope belay.
- Wear a helmet if within 20 feet of the cliff base (safety zone) and while climbing or rappelling.
- Anyone within 5 feet of the cliff top should be on belay or tied in to an anchor.
- Provide both bottom and top supervision for all rappelling by noncertified students.
- When using the sitting hip belay with a safety rope, cliff-top belayers must be seated and anchored. (This is usually the safest and is the most-used belaying system in rock climbing and rappelling.)

ON-SITE SAFETY

- Use the figure eight on a bight and double fisherman's knot for rope; use the water knot for webbing. Do not interchange a webbing knot for a rope knot, or vice versa.
- In knot tying, all loose ends should be secured with a safety knot and each safety knot should be positioned directly next to the major knot being used.
- Be sure the rappel rope anchor is in direct line with the rappel spot and the belay rope is at a slight angle from the rappel rope. (This prevents the two ropes from becoming tangled or rubbing against each other.)

GLOSSARY OF ROCK CLIMBING AND RAPPELLING TERMS

Anchor. Ropes, runners, and other pieces of equipment set up to secure a climber, rappeller, or belayer to an anchor point.

Anchor point. A well-rooted tree, rock protrusion, properly installed bolt, or other convenient location for attaching carabiners, runners, or rope for belay and rappel systems.

Ascending. Moving upward.

Belay. The protection provided a climber or rappeller tied to a belay rope. The rope is managed by a belayer in such a way that the fall of a climber or rappeller will be arrested almost immediately.

Belay device. A piece of hardware used for belaying; it simplifies the process of locking the rope to stop the fall of a climber or rappeller.

Belayer. The person who manages the rope and is responsible for stopping the fall of a climber or rappeller.

Bight. A bend in the rope. A bight is important for tying certain knots used for belaying, and for securing ropes into rappel or belay devices.

Bolt. An artificial anchor point formed by driving a special bolt into a hole drilled into a rock face. This should only be done by a skilled climber. A carabiner may be clipped into the hanger attached to the bolt.

Bouldering. Climbing on boulders or other steep faces without going more than six feet off the ground, usually protected by spotters rather than a rope belay.

Carabiner. A steel or aluminum ring with a spring-loaded gate. Carabiners are used to connect pieces of climbing equipment and to secure rope to webbing, anchor points, and protection devices.

Climbing. A challenging sport that always involves the skills of ascending and belaying or spotting, and may also include rappelling and bouldering.

Cling. A handhold involving one or more fingers bent over a hold.

Counterbalance. A combination hold that involves the entire body, requiring the climber to use position and weight distribution—for instance, applying pressure with the feet or hands in opposite directions—to make the most of minimal holds.

Descending. Moving downward by rappelling or down-climbing.

Down-climbing. Using hands and feet for balance while descending a moderate or steep face.

Dynamic rope. Rope that stretches 6 percent to 10 percent to absorb the energy of a fall.

Edge. The brink of a ledge or a small horizontal hold on a rock face.

Edging. Standing on a nub or narrow ledge of rock with the side of the climbing shoe.

Face. A surface suitable for climbing, usually a natural rock formation. (See “Wall.”)

Figure-eight descending device. The hardware most often used by rappellers to control the speed of their descents.

Foothold. A knob of rock, a crack, an edge, or some other feature of a climbing surface where a climber can place a foot while ascending or descending.

Handhold. A knob of rock, a crack, a ledge, or some other feature of a climbing surface that a climber can hold onto while ascending or descending.

Hard fall. An instance when a climber or rappeller falls far enough to place significant stress on the rope, webbing, or hardware. Records of hard falls must be noted in the written histories of the rope and gear involved, and factored into equipment retirement decisions.

Harness. Webbing either tied or commercially sewn to fit around the hips and legs. Harnesses allow climbers, rappellers, and belayers to attach themselves to belay systems and rappel ropes.

Jamming. Placing a hand or foot into a crack and wedging it so that it will not slip out.

Kernmantle. Strong, synthetic rope composed of a woven outer sheath surrounding an inner core. Kernmantle rope is the only rope that should be used for BSA climbing, rappelling, or belaying activities.

Lead climbing. When climbers establish points of protection as they ascend by inserting chocks, nuts, or other hardware into cracks in the rock, and clipping the belay rope to them with carabiners. This type of climbing may be practiced only during BSA activities with a top-rope belay.

Lieback (layback). A climbing hold accomplished by pulling against a crack or an edge with the hands while pressing on rock with the feet.

Locking carabiner. A carabiner fitted with a mechanism that can be screwed or set to hold the carabiner gate closed. A double locking carabiner is preferred for BSA climbing and rappelling activities.

Mantle. A climbing maneuver for hoisting oneself onto a ledge.

Nose-over-toes. A well-balanced position used to make descents on gentle slopes.

Pockets. Holes in rock that may be used as holds.

Protection. A piece of equipment used as an anchor point sometimes shortened to “pro.”

Protection system. The rope, hardware, webbing, and anchors used together to belay a climber or rappeller.

Rappel device. A piece of hardware such as the figure-eight descending device that helps rappellers control the speed of a rappel.

Rappelling. Descending by a controlled slide down a rope that is anchored at the top of a route.

Rest step. A way of settling the weight onto the skeletal system to let muscles recover during a climb.

Rope bag. A bag or pack designed for stowing and carrying a climbing rope.

Rope drag. Friction or resistance created when a rope runs over rock or through pieces of protection.

Rope stretch. The amount of “give” in a dynamic climbing rope.

Runner (sling). A loop of commercially prepared webbing used for various purposes including setting up anchors, placing protection, and connecting pieces of climbing equipment.

Safety knot. A knot tied in addition to the main knot to keep the main knot from untying or slipping. Also called a “backup” knot or “stopper” knot.

Slingshot belay. A top-rope belay featuring a belayer on the ground. The rope runs from the belayer up to an anchor at the top of the climb, then down to the climber, forming the shape of a slingshot.

Smearing. Pressing the sole of a climbing shoe against a surface and using the friction created to ascend a face.

Spotter. A person on the ground who provides protection to a boulderer to help prevent injury to the boulderer in case of a fall.

Static rope. Rope with minimal stretch. Static kern-mantle rope can be used for top-rope belays and for rappelling.

Tail. The free end of a rope or piece of webbing after a knot has been tied. A safety knot is often tied in the tail to help protect the primary knot.

Three-point stance. A stable position for a climber. One hand and both feet are on good holds on the rock, or two hands and one foot, freeing the other limb to move.

Top-roping. Belaying a climber with an anchor at the top of a climb. The belayer may be anchored at the bottom of a climb (see “Slingshot belay”), or at the top. All BSA climbing activities more than 6 feet above the ground must be protected with a belay.

Traversing. Moving sideways on a face without gaining or losing much elevation.

Tubular webbing. Nylon straps used to rig anchors, to form seat harnesses, to make runners, and for other purposes.

Tying in. Attaching a rope to a climber’s harness.

Undercling. A kind of hold with the palms facing up, usually under a rock formation.

Wall. A vertical climbing surface, often found at climbing gyms and constructed outdoor climbing facilities. Very high rock faces are also known as walls.

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ROLLER HOCKEY

BACKGROUND



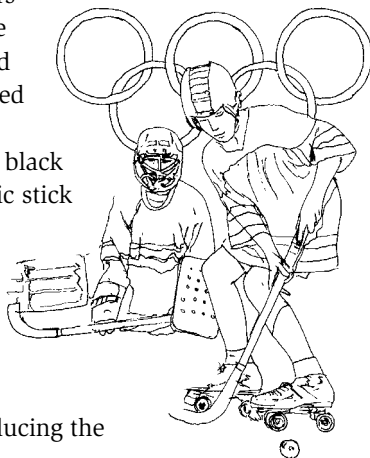
Invented in England under the name *roller polo*, roller hockey currently is played in nearly 50 countries. The first roller hockey world championship was held in 1936 and, except for the war-torn and global-rebuilding years of 1940–1946, the world meet has been held regularly ever since.

The United States roller hockey program got its start at the 1961 United States Roller Skating Championships, where the sport joined the already established speed and artistic skating divisions. After five years of rapid growth, the United States hockey program made its first international appearance in 1966, exactly 30 years after the formation of the world meet. Since then, Team USA has worked hard to make up for lost time to the European powerhouse teams such as Portugal, Spain, and Italy, but has yet to win a gold medal.

In 1979, roller hockey made its first appearance in the Pan American games and two years later was one of the first sports to compete in the world games as well. An Olympic sport, roller hockey enjoyed demonstration status at the 1992 Summer Olympic Games in Barcelona, Spain.

American roller hockey is governed by the United States Amateur Confederation of Roller Skating (USAC/RS), headquartered in Lincoln, Nebraska. USAC/RS oversees all three branches of competitive skating and selects athletes to compete in such competitions as the Pan American games, the world championships, and the U.S. Olympic Festival, to name a few. Approximately 23,000 U.S. athletes skated competitively in 1992, and the numbers continue to grow.

In 1987, USAC/RS introduced a new program to help beginning athletes remain competitive while they learn the finer points of their sport in their initial three years of play. It was called the Junior Olympic (JO) and for roller hockey, replaced the international-style wooden stick and hard, black rubber ball with a plastic stick and soft, no-bounce rubber ball. These and other modifications improved the game for beginners in a variety of ways, including drastically reducing the



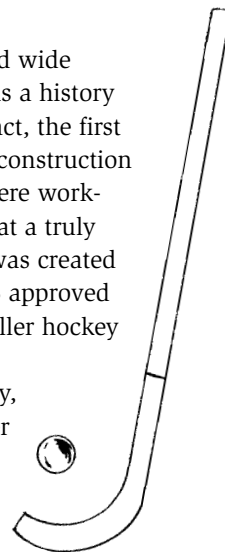
possibility of injury and keeping the game moving at a fast pace. The new version of the game is also more flexible because court dimensions may be altered to fit almost any size playing area.

In 1990, USAC/RS created the softball hockey program, which maintained the same rules, equipment, and playing area as the Junior Olympic game, but featured athletes who had used up their three years of Junior Olympic eligibility.

IN-LINE SKATING

Although the in-line skate has enjoyed wide popularity since the early 1990s, it has a history that stretches back considerably. In fact, the first recorded roller skates were of in-line construction and appeared in 1735. While these were workable, it wasn't until 250 years later that a truly practical version of the in-line skate was created in the form we know today. USAC/RS approved the in-line skate for all divisions of roller hockey in late 1990 and also submitted a petition to the world governing body, the Federation Internationale de Roller Skating (FIRS), to allow in-line skates at the international level as well. FIRS approved this petition in 1991 and now in-line skates are accepted equipment at every level of play.

Currently, in-line skates and in-line hockey games are everywhere, a testimonial to the game's versatility and ease of setup. Only 10 players are needed, and virtually any clean, level surface will make a court. While USAC/RS governs the only officially recognized competitive program and competitions, recreational programs have been started by parks and recreation divisions, health clubs, and even some schools. Teams participating in the USAC/RS program have the opportunity to compete at the local, regional, and even national championship levels. In addition, these teams may compete in or host officially sanctioned invitational and interclub tournaments, which, in addition to being fun, are an excellent source of income for the team.



PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with the help of the adult program advisor.

ADVANCEMENT

- Review each Varsity Scout's advancement status.
- Monitor the team advancement chart.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team's annual special high-adventure event (Philmont, Sea Base, etc.).
- Conduct a roller hockey event.

PERSONAL DEVELOPMENT

- Arrange for an expert to demonstrate roller hockey equipment and teach techniques of good skating.
- Carry out a fitness program for the team. Concentrate on exercises that would develop stamina for competitive roller hockey.

SERVICE

- Plan and carry out a community service project.
- Work with a Webelos den in earning activity badges.

SPECIAL PROGRAMS AND EVENTS

- Practice skating skills such as starting, stopping, turning, and skating backwards.
- Schedule roller hockey games with other Varsity teams.

SETUP, EQUIPMENT, TEAMS, AND OFFICIALS

SETUP

The maximum dimensions a roller hockey court can have are 140 feet long and 70 feet wide. A court may be smaller, as long as both teams agree to waive official dimensions and the length-to-width ratio remains 2-to-1 (for example, 100 feet long by 50 feet wide).

The surface should be clean, level, and in good condition, with no large cracks, holes, or other surface irregularities. It's also a good idea to sweep the court before beginning play. Acceptable surfaces are wood, asphalt, or concrete. Avoid slippery surfaces.

Three areas are designated along the sidelines. Two of these areas serve as team benches and must have clear

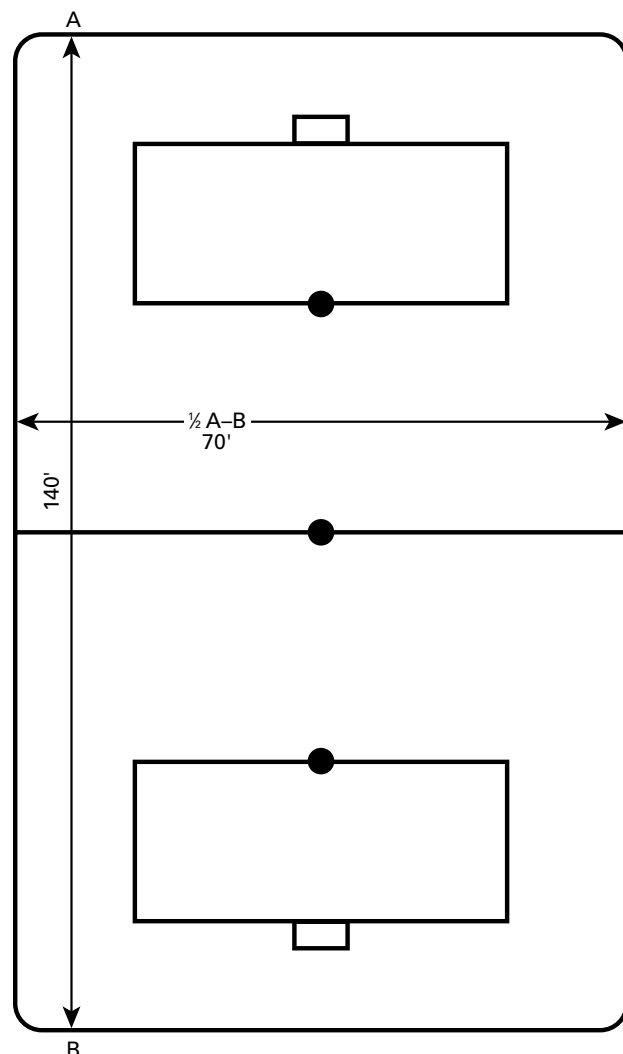
access to the playing surface to allow substitutions. The other designated area serves as the penalty box. Players in this area must be able to see the timekeeper.

Markings necessary for a roller hockey court include the following:

- A center spot
- A scoring line, 2 inches wide, running the width of each goal opening
- A penalty-shot line extending 4 inches on each side of each cage and 12 inches from the mouth of the goal toward the center spot
- A goalie penalty line that runs 1 foot, 8 inches from the mouth of the goal

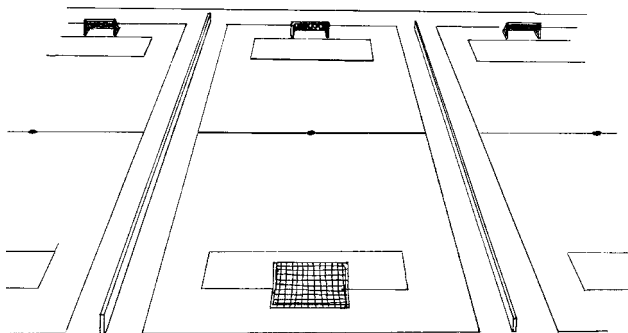
The 2-inch line must be marked using a different color than the ball being used. Markings may be made with permanent ink, washable felt marker, or tape.

An imaginary line will run the perimeter of the playing surface, set in 3 inches. These imaginary lines are used for most free hits and face-offs.



Goal cages should be placed a uniform distance at both ends of the playing surface. This distance may be a minimum of 3 feet and a maximum of 6 feet from the ends of the court.

To keep the ball in play, some type of barrier must be constructed to ring the playing surface. This can be as simple as 8-foot tables laid on their sides or as elaborate as 3-foot-high wooden barriers with braces. A good set of court dividers not only keeps the game moving but also can create up to three courts in an ordinary gymnasium, which comes in handy for tournaments and practice for large clubs.



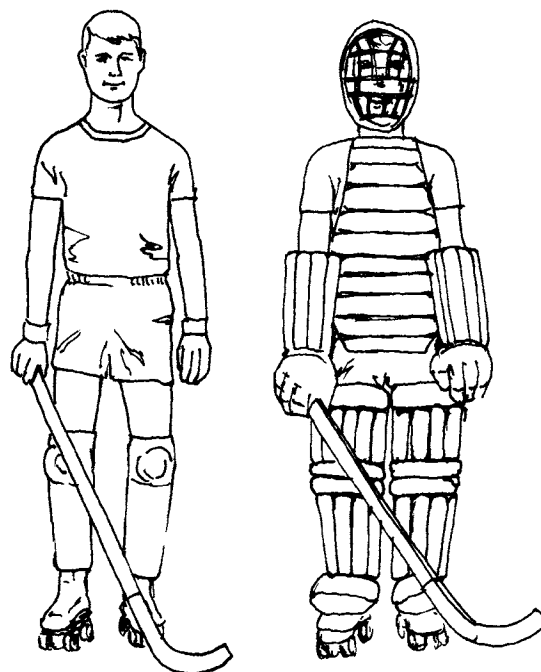
EQUIPMENT

PERSONAL EQUIPMENT

The single most important type of equipment in roller hockey is safety equipment for the players. While the game is built on a noncontact principle, the importance of protecting players against potential injury should not be ignored.

All players are required to wear helmets. USAC/RS has adopted the Canadian Hockey Standard for hockey helmets. The helmet must be on the head and securely fastened at all times—during practice, warm-up, and competition. In addition, the goalie is required to wear a face mask, which may be either attached to the helmet (as with ice hockey goalie masks) or separate (as with a baseball catcher's mask). Full face, nose, and eye protection must be provided for the goalie. Floor players may include clear plastic visors and eyeglasses on their helmets if desired, but all eyewear, including visors and eyeglasses, must be constructed of ANSI (American National Standards Institute)–approved, shatterproof material.

All players are required to wear mouthpieces to protect their teeth. Suitable types are models that are inserted into the mouth and rest between the teeth. External mouth protection or lip/chin guards are not acceptable because they do not provide adequate protection against upward blows to the chin.



In addition, males playing roller hockey are required to wear a protective cup, which may be made of aluminum or fiberglass.

Optional equipment for floor players includes

- Shin guards to protect the lower legs
- Knee pads, which may be connected to or separate from shin guards
- Gloves, either full or fingerless (Some provide additional padding to protect the back of the hand and fingers.)
- Elbow pads

Goalies must wear the following in addition to helmet, face mask, and mouthpiece:

- Chest protection, such as that for a baseball catcher
- Goalie glove, which is any glove used strictly to block, swat, or bat the ball away from the goal, but without fingers or mitt-style pocket to grab the ball
- Large, ice-hockey-style rectangular leg pads

Optional goalie equipment includes shoulder protection, such as football shoulder pads.

The Junior Olympic program allows either conventional (“quad”) roller skates or in-line (“rollerblade”-style) roller skates in competition. Skates must be in good condition and not have broken, loose, or defective parts that could cause them to malfunction or come apart. Decoration should be limited to coloring or stickers and may not include bells, good-luck charms, tassels, or other hanging material that could get caught in the

wheels and cause damage or injury. Also, skates with protrusions such as axle bolts should be checked frequently to make sure they do not mar the skating surface or prove dangerous to the skater or fellow competitors.

Everyone, including the goalie, must have a hockey stick. The official Junior Olympic softball hockey stick is made of plastic and is 44.8 inches long, although it may be shortened for younger players. Sticks are available through skate shops and some sporting goods stores or through the USAC/RS national headquarters.

GAME EQUIPMENT

The official ball is 9.75 inches in circumference and is made of soft, flexible plastic with virtually no bounce. Only one ball is needed for games, but several should be kept for practices and drills. These also are available through USAC/RS, skate shops, or some sporting goods outlets.

Official goal dimensions are 44 inches high and 60 inches wide, and two goals are needed for the court. Goals sold through USAC/RS are made of lightweight metal tubing, but goals also may be constructed of wood or PVC plastic pipe as long as they meet official dimensions. Netting is a lightweight mesh—no metal netting is permitted. Another optional feature is a drop net that hangs freely inside the cage and trails on the ground. This “catches” the ball and helps prevent confusion as to whether the ball has crossed the scoring line.

TEAMS

An official roller hockey team is made up of four floor players and one goalie. Additional team members may act as substitutes, up to a maximum of 12 total team members.

Teams may be made up of a combination of males and females, all males, or all females, and teams of any configuration may compete against each other (i.e., a male-female team versus an all-female team).

The team uniforms for the floor players must be of the same color and design. They should consist of short-sleeved shirts in the team color and hemmed shorts of the team color. The goalie will wear a shirt of a different color than the rest of the team. Cut-offs, bikini shorts, and “short-shorts” are not permitted. If one member of the team wears socks, all must wear them and they must be in the team color. The captain’s uniform will include a large “C” on the front of the shirt or an arm-band bearing the word “CAPTAIN.”

If, while a game is in progress, a team becomes shorthanded as the result of injury or penalty, that team may continue playing with four or three players. If the team is reduced to two active players, the referee will end the game.

OFFICIALS

REFEREE

As the main official (and in some cases, the only official) in a match, the referee commands absolute authority of the hockey floor. Only one referee is used for a match, but that one official must be well-versed in the rules, sufficiently physically fit to follow the action up and down the floor, and objective in all decisions. Any decision by the referee is final.

Anyone with a working knowledge of the rules can officiate for a hockey game at the practice or the intra-club level. Referees can be recruited from the ranks of parents, coaches, or other volunteers interested in the game. From the league level to the United States championships, referees are required to earn their commissions through a closed-book examination to ensure that competent officiating prevails in the higher levels of USAC/RS competition.

Referees are nonskating officials. It is recommended that they wear athletic shoes to keep up with the action. The official dress is white slacks and a white shirt. The referee must also have a whistle and three 3-by-5-inch index cards—one red, one blue, and one yellow. His or her duties begin before the game starts by making sure the floor is safe and contains all official markings. The referee also ensures that the goals and cages are safe and in proper position and that the players’ equipment and uniforms conform to regulations.

To begin the game, the referee is responsible for the coin toss, for placing the ball at center court, and for signaling the start. The referee must remain in constant contact with any other officials and be aware of messages they send in reference to such things as time. A referee working alone must also follow the clock and keep track of players in the penalty box. Because this is a lot to ask of an individual, it is recommended that a referee not officiate a game without at least one of the other officials described below.

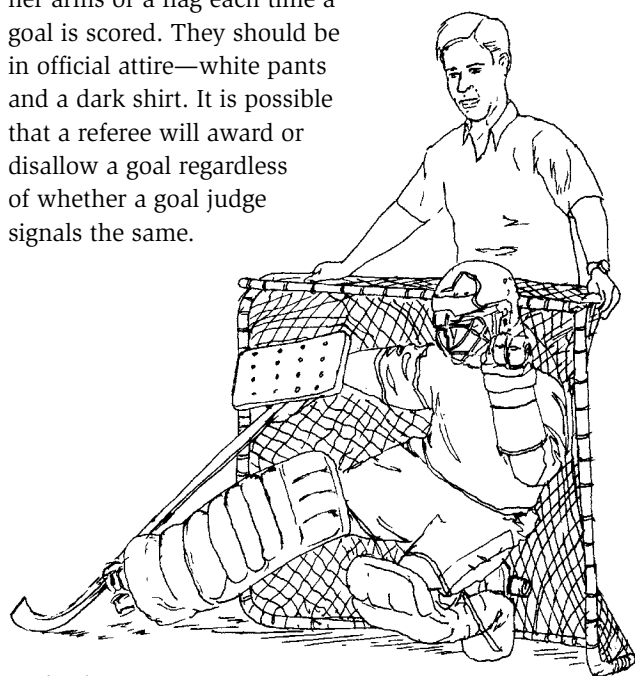
During the game, the referee’s duty is to ensure the game is played fairly for the maximum enjoyment and safety of all players. If a goal is scored, the referee has the power to call it valid even if a goal judge does not. The referee orders face-offs, calls penalties, and awards free hits, warnings, and penalties as necessary. The referee also has the power to call time-out at any time and should do so in the event of an injury or other official action.

The referee can suspend a match if a team has unacceptable uniforms, has insufficient numbers, or is unfit to compete. The referee may also stop the game before the end of regulation time if the teams’ scores are separated by eight points. Only the whistle of the referee can officially end the game, not the clock or other officials.

Most of all, the referee should exercise good judgment when calling a game. Repeatedly interrupting the game for minor infractions that don't affect the outcome or endanger other players is as unacceptable as allowing dangerous or unfair play to continue.

GOAL JUDGES

Goal judges, if they are used, stand on the back of the goal cages, thereby discouraging displacement of the cage and still maintaining a good view of the action. The goal judge will raise his or her arms or a flag each time a goal is scored. They should be in official attire—white pants and a dark shirt. It is possible that a referee will award or disallow a goal regardless of whether a goal judge signals the same.



Goal Judge

TIMEKEEPER/GOALKEEPER

The timekeeper should be thoroughly familiar with the rules of the game, should possess an accurate stopwatch or other timing device, and should have some manner of alerting the referee that time has expired. In some cases, this may be accomplished by voice. Other times, it may require a whistle or horn.

The timekeeper also keeps players informed of the status of their penalty time and signals when they may legally leave the penalty box.

The timekeeper may also be the scorekeeper, or the scorekeeper may be a different person. The scorekeeper registers goals, registers the names and numbers of players who score for statistical and MVP purposes, and runs the scoreboard.

STEWARD

Usually reserved for larger tournaments, the steward checks in all team members before the match, determines if the teams meet uniform and number requirements, and decides whether the players are fit to play. The steward also ensures that all players are wearing required safety equipment.

RULES FOR PLAY

OBJECT

The object of roller hockey is to score more goals than the opposing team. A goal is scored when the ball completely crosses the 2-inch line at the mouth of the goal. A goal scored by ricochet off the body, stick, or skates of a player against his or her own team counts.

TIME

A complete game consists of two eight-minute* periods with a three-minute halftime. The teams trade ends for the second half. A running clock will be used except in the final two minutes of the game or when the score is either tied or separated by one goal. In this instance, the clock will stop at each referee's whistle blow (penalty, face-off, free hit) and resume with the action.

Each team receives one time-out per game, which may be called at any time that team is in possession of the ball. The time-out lasts one minute. The referee may stop the clock any time he or she feels it is necessary. In addition, the clock will stop in the case of an injury or goalie substitution during play stoppage.

BEGINNING THE GAME

To begin the game, the team captains meet in the center of the floor. The referee tosses a coin and the visiting captain calls it in the air. The captain winning the coin toss can choose either possession of the ball or which goal to defend, with the loser of the coin toss receiving the other option (i.e., if the winning captain opts for possession, the other captain chooses which end to defend).

There is no face-off to start the game or to start the second period. The referee awards the ball to the appropriate team at the center-court marking, where only the player who will start the ball is allowed. All other players must be on their own sides of the court at the start of the game.

*Note that all times are exact; that is, eight minutes is exactly 8:00 minutes.

At the referee's whistle, play begins. The player must immediately strike the ball in any direction. If he or she hesitates, the opposing team may play it first. This procedure is repeated after every made goal.

DURING THE GAME

Play continues nonstop except for made goals, face-offs, free hits, or penalties, each of which is discussed below. It is important not only that players understand the following situations but also that coaches, who might double as referees, understand them.

MADE GOALS

Players. A goal counts for one point and is considered valid only when two things occur: the ball completely crosses the 2-inch scoring line at the mouth of the cage and the referee signals it as a made goal.

Referee. The signal for a made goal is both arms extended upward and hands open. **Note:** The referee is the absolute authority on the court. Thus, even if a goal judge signals a made goal, it does not count until the referee acknowledges it as such.

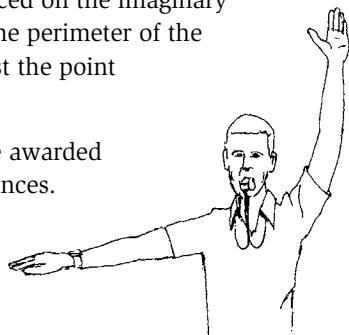
FACE-OFFS

When used. Whenever play is temporarily stopped, a face-off will be ordered.

Players. Once a face-off has been called, the player closest to the ball will bring it without delay to the spot indicated by the referee. Two opposing players stand over the ball with their backs to their own goals. They place their sticks out in front of them and rest the blades on the floor 9 inches from the ball. At the referee's whistle, they may play the ball. If a player violates the rules during a face-off, a free hit is awarded to the other side.

Referees. Face-offs are signified by lifting one arm above the head with two fingers extended into a V, signifying that both teams will take part. With the other hand, the referee points to the spot where the ball should be placed on the imaginary line running around the perimeter of the playing surface nearest the point of infraction.

Note. Face-offs will be awarded under these circumstances.



1. The ball has gone out of play after ricocheting off the sticks of opposing players.
2. It is unclear which team or player caused the ball to go out of play.
3. The ball was deliberately played with the intention of getting it out of play to benefit from a free hit.
4. The ball becomes lodged in the netting outside of the goal cage.
5. A goal cage has been accidentally displaced.
6. Play is being resumed after a team has taken a time-out.
7. The ball is "frozen" (lodged against a barrier wall, between two or more players, or unintentionally under a goalie) and cannot be dislodged through normal play.

FREE HITS

When used. A free hit will be awarded to a player when a member of the opposing team has committed a rule violation or foul.

Players. Once a free hit has been called, the player closest to the ball will bring it immediately to the spot indicated by the referee. The players on the opposing team take positions on the floor at least 9 feet from the player taking the free hit. The players on the team awarded the free hit may position themselves anywhere on the floor. As soon as the ball is placed and the players are in position, the player may take his free hit either as a pass or as a direct shot on goal.

Referees. The referee signals a free hit by raising one open hand above his head and pointing with the other hand to the point where the hit is to be taken. The ball is placed in a stationary position, either along the imaginary line running along the perimeter of the court or at the center spot, whichever is closer to the point of infraction.

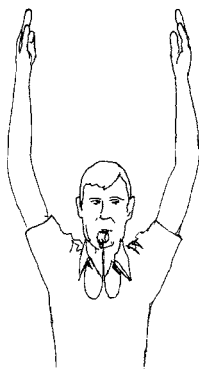
The referee does not whistle the start of the free hit. The player taking the free hit may do so as soon as the ball is placed and the players are in their respective positions.

Note. A player may not score on a free hit unless it touches at least one other player before crossing the 2-inch goal line. For example, if a free hit goes directly into the cage or ricochets off the goal posts and into the cage without touching any other player on the floor, the goal is disallowed. However, if the ball touches any

part of another player before crossing the score line, the goal is counted.

A free hit will be awarded when

1. A player “jumps the whistle” during a face-off.
2. A player attempts to play with a damaged skate.
3. A player attempts to play without a stick.
4. A player attempts to play with any part of his or her body touching the ground. (This rule does not apply to the goalie.)
5. A player attempts to play while holding onto the barrier.
6. A player attempts to play while holding onto the goal cage. (This rule does not apply to the goalie.)
7. A player chops, kicks, or lofts the ball.
8. A player is guilty of rough play.
9. A player raises a stick above his or her waist.
10. A player intentionally displaces a goal cage.
11. A goalkeeper intentionally covers the ball.
12. A player illegally plays a carom (rebounding shot) from a penalty shot.



for the player taking the shot, no player (including the goalie) is allowed to move until the referee blows the whistle. At that time, all players may move at will and the ball is immediately in play.

A penalty shot is a shot only; the player taking the penalty may not skate before shooting. Once the ball is in play, the shooter may not play the ball again unless it has first touched the goalkeeper or the exterior part of the goal. The striker may not play a carom solely off the barrier around the court.

Referees. If a goal is scored simultaneously with the whistle of the referee calling a penalty, the goal is allowed and the penalty shot is not taken.

WARNINGS AND PENALTY TIME

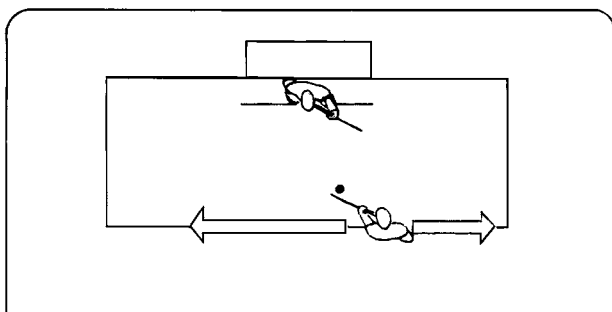
When used. Referees are encouraged to interrupt the game as little as possible for minor infractions. Thus, warnings and penalties are reserved only for those actions contrary to the spirit of the game. In those instances, a referee should not hesitate to issue warnings and even assess penalty time.

Players. The most immediate and obvious way for players to avoid penalty time is to avoid committing any infractions. To receive warnings and time out of the game sets a bad example for younger players, keeps players from enjoying the activity or helping their team, and does not reflect the ideals and values that a Scout holds. This is a noncontact game, and there is no excuse for fighting, excessive roughness, disrespectful conduct, or bad sportsmanship. These infractions don’t “just happen”; make sure they are not a part of the game plan.

The only foreseeable exception to this is an illegal substitution. However, when players keep their minds on the game, this violation should never occur. A legal substitution may be made at any time during the game. It does not require a stoppage of play, nor does it require the referee to admit a player into the contest.

The important thing to remember is that a team may not have more than five players on the court at any time during a game. Therefore, the outgoing player must be completely off the floor before the substitute player can enter the game.

The penalty for this infraction, which both the incoming and the outgoing players are required to serve, is two minutes in the penalty box. This mental mistake can be costly, considering that all players involved with the substitution have to sit down, regardless of how many players are entering the game. (For example, if one player comes into the game illegally,



PENALTY SHOTS

When used. Penalty shots are reserved for grave or repeated fouls within the penalty area.

Players. The player taking a penalty shot takes a desired position on the 15-foot penalty line. The goalie must be behind the 1-foot-8-inch goalie penalty line. All other players must be behind the center line. Except

two sit down. If two come in illegally, then four players from the same team serve the penalty.)

At the conclusion of the two-minute penalty, players cannot enter directly onto the floor from the penalty box without first letting the substitute come completely off the surface, or another penalty will result.

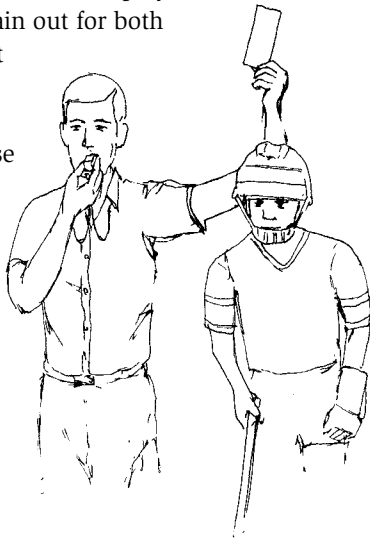
Goalies also are advised that they follow the same substitution rules as floor players. The only exception occurs during a stoppage of play, when the captain may advise the referee that a goalie change is being made. At this time the referee will stop the clock and allow a maximum delay of 30 seconds for the change.

Referee. In instances where warnings and penalties are warranted, the referee has the right to send a player to the penalty box for up to two minutes. In the event of a second expulsion of the same player, the player must remain out for both the remainder of that match and the next match as well.

The referee will use three cards (approximately 3 by 5 inches) to signal warnings or penalties. The official calls the offending player over, positions him or her so the player's number may be viewed by the scorekeeper, shows the card to the player, and then holds it above the player's head for the benefit of the scorekeeper. The color of the card denotes the severity of the foul, as follows:

- *Yellow.* Indicates first official warning to a player.
- *Blue.* Indicates that a player is expelled from the match for a period of two minutes. Blue must be used in all cases where a player has already received a yellow-card penalty.
- *Red.* Indicates that a player has been expelled for the balance of the current match and the next match. Red must be used in all cases where a player has already received a blue-card penalty.

Note. A player's penalty time begins the moment he enters the penalty box. The referee will advise the timekeeper of the length of the penalty and the timekeeper will track the time served and signal the player when the penalty time is completed.



ENDING THE GAME

The game will end any time there is an 8-point difference in the score, or if a team refuses to take part further in a match. Otherwise, the contest will span regulation time.

In tournament play, games may end in a tie. However, if a tie exists at the end of regulation time in a game that must have a clear winner (such as a championship bracket, semi-final, or title game), the following tie-breaker steps will be taken:

Extra time. At the end of regulation time of a game requiring positive results, teams will receive a rest period of three minutes, followed by two periods of five minutes, trading ends in between, with no interval between.

Shoot-out. Should the score still be tied after extra time, teams will engage in a shoot-out format where each side is awarded five penalty shots, to be taken alternately by five different players on each side. A coin flip determines the team who shoots first and which goal will be used. The team scoring the most goals out of those five shots is the winner.

Sudden death. If the shoot-out fails to break the tie, the teams will go to sudden-death format, wherein teams take turns taking penalty shots on goal. The first sequence whereby one team scores and the other team does not decides the outcome.

ROLLER HOCKEY PRACTICE

During the season that the Varsity team is playing roller hockey, practice sessions are held. Practice sessions can occur as part of the team meeting or a separate meeting. These sessions develop not only the physical side, but also the mental side of the Scout.

Many opportunities will occur to blend the sport of roller hockey with the game of life. Smart coaches and captains use these opportunities to strengthen the individual Scout as well as the Varsity team.

Practice sessions have four parts:

1. **Warm-up and conditioning exercises.** Simple warm-up exercises allow for loosening the muscles and help in avoiding injuries. Vary the pace and type of exercise. Questions should be asked to stimulate thinking about proper eating habits and the importance of exercise throughout life. This portion of the meeting should take about 10 minutes.
2. **Skills development drills.** Teaching fundamentals is essential at every level of roller hockey. Take time to

teach basic skills at every practice session and plan simple drills to reinforce the points. Players should work individually and in groups so that no one gets bored or slighted. Use as many balls as possible. Drills should be brief to keep things moving and to save time for scrimmage.

- 3. Team talk.** Make this a regular, normal part of practice. Use it for education and personal development. Team members should be encouraged to talk about such things as rules of the game, principles of team play, positions on the court, team tactics, and concepts of fair play.

These rules, principles, positions, tactics, and concepts apply to everyday life as well as to the sport of roller hockey.

- 4. Practice (scrimmage) game.** The warm-ups, skills development, and team talk should lead to the scrimmage. Team members enjoy this part of the meeting the most. Tie into the scrimmage what was just learned during the drills and team-talk segments.

WARM-UP AND CONDITIONING EXERCISES

Proper warm-up, conditioning, and cool-down exercises are as important in preparing for roller hockey as they are in preparing for any kind of athletic competition.

Proper warm-up is important. Warm muscles do not pull as easily and flexibility is at its peak. Every practice schedule should allow ample time for warm-up, followed by stretching. Good warm-up activities include moderate jogging or skating around the floor. Stretching should include all major muscle groups, both upper and lower. Plan for this in your schedule and make sure the team puts forth the necessary effort to benefit from it.

The importance of cooling down often is overlooked. However, it also should be incorporated into the practice schedule. Running or skating laps, moving shooting drills, or passing allows the body to readjust through the decreased physical demands of these activities.

Conditioning is essential in every active sport. It is also one of the few things team members can work on without equipment, facilities, or practice. Encourage players to run, do calisthenics, skate, play other sports, cycle, swim, or anything else that conditions the body, outside of roller hockey practice. Make sure your practice plan includes some time performing activities geared toward improving stamina and endurance. You might also consider holding a team or parents' group meeting on the importance of nutrition and sleep, particularly on or before game day.

One special area of concern is leg strengthening for goalies who must remain in a squatting position for extended periods of time. The rules prohibit (and penalize) the goalie who spends an inordinate amount of time playing on the knees. Therefore, leg lifts, running stairs, and jumping exercises are critically important.

Weight training is an acknowledged asset in any athlete's development. However, opinion remains sharply divided on a comprehensive program for young athletes. A weight-training program should never be undertaken without the input and supervision of trained personnel who can design an individual regimen based on the needs, abilities, and developmental situation of each team member.

PRELIMINARY EXERCISES

Healthy young players are always ready to play the game; they rarely look forward to any preliminary "exercises." It is important to avoid making the warm-up drudgery. Interpret its importance in helping get players ready for strenuous exercise.

The warm-up exercises used and the attitude about them will strongly influence the Scouts' lifetime attitudes about exercise.

Select new exercises for each practice and also repeat some that have been done before.

To begin, players position themselves in a circle, in double lines, or in a semicircle facing the leader. Let players take turns choosing and leading exercises.

When a player leads, coaches can work closely with individual players or exercise with the players.

Remember: Demonstrate the exercise or game first. Tell why the exercise is important. Have players do the exercise slowly together. Then exercise at regular speed.

STRETCHING EXERCISES

- **Deep breathing.** Ask players to take several deep breaths, expanding the chest fully by inhaling, then relaxing while exhaling.
- **Slow arm circles.** Walk in a circle. Swing arms forward and then backward.
- **Side benders.** Hands on hips, bend to one side, then the other.
- **Trunk twist.** Hands on hips, twist to side, then the other.
- **Toe touching.** Touch opposite toe, with knees slightly bent.
- **Front thigh stretch.** Lift leg with knee bent. Grasp shin bone and pull knee close to chest.

- **Back thigh stretch.** Bend knee and bring heel up toward backside. Grasp ankle and pull toward backside.
- **Neck rotation.** Gently rotate head from side to side.
- **Ankle rotation.** Rotate the foot without moving the knee, then with knee rotating.
- **Thigh and leg stretch.** Take position of sprinter on toes. Lower the hips to the ground without moving feet. Repeat each side.
- **Forward crawl stroke.** Stretch arms forward in crawling motion.
- **Calf stretch.** Two exercises are good:
 - a. Wall push. Face the wall with heels about 2 feet from the wall, with knees straight and hands on the wall at chest height. Slowly bend the elbows and bring chin close to wall, then return to upright position.
 - b. Heel and toe rises. Rock closely up and down on the toes. Then rock back on the heels while lifting the toes up and down.

JUMPING AND CIRCULATORY EXERCISES

- Jump up and down for 30 seconds, bouncing on the toes.
- Use a jump rope. Skip on both feet, on left foot, on right foot; alternate skip from left to right to both feet.
- Sit-ups (15 to 20).
- Push-ups (15 to 20).
- Windsprints (dash the length of the court).
- Round the floor (jog the outer perimeter of the floor both forward and backward).

SKILLS DEVELOPMENT DRILLS

Roller hockey drills can be divided into three distinct categories: skating, ball handling, and defense. Good players (and those who want to be good) should try to maintain as much of a good balance of this hockey triangle as possible, as one affects the others and the others affect the first so distinctly. The ability to skate fast is of little use in roller hockey if an athlete cannot effectively deliver a pass or shoot accurately. And the benefits of explosive offensive skills are minimized by a poor defense. Likewise, the best offensive technician or the stingiest defensive player is useless if he or she cannot skate. Balance is the key.

Wearing protective equipment, especially your helmet, is essential whenever you are on skates or participating in a drill.

SKATING SKILLS

Roller hockey requires a variety of skating skills. Probably the most prevalent are the abilities to start and stop quickly and to turn sharply. Also, the ability to accelerate quickly is helpful. Ironically, it is in this area that a conventional or “quad” skater has an advantage over skaters who use in-line skates. A major drawback to the in-line skate in roller hockey is being slow at the start. This is something you need to overcome if you will be going up against quad skaters.

It is nearly impossible to go from “no skate” to “pro skate” with this chapter, but the following drills and suggestions will help sharpen your skills and add variety to your practice time on wheels. Start gradually, working up in difficulty and speed as you feel comfortable.

SPRINTS

Several skaters line up at one end of the floor. On command, they sprint to a designated point on the floor. This also may be done head-to-head or one-on-one. Times should be kept to map the progress of the skaters.

STICK AND MOVE

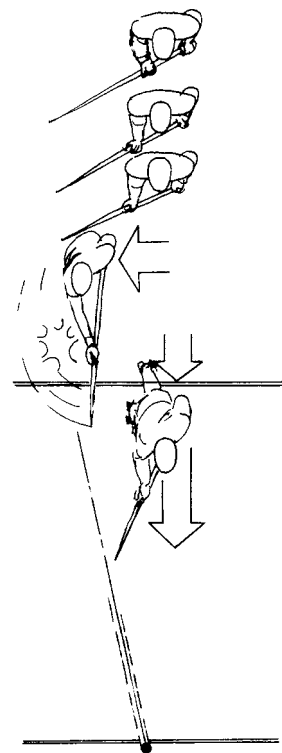
Depending on space, four to six skaters face the coach, who motions either right, left, back, or front. Skaters respond by skating in that direction. On the “Stop” command, players immediately assume a shooting posture. Start this drill without sticks, adding them later.

OBSTACLE COURSE

Use traffic cones to create a maze of turns, stops, and straight-aways. Time skaters and chart their progress as they move through the maze.

CHASE RACE

Divide the team into two smaller teams. Line up the teams parallel to each other, single-file, on one endline. The second person in each line stands at least two steps



Chase Race

to the right or left of the row of skaters and slaps the ball toward the other end of the court. As soon as the ball has crossed half-court at any point, the first person in line skates after and retrieves the ball, and then slaps it back to the skater who has moved up into the second spot in line. This person handles the shot and slaps it across the center line in the same manner. This process is repeated until all team members have gone through the line and chased down a shot. To avoid collisions, skaters who have gone through the line should assemble at the opposite end of the surface until the conclusion of the drill. Either the last person in line can slap it across the center line and chase his or her own shot or a coach can shoot the ball across the center line for the final skater.

BALL-HANDLING SKILLS

No one will deny the importance of a well-tuned offense. But what many people sometimes forget is that being a good offensive player does not automatically mean being the high scorer. Clean passing and accurate ball placement are just as important (if not more so) for an effective scoring attack.

As with basketball or soccer, ball handling is important not only in kick-starting the offense, but also in protecting possession of the ball. Obviously a team can't score without possession of the ball. Skaters need to know where they need to be and what is expected of them.

DRIBBLING ►

Dribbling is one of the most fundamental drills in the game. Set a row of pylons single-file about

16 feet apart. Players skate over the pylons, keeping the ball in front of them as they weave the ball between the pylons, using only the stick. Keep your head up, start slow, and work to a level where you can move through the line one-handed and at a respectable speed.

◀ PIVOTING

This drill requires two pylons. Athletes skate toward the first, circle around the top of it, head to the other, circle over the top of it, and skate off the surface.

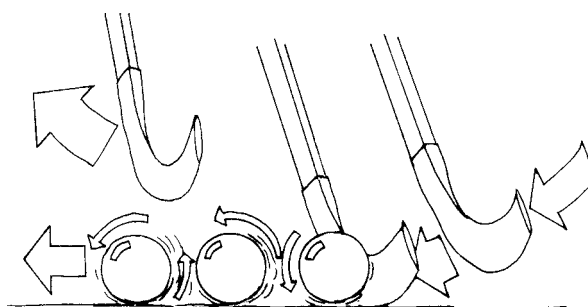
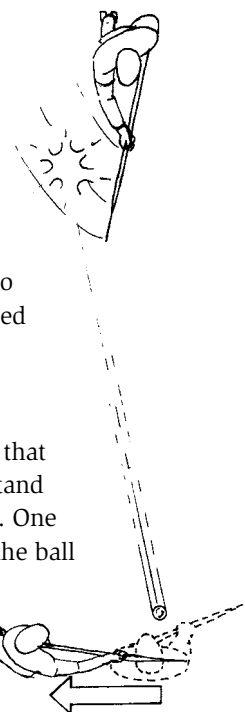
In conducting this drill, imagine that the pylons are defensive players. Your task is to protect the ball from them by positioning it to the inside of the foot closest to the pylon. Focus on maintaining the ball in its position and not letting it get away in front of the foot closest to the pylon where it is the best protected against opposing defenders.

LATERAL REACH ►

The lateral reach is an excellent drill that requires only two players. Athletes stand 20 to 25 feet apart, facing each other. One player passes to the other, directing the ball to the partner's foot. Just before the ball arrives, the recipient darts sharply to the right or left, reaching out with the stick to take the ball along. This drill is an excellent way to improve reflexes and helps players react to and handle bad passes in game situations.

PASSING SKILLS

The best shooter in the league is useless if he or she does not get the ball when open. As with every team sport, the ability to move the ball is a crucial skill that every member should work to perfect.



As with becoming a good skater or ball handler, the important thing to remember is to progress at your own pace. If you try to do too much too soon or too fast, you might make many errors. Gradual progress will help you become an effective team member. On the other hand, playing it safe all the time will never improve you as a player. In practice, don't be afraid to take a chance to stretch your expertise. Some of the important basics about passing are:

1. Keep your head up. As in basketball, the easiest way to lose possession of the ball is to look down at it.

2. Use only the force necessary to get the ball where it has to go. Don't let the excitement of spotting an open teammate affect your shot. Stay calm; your accuracy will be better.
3. Work to perfect putting topspin on the ball. The more spin, the easier it is to handle because the pass won't roll off the receiver's stick, regardless of the difficulty of the pass. Topspin is achieved by sweeping the blade up and over the ball, causing it to spin over and forward toward the desired target.

Try some of these drills until you become a better passer:

PASSING DRILL 1

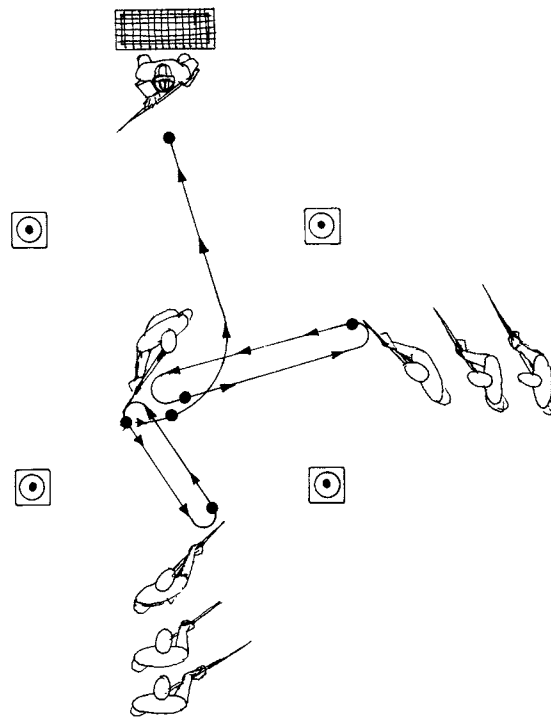
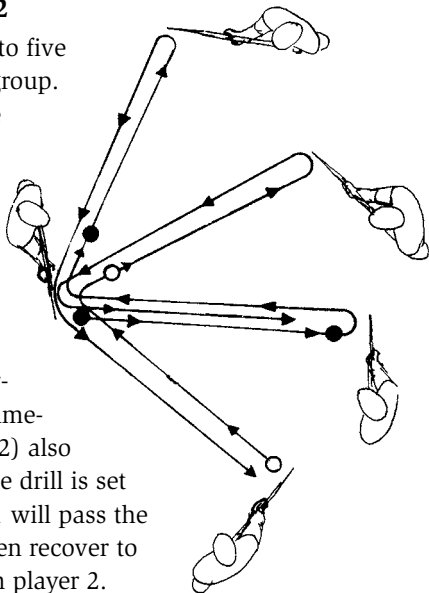
Divide the team into three groups, forming three parallel, single-file lines at one end of the floor. The first three skaters (one from each line) skate simultaneously to the end of the floor and back, passing the ball among them. The emphasis should be on accuracy first and then on speed. If any errors are committed, the same three skaters go again until they make a complete down-and-back round trip without a mistake.

PASSING DRILL 2

Divide the team into five or six skaters per group.

All players but one form a semi-circle. The remaining player, player 1, faces them with one ball. The player at the base of the semicircle to player 1's immediate right (player 2) also has a ball. Once the drill is set in motion, player 1 will pass the ball to player 3, then recover to receive a pass from player 2.

Player 1 takes this and passes to player 4, then recovers in time to receive a return pass from player 3. Player 1 receives this and sends it to player 5. Repeat this pass-catch interaction between the players and player 1 all the way around the semicircle and back, if desired. At the end of the cycle, player 1 joins the semicircle and another player takes his or her place. Again, start slowly and work up to speed.



1-2-3 SHOOT

This drill bridges the gap between passing and shooting. Set up four pylons to form a 20-by-20-foot square. The top of the square should be about 10 feet from the mouth of the cage.

One player is in the middle of the square. The remainder of the team divides into two equal groups. One group lines up single-file outside the box to the center player's immediate right (or left). The other group sets up single-file outside the box behind the center player.

The object is to rapidly complete passes between the first person in each line and the center player. To accomplish this, the center player receives the first pass from the side, passes it back to the side, and receives it back again from the side in quick succession. On the third pass, the center player fires a shot into the cage without stopping it first to set up the shot. The center player then repeats this sequence with the line behind him. Players in the two groups rotate through the line until all players have had a turn at passing and receiving. Once everyone has had a turn, the drill is completed, or you may choose another center player and go through it again.

This drill helps develop the quick back-and-forth passing and sharp shooting skills that can be extremely effective in confusing a defense.

SHOOTING SKILLS

Although shooting and scoring have been overrated as the true measures of a good player in many sports, the fact remains in roller hockey that the team with the most points wins. But instead of thinking of how many points you can score, the best way for any hockey player to look at things is how many goals *the team* can score. Even more importantly, how can *I* be a part of *we*?

The answer is surprisingly simple. Be a part of the play that most often produces positive results. Know your role and know your spot on the floor. Count on your teammates to do their best and do yours so that you never let them down. Learn how to recognize a situation unfolding and, while you should never be afraid to take a good shot, learn how to recognize the markings of a tailor-made assist opportunity. And in all things—accuracy, accuracy, accuracy!

AROUND THE WORLD

Designate several spots on the floor, making sure you include straight and angle shots, moving and nonmoving, long and short. Players need to make a required number of shots or shoot 10 and keep track of how many go in. This is a good drill because it is so versatile. Players can shoot at an empty goal, at a stationary goalie, or at a goalie with full range of motion. You might also set up token defensive players so shooters get used to shooting around or between opponents.

DEFENSE

Defensive skills should enjoy the same attention in practice as the offensive drills or scrimmages. In high-scoring teams, the defense can command even a larger share of the allotted time in practice, because if a player is already a good scorer, the chances are that any *individual* practice will be to enhance those areas where the player already excels. Therefore, practice time may very well be the only time defense is stressed.

The most pivotal part of any defense is the goalie. Therefore, most of the drills available focus on developing that position. However, other players must be taught what is expected of them in defensive game situations by constantly moving toward the ball and positioning themselves in such a way as to always be between the goalie and the ball. These instincts can be polished by adding live defenders into any of the offensive drills already presented.

Additional drills include the following:

SLAP BACK

The coach, trainer, or a teammate passes the ball to the goalie, who slaps it back. With each consecutive pass to the goalie, the shooter uses considerably more steam. The goalie's challenge is to consistently stop the passes.

SPIN SAVES

The goalie must assume a squatting position, facing one side. Behind the goalie, the shooter fires a shot on goal, simultaneously giving some command (for example, "Now! Shot! Go!"). The goalie must spin and knock the shot away with the hockey stick. (Keep in mind, intentionally covering the ball with the body is a penalty.)

THREE-ON-TWO

The goalie is joined by a defensive player who tries to repel three offensive players: a point player and two wings. If the defense manages to get the ball away without any of the three scoring, the former defensive player becomes the new offensive point player, heading the other direction along with the two offensive wings. The original offensive point player must hustle back to the other side, joining that goalie in the new three-on-two configuration.

ONE-ON-ONE

One-on-one is a classic drill where the rest of the team can take their best shots on goal and the goalie tries to stop as many as possible. This drill may be done from a set distance, or the shooter can move to a new position for each set.

PREVENTION AND CARE OF INJURIES

Roller hockey is a relatively safe sport for players. But since it is a bodily contact game played with little protective equipment, injuries may occur.

All Varsity Scout youth sports are as safe as the environment established by adult leadership for the sport. Roller hockey coaches should take all necessary precautions to help prevent injury and be prepared to respond when they do occur.

SAFETY CHECKLIST

<input type="checkbox"/>	Facilities are in good repair and clear of any obstructions around the court.
<input type="checkbox"/>	Teams warm up properly before practice sessions and games,
<input type="checkbox"/>	Rules and equipment are modified to adjust the physical demands of the sport to the development level of players.
<input type="checkbox"/>	Teams are properly supervised and coached during practice sessions and games.
<input type="checkbox"/>	Coaches know the proper emergency steps to take when accidents do occur.
<input type="checkbox"/>	Players do not play when hurt.
<input type="checkbox"/>	Players are taught how to prevent blisters by wearing footwear that fits properly, gradually breaking in new shoes, and wearing two pairs of socks when needed.
<input type="checkbox"/>	Players are taught to treat bruises and sprains with ice packs to reduce swelling and pain.
<input type="checkbox"/>	Practice sessions are reasonable in length and planned to include brief rest periods.
<input type="checkbox"/>	Game rules are enforced by officials and excessive fouls are avoided.
	The emphasis should be on prevention of injury through proper warm-up, conditioning, supervision, and education.
	Players should be conditioned properly for match play. When injuries do occur, it is necessary to be familiar with the immediate recommended treatment. First aid is the immediate handling of athletic injuries. If pain persists, refer to family physician for follow-up.

Injury	Suggested First Aid
Muscle pulls, sprains, and bruises	Use ice pack immediately to reduce swelling. Speed of application is essential.
Small cuts	Apply pressure to reduce bleeding. Wash with antiseptic solution and apply sterile dressing if necessary.
Nosebleed	Have player pinch nostrils and hold until bleeding stops. Apply ice pack.
Foreign body in eye	Pull upper lid down, holding eyelash. Wash out with eye-cleaning solution. If substance is not removed, refer to physician.
Fainting or loss of wind	Rest in cool place. Try to relax player and slow down breathing.
Scrapes and bruises	Wash with cleansing solution. If necessary, cover with gauze.
Elbow or knee injuries; jammed finger or toe	Elevate area and apply ice pack. Refer to physician if pain persists.
Shin injury	Apply ice pack and compression. Refer to physician if pain persists.
Back or neck injury	Keep the player calm. Do not allow the player to move or sit up if pain is severe. If pain is slight, apply ice pack.
Blisters	Keep clean, wear two pairs of socks, puncture if necessary to relieve pressure. Remove dead skin for quicker healing.

Remember: Never send a hurt player back into practice or a game. First aid is the immediate handling of athletic injuries. Refer a hurt player to the family physician for follow-up treatment if pain persists.

GLOSSARY OF ROLLER HOCKEY TERMS

Bad conduct. Any action designed or intended to antagonize the opponent, the referees, other officials, or the crowd. Includes but is not limited to throwing the stick in the direction of a player or ball.

Ball. The object that must cross the scoring line to register a legal goal. In the softball version, the ball is made of a nearly collapsible, virtually no-bounce plastic and measures 9.75 inches in diameter.

Cage. Another name for the goal.

Captain. The elected leader of a team. Signified by either a large C on the uniform or an arm band bearing the word "CAPTAIN."

Center spot. A mark on the floor that designates the playing surface's exact midpoint. Used to start the game and second half, in penalty shots, and, in some cases, a free hit.

Chopping. Hitting the ball with the acute (sharp) edge of the stick rather than the flat (face) part of the blade. Illegal in shooting and passing and penalized as dangerous play.

Equipment. Includes skates, stick, and ball. Players may wear either in-line or conventional skates.

Extra time. Two periods of additional playing time employed to break a tie, five minutes each way with no time in between.

Face-off. Called when the ball is "frozen" (stuck in one place too long) and the action has stopped. Also used when the referee cannot determine who is responsible for a ball's sailing out of bounds or if its exit involves two players.

Floor player. Any player who is not a goalie.

Free hit. Occurs as the result of minor violations. Opposing players cannot come within 9 feet of the player taking a free hit. A goal cannot result directly from a free hit unless it ricochets off another player from either side.

Goal. A valid score where the ball completely crosses the 2-inch-wide scoring line at the mouth of the goal.

Goal judge. Assists the referee in determining valid goals. The goal judge takes position on the back of the hockey cage to look down and observe whether the ball crosses the 2-inch scoring line at the mouth of the cage.

Goalie. Primary defender of the goal cage. Goalies are allowed to stop the ball with their stick or any part of their bodies, but they are not allowed to intentionally trap the ball with their body or to catch, trap, or otherwise grab and hold the ball.

Goalie penalty line. A line 1 foot, 8 inches from the mouth of the cage, behind which the goalie must remain stationary during a penalty shot.

High sticking. A penalty where a player raises a stick higher than the level of his waist.

In-line skates. Roller skates constructed with the wheels running single file down the middle of the skate. May be of three-, four-, or five-wheel design.

Junior Olympic. A program designed and overseen by USAC/RS, open to all competitors in their first three years of official USAC/RS competition.

Kicking. Definite forward motion of the foot to propel the ball. Illegal except in case of accidental and random ricochet or in the case of a goalie stopping a shot within the penalty area.

Lofting. Ball rises above the height of the cage. Illegal, except when accidental.

Match. An official hockey game.

Mercy rule. Enforced whenever one team gains an 8-point advantage over their opponents. Results in the official end of the game.

MVG. Most valuable goalie. Awarded in each age division to the player letting by the fewest shots in the final rounds of a tournament. The players with the lowest number of goals scored against them are recognized at the end of the tournament.

MVP. Most valuable player. Awarded to the player in each age division with the most MVP points at the end of the tournament. A player receives MVP points as follows:

- Per goal scored (in final rounds) = 1 point
- Per assist (in final rounds) = 2 points

Penalty. The result of a more serious infraction. Penalties can result in free hits, penalty shots, or penalty time.

Penalty spot. A mark or line 15 feet from the cage from which the recipient of a penalty shot can shoot.

Penalty time. Used at the referee's discretion and imposed as the result of unsportsmanlike conduct, rough play, or excessive fouls. May be a two-minute period (signified by a blue card), or may be a suspension for the rest of the match and the duration of the following match (signified by a red card). Must also be used for illegal substitution.

Quad skates. Roller skates employing the design of four wheels connected by axles under the ball and heel of the foot.

Referee. The main official of a hockey match. May be assisted by goal judges, timekeeper, and/or scorekeeper.

Regulation time. The duration of a standard match. Composed of two eight-minute halves and a three-minute halftime.

Safety equipment. Essential at all times players are on wheels. Includes helmet and mouth protection for floor players; helmet, face mask, leg pads, goalie glove, mouth protection, and chest protection for goalies. Male players must also wear a protective cup. Optional equipment includes shin, knee, and elbow pads, end gloves for floor players, and/or shoulder pads for goalies.

Scorekeeper. Keeps a running score of the match and also notes times and nature of penalty cards issued.

Shoot-out. Another method of breaking ties existing after extra time. Each team is awarded penalty shots and the team that can score on the most of those five is declared the winner.

Softball hockey. A program designed and overseen by USAC/RS for those players who have exhausted their three years of Junior Olympic eligibility but who still wish to play Junior Olympic-style games.

Steward. An official, usually used only in larger tournaments, who handles check-in duties of the teams participating in the next match. Also monitors numbers, uniform requirements, and safety equipment.

Stick. Utilized to propel the ball in the desired direction. Official dimensions are 44.8 inches long of the short, curved-blade construction. The stick may be shortened for younger players.

Sudden death. The final method of tie-breaking, should the game still be deadlocked after the shoot-out. Teams alternate taking penalty shots until one team scores and the other team does not on successive shots.

Team. May be coed, all male, or all female, and is composed of between five and 12 players.

Time-out. Official stoppage of play. Each team is awarded one one-minute time-out per game. The referee may stop the clock at any time during the match.

Timekeeper. Maintains the clock and signals the referee at the end of the first and second halves. Also tracks penalty time and signals offending players when their penalty time is up.

Tournament scoring. Used to determine which teams move out of pool play (preliminary) games into the final (elimination) rounds. Team will play all other teams in a given group or pool. Their performance is awarded tournament scoring points as follows:

Win = 3 points

Draw = 1 point

Lose = 0 points

Uniform. The respective outfits of the two teams. Must match in design and color, except for the goalies, who must wear colors different from those of the floor players. Includes shirt, shorts, and, if desired, socks.

Warning. The first stage of on-court disciplinary action. Signified by a yellow card.

RESOURCES

Officially recognized by the United States Olympic Committee as the national governing body for American roller sports, the Amateur Confederation of Roller Skating (USAC/RS) (4730 South St., Lincoln, NE 68506; telephone 402-483-7551) is an excellent resource for equipment, area teams, rules interpretations, and competitions. The USAC/RS hosts regional and national championships in Junior Olympic and softball hockey every summer. It also offers the following materials:

Ball Roller Hockey. This features the most up-to-date rules and rules changes, competitive age divisions, court diagrams, and equipment specifications.

Roller Hockey: A Game of Skills. This technical manual was written by Bob Hemhill, three-time coach for the roller hockey Team USA. It details the importance of each skill area—passing, shooting, ball handling, and defense. It provides pointers on technique and form and contains almost 80 drills in these areas. It also includes a training schedule and diagrams.

Coaching Roller Hockey. This technical manual takes the beginning coach through all steps of the game, including skating, offensive and defensive formations, strategy, and more. Excellent for the first-timer.

Junior Olympic Hockey videotape. Take your program from square one to No. 1 with this informative and entertaining one-hour videotape. *Junior Olympic Hockey* is an excellent way to take a group of beginners and mold them into a team. It is hosted by Charlie Kirchner, five-time gold medal coach, Junior Olympic National Championships.

1991 World Hockey Championships videotape. Want to see how the big boys play? This high-quality videocassette was professionally filmed at the 1991 World Hockey Championships in Porto, Portugal, and features Team USA at its finest. Witness the heartbreaking double-overtime loss to Argentina, the triumph over Germany, and the title game between 13-time world champion Portugal and underdog Holland.

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SHOOTING SPORTS

BACKGROUND



Shooting has a long history as a sport. Illustrations found on ancient Egyptian tombs show target-shooting activity and lessons in bow and arrow shooting.

Shooting clubs were first organized among the Germans in the 12th century. They competed with crossbows in one-shot competitions using specially painted wooden targets. Gunpowder, discovered in Asia and brought to Europe in the 1100s, brought about the replacement of the crossbow with the firearm. By the 16th century, firearms with rifled barrels were being used in shooting competitions.

Organized shooting got its start in America when frontiersmen came together to “shoot at a mark” (the origin of the modern term “marksman”), which was usually an “X” carved on a slab of wood. Pennsylvania and Kentucky flintlock rifles were usually the guns of choice in these activities. Today, shooting sports remain a popular recreational activity in America. Approximately 70 million adults own firearms, with nearly half of all United States households containing at least one firearm. Tens of thousands of competitors participate in matches from neighborhood-level competitions to the Olympic Games. In fact, shooting is the third most popular Olympic sport, behind only track and field and boxing in the number of nations participating.

The Shooting Sports chapter includes sections on gun safety and gun care, equipment, rifle shooting, shotgun shooting, and other shooting opportunities. Many American households have guns. This chapter will teach team members to respect the deadly nature of firearms while introducing them to the fun and excitement of shooting sports.

WHY PARTICIPATE IN SHOOTING?

Shooting is a skill sport. Every sport tests different athletic abilities. Sports such as running, swimming, and cross-country skiing test speed and endurance. Weight lifting and the shot put test strength. Other sports, like figure skating, diving, gymnastics, and shooting, test coordination and how well a special movement or skill is performed.

Shooting tests how well you can control your mind and body in using a firearm to hit a target. It’s hard to imagine being able to control yourself so well that you can almost always hit a target the size of a dime half a football field away—but in shooting, that is just what you can learn to do.

Shooting is a participation sport. In shooting, no one has to sit on the sidelines and watch; everyone can take part. This is important since sports are more fun when people can actually participate instead of just watching others. Those with physical handicaps can also take part in shooting, usually alongside other shooters in regular matches.

Shooting is a sport with many rewards. Participating in shooting can teach many skills that are valuable in other aspects of life. For example, learning to be a safe shooter teaches responsibility. Learning to hit a difficult target teaches self-discipline and self-control. Learning to hold a firearm steady and hit a target teaches concentration. Knowing that you are ultimately the one responsible for your shooting performance teaches self-reliance and enhances individual self-esteem.

Shooting is a safe sport. Injuries are so rare in target shooting that accident records are not even kept. Shooting is safe because it has a strict code of safety that all shooters follow.

Shooting is a lifetime sport. People of all ages participate successfully in shooting. Children as young as 8 or 9 can learn to shoot using lightweight BB guns. And many senior citizens enjoy shooting activities, whether they are competitive or recreational.

Shooting is an exciting sport. Hitting a target and then trying to improve on that last shot is thrilling. It’s fun to see your abilities advance. Every shot you fire is a rehearsal for what will someday be the last shot on the best round you’ve ever fired, or perhaps even the last shot of a world record score. Welcome to the world of recreational shooting!

PROGRAM FIELDS OF EMPHASIS

The following ideas will help you plan a well-rounded program. Program managers carry out these ideas with help from a team committee member.

ADVANCEMENT

- Review each Varsity Scout’s advancement status.
- Conduct Rifle Shooting and Shotgun Shooting merit badge clinics.
- Monitor the team advancement chart.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team's annual special high-adventure event (Philmont, Florida Sea Base, etc.).

PERSONAL DEVELOPMENT

- Learn about the laws covering firearm ownership in your community.
- Conduct a hunter's safety course for team members.

SERVICE

- Carry out a service project in conjunction with your local police or sheriff's department.
- Assist your local fish and game agency with a restocking project.
- Encourage each team member to carry out an individual service project at home in addition to regular chores.

SPECIAL PROGRAMS AND EVENTS

- Visit a shooting range and learn how it operates.
- Invite a member of the National Rifle Association to visit and give a presentation.

SHOOTING EQUIPMENT

RIFLE PARTS AND HOW THEY WORK

Many rifles may look similar at first glance. However, they come in many variations and are surprisingly versatile. They also come with a vocabulary all their own, which you must learn to understand how a rifle works.

A rifle can be divided into three major parts or "assembly groups." The **stock** is the handle by which the rifle is held. The **barrel** is the metal tube through which the projectile (bullet) passes when the rifle is fired. And the **action** is the segment of the rifle containing the moving parts that load, fire, and unload the rifle. Let's look at each of these major parts.

THE STOCK

Stocks are designed to give the shooter comfort, ease of handling, and maximum shooting accuracy. Most stocks are still made of traditional wood; however, many modern stocks are made of fiberglass or other synthetic materials. The "fit" of the stock to the shooter is an important consideration in shooting.

THE BARREL

There is more to this simple-looking tube than meets the eye. The barrel has several different parts, and each has a specific job to do for the projectile to travel accurately to the target.

The hollow inside the barrel—the hole through which the bullet passes—is called the **bore**. The bore's diameter is measured in thousandths of an inch or in millimeters. The resulting number is called the caliber of the rifle. The wider the diameter of the bore, the larger the caliber and, therefore, the larger the size of the bullet it will accommodate.

The rear of the barrel is called the **breech**. The opening through which the bullet leaves the barrel is called the **muzzle**.

The **chamber** is located at the breech end of the barrel. That is the portion of the barrel into which a **round** of ammunition (cartridge) is placed for firing. Chambers are shaped identically to the proper ammunition. If you are using the correct ammunition (and this is extremely important), the fit of the cartridge into the chamber should be perfect, not tight or loose.

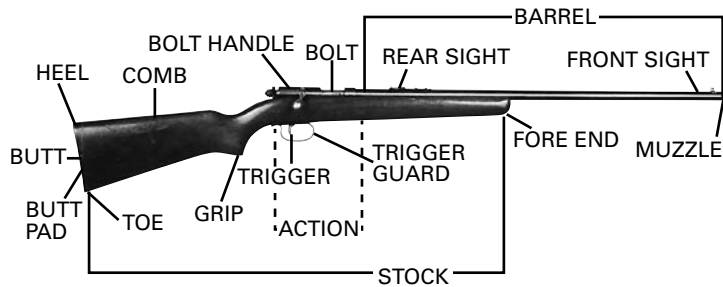
For its remaining length, the bore of the barrel is lined with a series of spiral **grooves**. The flat, raised ridges of metal standing between the grooves are called **lands**. When a bullet passes through the barrel, the lands cut into the bullet and cause it to spin. This spinning action makes the bullet more stable and accurate in its flight toward the target, just as spinning makes a toy top or thrown football stable. Together, the lands and grooves inside the barrel are known as **rifling**, which is how the rifle got its name.

THE ACTION

The action allows the shooter to load, shoot, and unload the rifle. Several different designs or types of actions have been developed to accomplish these purposes.

Loading is achieved by first opening the action, which allows you to place a cartridge in the chamber. With the cartridge in place, the **bolt** or **breech block** is closed. In most rifles, merely opening and closing the action cocks the firing pin, thus readying the rifle for firing. However, some rifles must be cocked separately.

Firing takes place when you pull the **trigger**. This allows a powerful spring to drive the **firing pin** forward to strike the primer and fire the cartridge. When you reopen the action after firing, the used cartridge case is usually ejected so that a new one can be loaded and fired.



Rifle parts

In addition, many rifle actions have two other features that add to the convenience and safe handling of the rifle—the **magazine** and the **safety**.

The magazine (often incorrectly called a “clip”) is a container attached to the rifle into which multiple cartridges can be placed. While most rifles can be loaded manually, using one cartridge at a time, many use a magazine to speed up loading and reloading. No rifle chamber can accommodate more than one cartridge at a time, but the magazine makes it possible to load a new cartridge into the chamber after each shot without doing so by hand. When the action is opened and closed, a new cartridge is automatically pushed from the magazine into the chamber. The rifle may then be fired repeatedly until the magazine is empty. The two most common magazines are the “box type,” located inside the bottom portion of the action, and the “tube type,” located under the barrel or in the stock.

The safety is a mechanical device. When activated or placed in the “on” position, it is designed to block the operation of the firing pin, thus preventing the rifle from firing. To fire, the safety is placed in the “off” position. Remember, the safety is mechanical and therefore subject to malfunction. **NEVER** depend on the safety as a substitute for following the safety rules. **Nothing takes the place of always pointing the gun in a safe direction.** At best, a mechanical safety is only extra insurance. **YOU** are the best safety.

TYPES OF ACTIONS

There are four popular types of cartridge rifle actions. To give a general idea of how these actions operate, the following list describes the loading and unloading procedures for these more common designs. It should be noted that there are many operational variations for these basic types, as well as other types of action designs. Therefore, it is still your responsibility to thoroughly study and understand the operation of the particular rifle you will be using before attempting to use it.

Bolt. The bolt-action rifle operates on a lift, pull, and push sequence similar to a door bolt. The bolt action is probably the most common type of action.



To Load Box Magazine (nonremovable)

- 1.** Open the action by lifting the bolt handle up and to the rear.
- 2.** Lay the cartridge in the open action and press downward into the magazine. Repeat the process to load additional cartridges.
- 3.** Push the bolt handle forward and down, pushing the cartridge into the chamber and locking the action.

To Unload

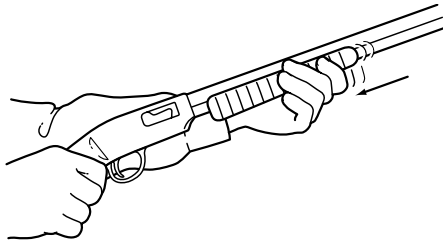
- 1.** Open the action, ejecting the cartridge from the chamber.
- 2.** a. Actions with releasable floor plates:
 - (1) Release the floor plate latch to open the magazine.
 - (2) Catch the falling cartridges in your hand.
 - (3) Return the floor plate to the locked position.
 b. Actions with nonremovable floor plates: Continue to open and close the action, working each cartridge through it until the rifle is empty.
- 3.** Visually check the chamber and the magazine to be sure the gun is completely unloaded.

To Load Box Magazine (removable)

- 1.** Open the action and press the magazine release.
- 2.** Remove the magazine from the rifle.
- 3.** Load the magazine with cartridges.
- 4.** Return the loaded magazine to the rifle.
- 5.** Close the bolt, loading the cartridge into the chamber.

To Unload

- 1.** Remove the magazine from the rifle.
- 2.** Open the action, ejecting the cartridge from the chamber.
- 3.** Remove the cartridges from the magazine.
- 4.** Visually check to be sure the rifle is unloaded.



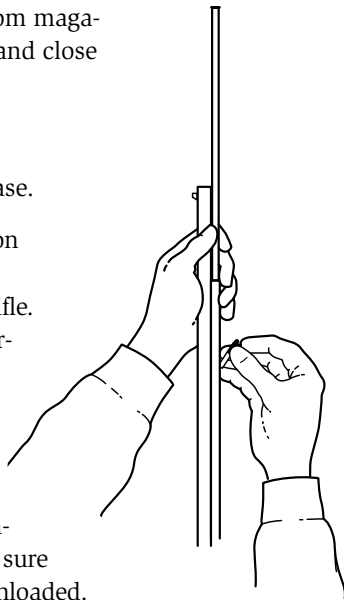
Pump. On pump- or slide-action rifles, the forearm of the stock is pumped back and forth to open and close the action.

To Load One Type of Tube Magazine

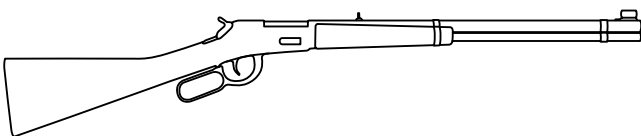
1. Open the action by pressing the action release and pulling the forearm to the rear.
2. To open the magazine, pull the plunger past the magazine cartridge opening.
3. Place the cartridges in the magazine opening, letting them slide down the magazine tube.
4. Return the plunger tube to its original position and lock in place; push the forearm forward to close the action.
5. To feed the cartridge from magazine to chamber, open and close the action.

To Unload

1. Depress the action release.
2. Open and close the action until no cartridges are being ejected from the rifle. Count the number of cartridges or empty cases to be sure they equal the number loaded.
3. With the action open, visually check the chamber and magazine to be sure the rifle is completely unloaded.



Lever. The action on a lever-action rifle is



opened by pulling the cocking lever downward and forward away from the stock. It is closed by simply returning the lever back to its original position. Lever-action rifles, like pump-action rifles, also allow the rapid reloading of additional cartridges.

To Load

1. Load cartridges into the magazine through the loading port on the side of the action.
2. Open and close the action, feeding a cartridge from the magazine into the chamber.

To Unload

1. Open and close the action by lowering and raising the lever until no cartridges are being ejected from the rifle. Count the number of cartridges or empty cases to be sure they equal the number loaded.
2. With the action open, visually check the chamber and magazine to be sure the gun is completely unloaded.



Semi-automatic. These actions are sometimes appropriately called *auto-loaders*. Each time a semi-automatic rifle is fired, the cartridge provides the energy to operate the action.

To Load

1. Pull the bolt open and lock.
2. Remove the magazine and load.
3. Return the loaded magazine to the rifle.
4. Close the action to load the cartridge in the chamber.

To Unload

1. Remove the magazine from the rifle.
2. Open the action, ejecting the cartridge from the chamber, and lock the action open.
3. With the action open, visually check the chamber and magazine to be sure the rifle is unloaded.

Some semi-automatic rifles do not have a system for locking the action open. In this situation, a wood block should be placed in the action to show that the rifle is unloaded and clear.

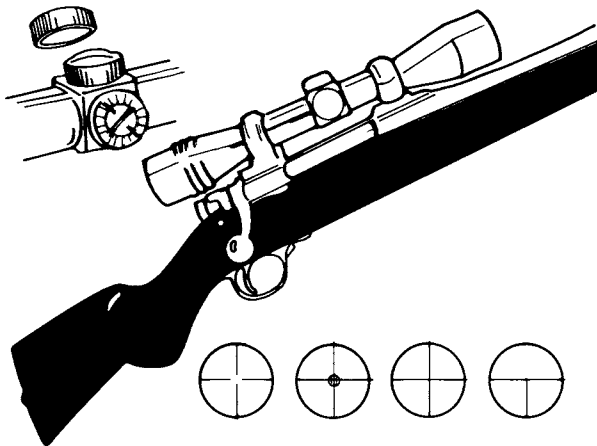
SIGHTS

Sights enable you to aim the rifle. Although there are many different types of sights, they generally fall into three categories: **optical sights**, **open sights**, and **aperture sights**.

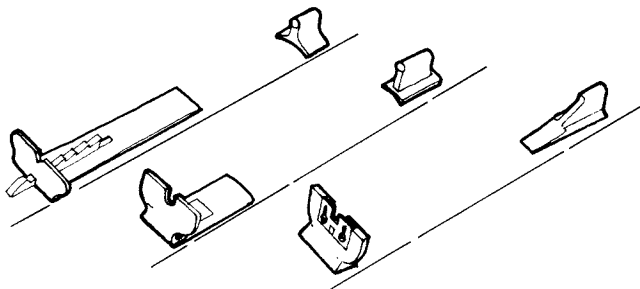
Optical sights are small telescopes, mounted atop the barrel or action. They are a good sight for new shooters because they are simple to use. Optical sights have a

reticle (crosshairs or a dot) that acts as an aiming point and is aligned with the target. Optical sights give the shooter an advantage because they make it possible to see both the sight and the target in clear focus. Optical sights also magnify the target and make it possible to aim more precisely. Two types of scopes are available—“fixed” magnification and “variable” (adjustable) magnification. Scope mounts are used to attach optical sights to rifles. It’s important that they be of the right design and size for the rifle and scope. Mounting screws must be tight to ensure consistent accuracy.

Open sights are standard equipment on most factory-made rifles. They include an open rear sight (a notch or V), located near the breech end of the barrel, and a front sight (a post or bead), located near the muzzle. To aim, the shooter aligns the front sight in the center of the rear notch (left to right) and aligns the top of the front sight with the top of the rear notch and then aims the aligned sights at the target.



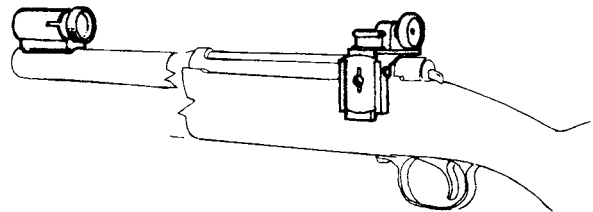
Pictured above are some of the more common reticles used in optical sights. Left to right: duplex, dot, crosshair, and post. Choice is largely a matter of personal preference. The reticle can be easily adjusted by turning the adjustment knobs on the scope in the direction you wish to move your shots on the target.



Open sights are available in a variety of adjustable and fixed designs.

Aperture sights are usually mounted on the rear part of the rifle action and are often called “peep” sights because they have a small hole in the rear sight that you look through when aiming. When using this type of sight, simply align the front sight in the center of the rear sight opening. When the eye looks through a small opening, it is naturally drawn to the center of the opening where the light is brightest. These sights make aligning the sights much easier and more precise than with open sights, but they are not as fast or easy to use when shots must be fired very quickly.

Aperture rear sights, scopes, and some open sights can be precisely adjusted without special tools. Sight adjustment is absolutely essential because it enables you to get your shots to hit the target exactly where your sights are aimed. Generally, you can make both elevation (up or down) and windage (right or left) adjustments. The standard rule when adjusting sights or scopes is to **move the rear sight in the same direction you want to move the location of the shot on the target.**



Aperture sights are popular with target shooters because they are easily adjusted.

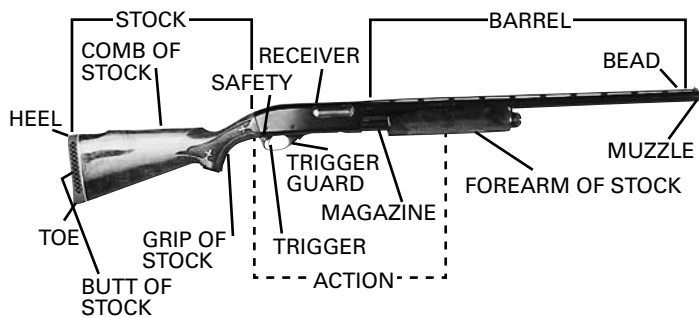
SHOTGUN PARTS AND HOW THEY WORK

As with the rifle, knowing the shotgun you will use is the first step to knowing how to shoot well. Let’s begin with a simple definition. The shotgun differs from other firearms in that it fires a number of projectiles, called **shot**, instead of a single projectile. Once they are expelled from the gun, these projectiles begin spreading out. The impact area covered by the shotgun’s **pattern**, then, is considerably larger than the hole cut by a single bullet fired from a rifle. Consequently, shotguns are generally the firearms of choice in shooting a moving target.

Also like the rifle, a shotgun is composed of three main assembly groups: **stock**, **barrel**, and **action**.

THE STOCK

The stock serves as the handle of the shotgun. Its size and shape have a special significance in proper shooting. It is carefully designed to allow the shooter to point and shoot the shotgun accurately.



Shotgun Parts

THE BARREL

The barrel is the metal tube through which the shot travels on the way to the target. The inside portion of the barrel is called the **bore**. The diameter of the bore will vary, depending on the design and intended use of the gun. Most shotgun bore measurements are designated by a term known as **gauge**, rather than caliber, as is the case with rifles. The smaller the gauge number, the larger the bore size.

Starting with the largest bore, modern shotguns are available in 10, 12, 20, and 28 gauge. The exception to the gauge measuring system is the .410-**bore** shotgun (often inaccurately referred to as the .410-gauge shotgun); it is actually a 67-gauge shotgun. The bore of this smallest of modern shotguns is measured in thousandths of an inch, just as are rifles and pistols.

Modern shotguns are loaded at the rear (or **breech**) end of the barrel by the insertion of a round of ammunition known as a **shot shell**. Like the rifle, this is loaded into the **chamber**, and the shot exits the barrel through the **muzzle**.

Most shotguns have a narrowed area of the bore near the muzzle called the **choke**. Since shot begins to spread out immediately upon exiting the muzzle, the more concentrated the shot is at the time it is expelled, the further it will travel as a compact group. The degree of this initial concentration is determined by the extent of the choke. The greater the choke, the greater the narrowing, and generally, the greater the effective range of the gun's shot pattern.

A **full-choke** shotgun barrel has the most narrowing and the greatest effective range. At close range, however, a full-choke shot pattern may be too small to hit moving targets consistently. A **modified-choke** shotgun offers a somewhat less narrow pattern, while an **improved-cylinder-choke** shotgun provides still less, in each case

trading an increasingly larger pattern for a decreasing effective range. Shotgun barrels that have no choke at all are referred to as **cylinder bore**. Generally, choke designations are indicated on the outside of the barrel. Most modern shotguns are equipped with screw-in chokes at the muzzle. Most of these can accommodate steel shot.

THE ACTION

Shotgun actions function in exactly the same manner as rifle actions of the same design. The hinge-type action is found far more frequently in shotguns than in rifles, while the bolt-type action very common in rifles is rarely found in modern shotguns.

TYPES OF ACTIONS

Pump. The actions of pump-action shotguns are opened and closed by “pumping” the forearm of the stock back and forth. Pump actions are sometimes called “slide” actions.

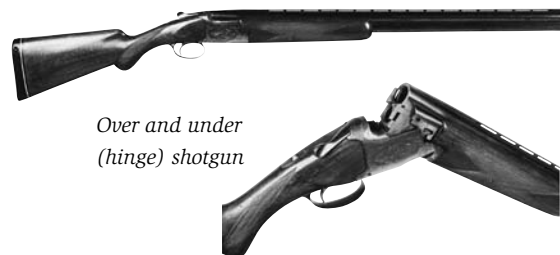
Hinge. Similar to the movement of a door hinge, the hinge action can be opened when the release lever is pushed to one side. This separates the standing breech block from the barrel. Many shotguns of this type have two barrels and, based on placement, are referred to as either “over and under” or “side by side.” They can also come with just one barrel; these are generally referred to as “single barrel.”

Semi-automatic. This type of action is also appropriately known as **auto-loading**. When a shot is fired, gas from the burning gunpowder provides the energy needed to operate the action and load the next shell. This type of action delivers less recoil to the shooter.

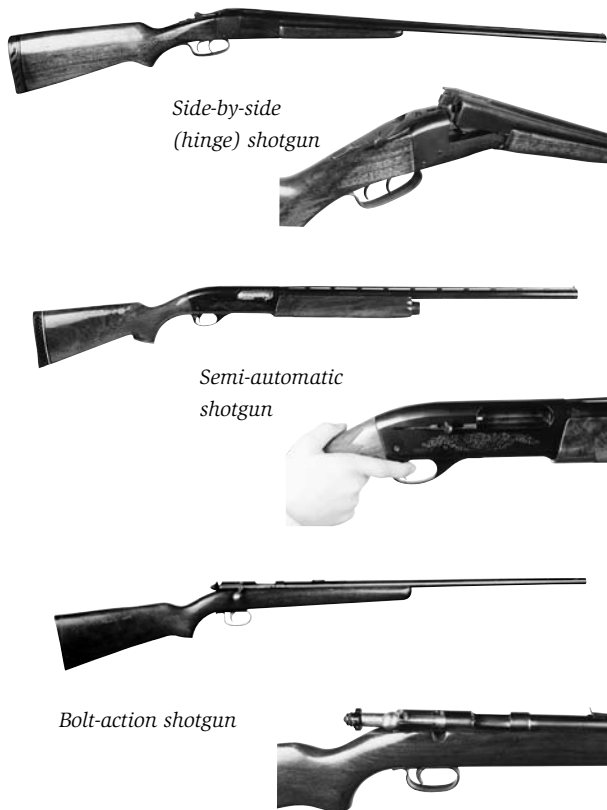
Bolt. A bolt-action shotgun operates in the same lift, pull, and push sequence used in operating a common door bolt. It even looks like one.



Pump-action shotgun



*Over and under
(hinge) shotgun*



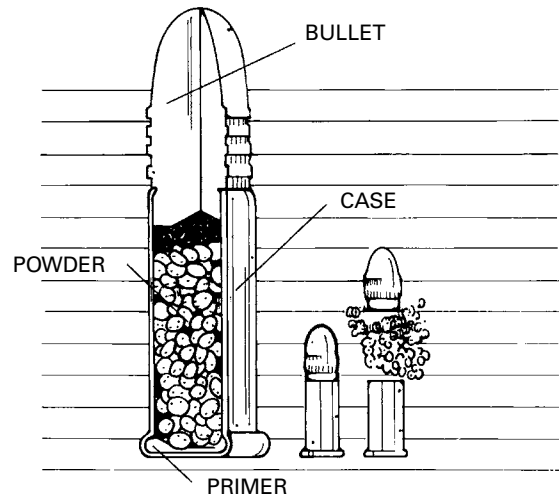
SIGHTS

Unlike most other modern firearms, the wide spread of the shotgun's pattern means that the sighting mechanism can be very simple. One or two **beads** are positioned on the top of the barrel to help the shooter point at the target. Some shotguns also have a flat **rib** running the length of the barrel to help reduce distortions in the sight picture caused by reflections off the barrel's curved upper surface, or resulting from the heat rising from a barrel that has been warmed by repeated firing.

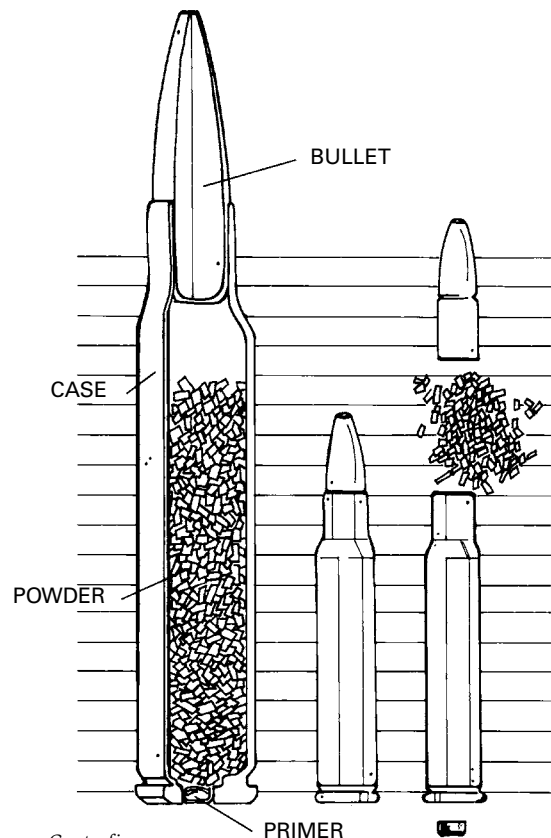
RIFLE AND SHOTGUN AMMUNITION

The types of ammunition available for rifles and shotguns today are as diverse as the types of guns themselves. However, all modern ammunition is made up of just four basic parts: case, primer, powder charge, and projectile. Together they form a rifle **cartridge** or a shotgun **shot shell**.

Modern firearms depend on the burning of gunpowder within the case to produce the extremely high gas pressure that propels the projectile through the barrel and onto the target.



Rimfire



Centerfire

AMMUNITION PARTS AND FUNCTION

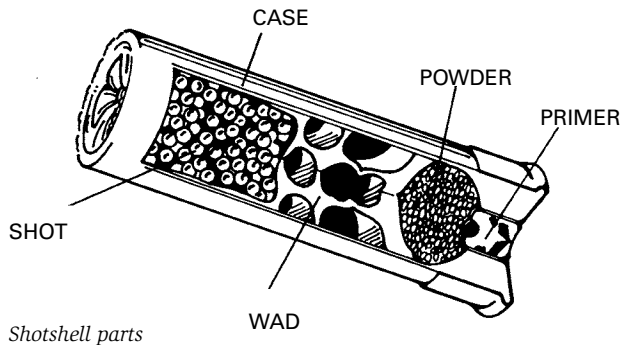
The case. The case is the container into which the other ammunition parts are assembled. Rifle cases are typically made of brass. There are two basic types of cases in use today: **rimfire** and **centerfire**. The difference between the two is the location of the primer. Shot shells, which are exposed to much lower pressures, are generally made of plastic or paper with a metal (usually brass) base.

The primer compound. The primer compound is an explosive chemical mixture that detonates when hit by the firing pin. This explosion ignites the powder charge. The mechanics of firing are the same whether the ammunition used is rimfire or centerfire.

In rimfire ammunition, the priming chemical is contained inside the hollow rim at the base of the cartridge case. The rim is soft enough that when the firing pin strikes, it crushes the priming compound, causing the primer to detonate and ignite the powder charge. Today, this ammunition is used only in .22-caliber rifles and handguns.

In centerfire ammunition, the primer is contained in a separate soft metal cup located in the center of the base of the cartridge or shot shell. The firing pin strikes the primer and the resulting indentation sets off the ignition process. This type of primer arrangement is used in high-power rifle and handgun ammunition, which requires stronger cases, and in all modern shotgun ammunition.

The powder charge. The powder charge is a chemical compound that is designed to burn rapidly and produce a high volume of gas. Modern smokeless gunpowder is a combustible solid, not an explosive. When ignited by the primer's flame, the rapidly expanding powder gases escape through the bore, providing the force needed to propel the projectile through the bore and out the muzzle.



The projectile. The **bullet** is a projectile shot from a rifle; the **shot** and the **wad** are the projectiles shot from a shotgun. Bullets are manufactured of lead and may also have a **jacket** of a harder metal such as copper. Shot are small, round projectiles, usually made of lead or steel. The wad in a shot shell serves only to create an airtight seal between the loose shot and the expanding powder gases to get the shot charge out of the muzzle. Once the shot exits the muzzle, the wad falls to the ground.

Like rifle bores, bullets are measured in thousandths of an inch, and their caliber must match that of the barrel in which they are fired, or an extremely unsafe

condition can result. Shot size is designated by a number system, with the lower numbers representing the larger shot size. A single shot shell may contain from 9 to 700 individual shot.

YOUR DOMINANT EYE

One other item of “equipment” is important to your shooting success: YOU! How do you know on which side to shoulder the gun? The answer isn’t as obvious as it may seem. Just because you may be right-handed doesn’t mean that your right side is necessarily the best for firing. The real test is whether your right or left eye is dominant.

Most people have one eye that is more dominant than the other. That means that the dominant eye exercises greater “control” over what the eyes transfer to the brain. Your shooting will be more successful if you harness the power of your dominant eye, even if it turns out to be the one opposite your primary hand.

How do you determine which eye is dominant? Take this easy test:

1. Extend your hands in front of your face, placing them together so that only a small opening remains between them. Now look through this space, focusing on some distant object.
2. While maintaining your focus, keep both eyes open and slowly move your hands closer to your face. Continue this motion until your hands reach your face.



At this point, you will have instinctively lined up the opening in your hands with a single eye. That’s your dominant eye! Now that you know this, you can learn and practice the fundamentals of shooting.

RIFLE SHOOTING

THE FUNDAMENTALS OF RIFLE SHOOTING

Learning to shoot a rifle is much the same as being introduced to any other skill. To shoot a rifle accurately, you must first learn and master the basic skills or fundamentals of rifle shooting. There are five fundamentals:

1. Shooting position
2. Shot preparation
3. Sight picture control
4. Trigger control
5. Follow-through

SHOOTING POSITION

The shooting position is simply the posture of the body and rifle during the act of shooting. There are several positions and position variations that are used in rifle shooting. A knowledgeable rifle shooter should know five basic rifle shooting positions: bench rest, standing, prone, kneeling, and sitting.

Even though the position of the body can vary greatly, the position of the rifle basically remains the same.

Each position is best suited for certain conditions. The position you choose depends on the kind of shooting, terrain, shooting time, and target difficulty. In addition, the traditions and rules of the sport have greatly influenced the established positions and when they are used.

The importance of building rifle shooting skill on a foundation of good positions cannot be overemphasized. The position must give you a solid, steady hold on the target. A good shooting position involves the position of the body and the position of the rifle.

The **position of the body** is the arrangement of the head, torso, arms, and legs, and their relationship to the target. Positioning the body is the first step in assuming every shooting position. Three conditions are essential for a good position. First, you must be comfortable, relaxed, and balanced. This means getting as *natural a body position* as possible without straining your muscles. Second, the position must provide *maximum bone support*. Use bones and not muscles to support the body and rifle. Third, your position must be *aligned with the target*. If the preceding conditions are met, the rifle will settle into a natural point of aim. The whole position must then be adjusted to align that natural point of aim on the target. Never muscle the rifle onto the target.

The **position of the rifle** involves the proper positioning of the rifle to the body. The rifle must be positioned against the shoulder so that you can look through the sights with your dominant eye comfortably and naturally. Alignment with the eye is essential to proper rifle position.

Correct hand and index finger placement on the rifle grip and trigger is a must to correctly hold the rifle and pull the trigger. Grasp the grip of the stock firmly with the lower three fingers, lightly resting the thumb on the top of the stock. Place the hand so that the index finger can pull the trigger straight to the rear.

For a right-eye-dominant shooter, the fore-end should rest in the left hand. It is best not to grip or squeeze the fore-end. However, with more powerful calibers it may be necessary to grip the fore-end to maintain control when firing.

Note: All position descriptions and photos in this chapter are for right-handed shooters unless designated otherwise. Shooters who shoot from the left shoulder (left-handed) will need to reverse position information.

SHOT PREPARATION

Once in position, two actions are necessary to prepare to fire a shot. These are aiming and breath control.

AIMING

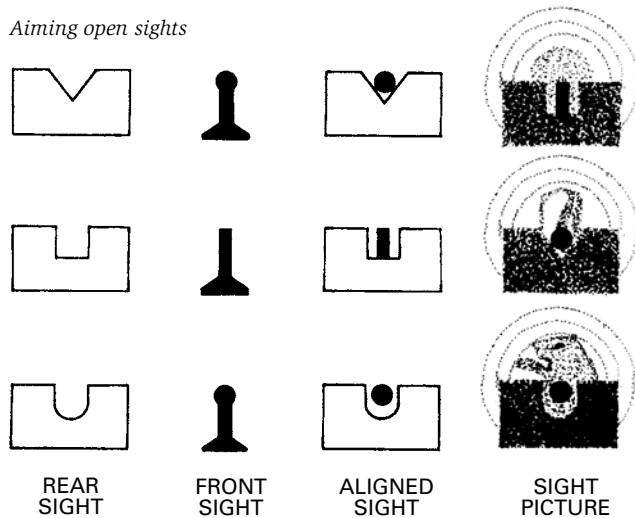
Simply stated, aiming is the process of lining up the rifle with the target. It involves the alignment of the eye, the rear sight, the front sight (or scope), and the target. Aiming is done in two steps: sight alignment and sight picture. The most critical step in rifle shooting is sight alignment, the first step.

Sight alignment is the relationship between the eye, the rear sight, and the front sight or scope. Consistent and proper sight alignment is necessary for accurate aiming. When using open sights with a post or bead front sight, you have correct sight alignment when the front sight is centered in the rear sight notch and the top of the front sight is even with the top of the rear sight. With aperture or peep sights, correct sight alignment is achieved when the front sight ring or the top of the front sight post is centered in the rear sight aperture. When using a telescopic sight, you achieve proper sight alignment by positioning your eye so that you can clearly see the entire field of view when looking through the scope.

Sight picture is the relationship between the aligned sights or scope and the target. Sight picture will vary according to the type of sights you are using and the kind of target you are shooting. An aligned bead front sight should be aimed at the center of the target.

The post front sight is centered on the target bull's-eye. The target should be centered inside an aligned front sight ring. A scope reticle is simply centered on the target.

Aiming open sights



BREATH CONTROL

This means stopping your breathing before you fire a shot. Breathing causes your body to move. That's fine, unless you happen to be ready to fire a shot. Continuing to breathe makes it impossible to get a steady sight picture. Before firing the shot, be sure you are relaxed and comfortable. Then simply stop breathing. This will assist you in aiming by reducing the movement of your body and rifle in relation to the target. Generally, you should hold your breath no longer than six to eight seconds. If you are not able to fire the shot within this time, simply take a breath or two, relax, and start the process again.

SIGHT PICTURE CONTROL

Sight picture control is attempting to keep the aligned sights or scope reticle aimed as close as possible on the center of the target. It is the most important period in the firing of a shot. Even though a proper and relaxed position has been assumed and breathing interrupted, you will still notice movement in the sight picture. This movement is natural; it is only with a support, such as a bench rest, that a shooter can come close to eliminating it completely. However, movement can be controlled and reduced by concentrating on achieving the proper sight picture and holding as still as possible. **Learn to concentrate totally and consistently on sight picture control when firing.**

Controlling movement in the sight picture is not something you can learn in one or two shooting sessions. All other fundamentals of shooting can be learned in a fairly short time, but sight picture control is practiced by champion shooters for years without achieving perfection. Absolute perfection may not be possible. However, beginning shooters will notice rapid improvement in their sight picture if they concentrate on achieving good sight picture control and practice regularly.

TRIGGER CONTROL

Once you have your best sight picture, slowly pull the trigger straight back in a smooth, controlled motion until the rifle fires. This process is referred to as *trigger control*. The key is to pull the trigger so smoothly that it does not disturb your sight picture. Initially, you may not be able to cause the rifle to fire when the sight picture is best. With practice, however, as you become familiar with the rifle's trigger, you will be able to fire the rifle when the sight picture is right. Remember that during this firing process you must continue to concentrate on sight picture control.

FOLLOW-THROUGH

Follow-through is the act of continuing to maintain breath control, sight picture control, and trigger control immediately following the shot. Allow enough time for the rifle to return to its normal position after the recoil. Follow-through reduces the possibility that any sudden movement during the split second after the shot is fired and before the bullet leaves the muzzle could disturb the sight picture and radically change the bullet's path.

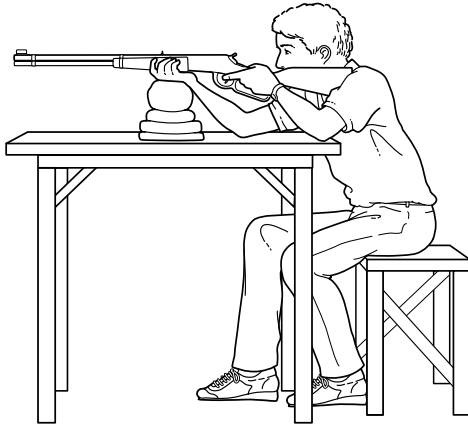
FIRING YOUR FIRST SHOTS

For those who have a choice, a .22-caliber rimfire rifle is probably the best cartridge rifle with which to learn the fundamentals. It has light recoil and, when compared to a centerfire rifle, is inexpensive to shoot. It is also easier to find range facilities for the .22-caliber than for the larger calibers.

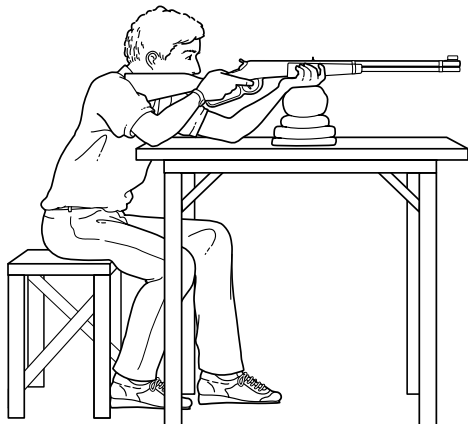
Paper targets are recommended for beginning shooters' practice. While other types of safe targets can and may be used for greater interest during shooting activities, paper practice targets let you see precisely where all your shots are striking. This is a must when learning the fundamentals of rifle shooting. Homemade targets can be easily created by merely drawing and coloring a circle (bull's-eye) on an ordinary piece of paper.

START FROM THE BENCH-REST POSITION

Now that you've been introduced to the fundamentals of rifle shooting, it's time to get started. Start shooting from a table in a bench-rest position. You'll need a sandbag or other solid support to place under the fore-end of the rifle. The support helps hold your rifle steady and enables you to concentrate on learning how to shoot a good shot. If a table or bench is not available, the sandbag/support should be placed on the ground and a supported prone position used.



Left-handed position



Right-handed position

There are four basic steps to follow when learning any shooting position. Use them to learn the bench-rest position.

- Step 1 **Study the position.** Learn what a good bench-rest position looks like by studying the pictures in this chapter.
- Step 2 **Practice the position without the rifle.** Learn to put your feet, legs, body, and arms in the correct position first by getting into position behind the table without the rifle. Practice this until you are comfortable with the position.

- Step 3 **Practice the position with the rifle.** Add the rifle to the position you have already assumed. Again, concentrate on becoming comfortable and familiar with the position.
- Step 4 **Align the position with the target.** Adjust the position so that the rifle points naturally at the target.

THE BENCH-REST POSITION

Position of the Body

1. Body sits behind the table, facing the target.
2. Both elbows rest on the table.
3. Rifle lies in the left hand, which is supported by a sandbag.
4. Right hand grasps the rifle grip.

Position of the Rifle

5. Butt of stock is positioned against shoulder so rifle sight is at eye level.

Getting into Position

Follow these steps to get into the bench-rest position:

1. Take a seat at the table facing the target.
2. Grasp the rifle grip with your right hand and position your elbows on the table.
3. Lay the rifle across your left hand and rest your hand on the sandbag.
4. Position the rifle against your face and shoulder so that your dominant eye can look through the sights comfortably and naturally.

Align Position With Target

1. Vertical adjustments can be made by adjusting the height of the sandbag support.
2. Horizontal adjustments can be made by moving the sandbag support either left or right on the table or by moving the body on the chair.

DRY FIRING

The best way to begin learning shooting fundamentals is with a dry run. A technique called *dry firing* is used to practice the fundamentals before actually using live ammunition. Dry firing consists of closing the rifle's action on an empty (unloaded) chamber, then practicing the steps involved in firing a shot as if the rifle were actually loaded. To do this, get into position with the rifle on the target, and make sure you are comfortable and relaxed. When you feel ready, begin aiming and control your breathing. Concentrate on reducing the movement of the sight picture. When it looks good, squeeze the trigger smoothly to the rear. After the shot "fires," follow through by continuing all of the fundamentals.

Dry fire several shots to get a feel for how much pressure is required to move the trigger smoothly without disturbing the sight picture. This requires total concentration on the sight picture at the moment of firing. Most rifles will sustain rear-chamber damage if dry fired without an empty brass case in the chamber.

LIVE FIRING

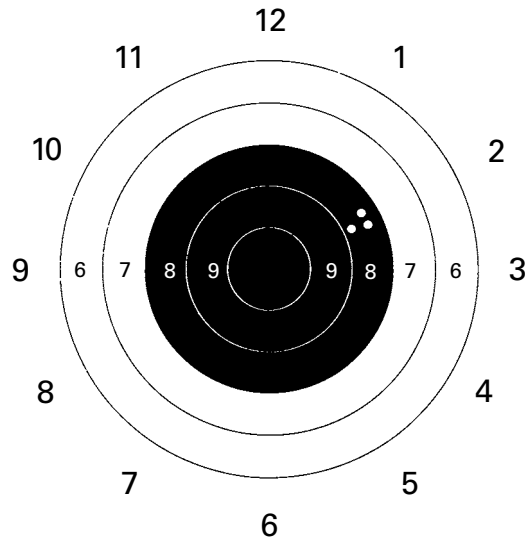
It's now time to fire live ammunition. Shoot three to five shots at the target. Be sure to apply the same fundamentals as applied during dry firing. If you've been consistent in applying the fundamentals correctly, your shots should form a cluster or shot group on the target. At this point don't worry about where the group is on the target. Your only concern now should be whether the shots fall together in a group. Shoot several groups. With practice, your groups should become smaller and smaller. If your shots are scattered all over the target, do more dry firing and review the fundamentals. Also, be sure your sight, scope blocks, or mounts are tight; any movement there can cause wild shots.

SIGHT ADJUSTMENT

Once you are shooting good groups with shots placed closely together, you are ready to adjust the sights to move the shot groups to the center of the target. This adjustment is made by moving the scope reticle or rear sight in the same direction you want the group to move. For example, if the group is high and left, move the scope reticle or rear sight down and to the right. Most adjustment knobs are marked to show which way the knob should be turned to move a shot group in a particular direction. The instructions with most sights will tell how far one "click" or gradation of sight adjustment should move a shot at a specific distance. This can vary depending on the quality and manufacturer of the scope or sights. Be sure to understand the system before

trying to adjust the sights. If the rifle does not have a click-type sight adjustment, check the manufacturer's manual for means of adjustment.

Test your calculation by firing another group. The goal is to have the center of the group in the center of the target. If you're still off, continue making adjustments until the group is in the center. Also remember that the scope or sights will likely need to be readjusted if you should shoot at a target at a different distance.



Shots on a target can be read according to the face of a clock. The shot group above is at 2 o'clock in the 8 ring.

RIFLE SHOOTING POSITIONS

As mentioned earlier, a number of positions may be used in rifle shooting. Once you have learned the fundamentals involved in firing a shot in the bench-rest position, it's time to move on to the other basic positions: standing, prone, kneeling, and sitting. Be sure to practice all safety rules and always point the muzzle in a safe direction in every shooting position. Remember the four steps you used to learn the bench-rest position. These steps should be followed in learning every shooting position.

Regardless of your shooting plans, it's important that you master all five of the standard firing positions. The steps may seem a bit complicated and, in some cases, even awkward at first. The awkwardness you experience at the beginning will help you monitor your development as a shooter. As you progress and your shooting improves, the positions will feel more natural. Your ultimate goal in getting good results from your shooting positions can be summed up in these words:

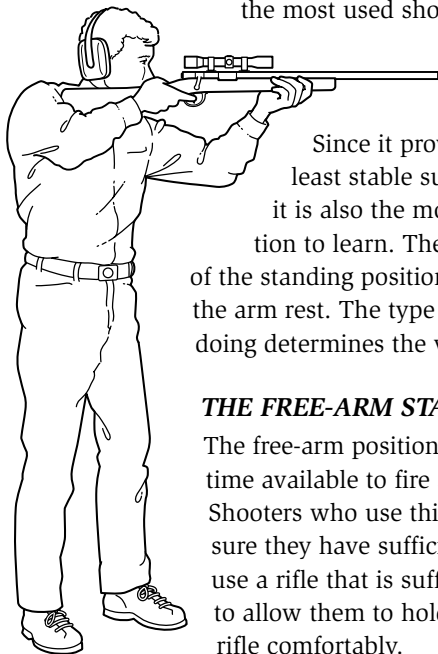
Practice = good shooting!

The steps for learning a position are:

1. Study the position.
2. Practice the position without a rifle.
3. Practice the position with a rifle.
4. Align the position with the target.

These steps are described for each of the following positions.

THE STANDING POSITION



Standing is probably the most natural and the most used shooting position. It is also the quickest and easiest position to assume. Since it provides the highest and least stable support for the rifle, it is also the most challenging position to learn. There are two variations of the standing position: the free arm and the arm rest. The type of shooting you are doing determines the variation you will use.

THE FREE-ARM STANDING POSITION

The free-arm position is used when the time available to fire a shot is very short. Shooters who use this position should be sure they have sufficient arm strength, or use a rifle that is sufficiently lightweight, to allow them to hold and control the rifle comfortably.

Position of the Body

1. Feet are shoulder-width apart.
2. Body weight is distributed equally on both feet.
3. Head and body are erect.
4. Left arm is free from body.
5. Left hand under fore-end supports weight of rifle.
6. Right hand grasps rifle grip.

Position of the Rifle

7. Butt of stock is positioned against shoulder so rifle sight is at eye level.

Getting Into Position

Follow these steps to get into the free-arm standing position:

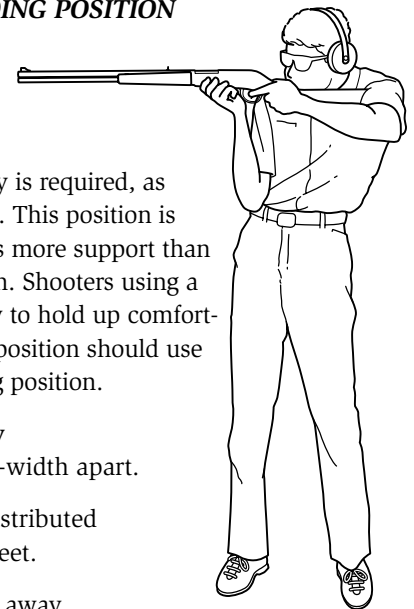
1. Holding the rifle in both hands, move to the firing point.
2. Turn your body to the right of the target.
3. Raise the rifle to eye level and position it against your shoulder.

Align Position with Target

1. Vertical adjustments can be made by simply lifting or lowering the rifle.
2. Horizontal adjustments are made by moving the feet.

ARM-REST STANDING POSITION

The arm-rest standing position is used when a higher degree of stability and accuracy is required, as in most target events. This position is steadier and provides more support than the free-arm variation. Shooters using a rifle that is too heavy to hold up comfortably in the free-arm position should use the arm-rest standing position.



Arm-rest standing position

Position of the Body

1. Feet are shoulder-width apart.
2. Body weight is distributed equally on both feet.
3. Body bends back away from rifle.
4. Head is erect.
5. Left arm rests on side or hip.
6. Left hand supports the rifle; wrist is straight.
7. Right hand grasps the rifle grip.

Position of the Rifle

8. Butt of stock is positioned against shoulder so rifle sight is at eye level.

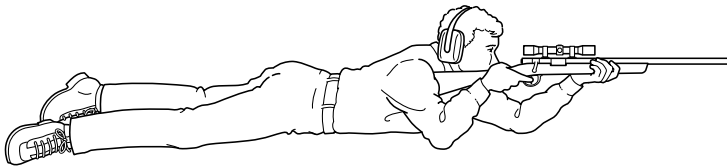
Getting Into Position

Follow these steps to get into the arm-rest standing position:

1. Hold the rifle in both hands and move to the firing point.
2. Stand sideways to the target.
3. Grasp the fore-end between the thumb and forefinger of your left hand with your wrist straight.
4. Raise the rifle to eye level and position it against your shoulder, resting your left arm against your body.

Align Position with Target

1. Vertical adjustments can be made by varying the position of the left arm against the body, on the hand under the forearm.
2. Horizontal adjustments can be made by moving the feet.



Prone position

THE PRONE POSITION

The prone position is the steadiest of the four positions described. Both elbows and the entire body are placed in contact with the ground, thus providing a large area of support.

Position of the Body

1. Body lies facing the target and angled slightly to the left.
2. Left elbow is extended forward of the body.
3. Right knee is bent slightly.
4. Rifle fore-end rests in the left hand.
5. Right hand grasps the rifle grip.

Position of the Rifle

6. Butt of stock is positioned against shoulder so rifle sight is at eye level.

Getting Into Position

Follow these steps to get into the prone position:

1. Holding the rifle in both hands, move to the firing point.
2. With the rifle in your left hand, lower yourself to your knees.
3. Lower your body to the floor (prone position).
4. Extend your left elbow forward.
5. Raise the rifle to eye level and position it against your shoulder.

Align Position With Target

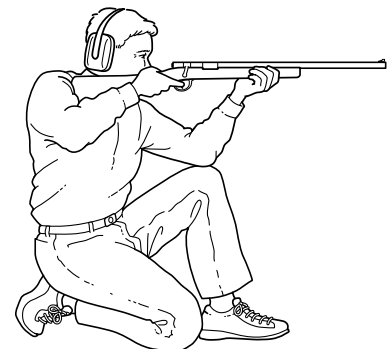
1. Vertical adjustments can be made by moving the left hand forward (lowers rifle) or to the rear (raises rifle) on the fore-end.
2. Horizontal adjustments can be made by rotating position left or right around the left elbow.

THE KNEELING POSITION

In addition to being an important target position, the kneeling position is particularly useful in the field. It is quick to assume, is steadier than standing, and provides the clearance necessary to shoot over terrain such as tall weeds or brush.

Position of the Body

1. Body sits on the heel of the right foot.
2. Lower left leg is vertical.
3. Left elbow rests on the left knee.
4. Rifle fore-end rests in the left hand.
5. Right hand grasps the rifle grip.



Kneeling position

Position of the Rifle

6. Butt of stock is positioned against shoulder so rifle sight is at eye level.

Getting Into Position

Follow these steps to get into the kneeling position:

1. Holding the rifle in both hands, move to the firing point.
2. Turn your body to the right of the target.

3. Drop down onto your right knee and sit on your right foot.
4. Adjust your left leg so that the lower left leg is vertical.
5. Place your left elbow on your left knee.
6. Raise the rifle to eye level and position it against your shoulder.

Align Position With Target

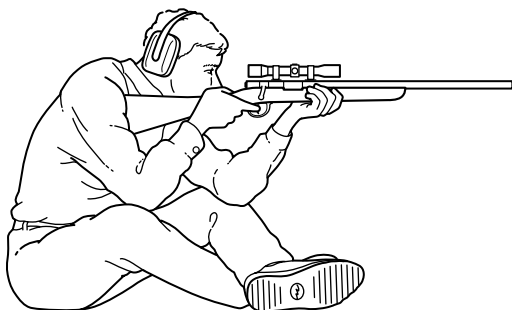
1. Vertical adjustments can be made by moving your left hand forward (lowers rifle) or to the rear (raises rifle) on the fore end.
2. Horizontal adjustments can be made by rotating the position left or right around the right foot.
In kneeling, most of your body weight should be on the right foot. You can place a tightly rolled strip of carpet, jacket, cylindrical cushion, or similar support (kneeling roll) under the right foot for additional support and comfort.

THE SITTING POSITION

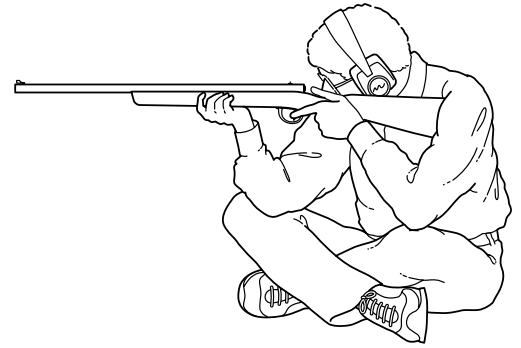
The sitting position is stable and it provides support for both elbows, which helps steady the rifle. Most shooters also find it a more comfortable and easier-to-assume position than the kneeling position.

Position of the Body

1. Body sits on the ground.
2. Legs are extended from the body, with ankles crossed.
3. Elbows rest on legs just in front of the knees.
4. Rifle fore-end rests in the left hand.
5. Right hand grasps the rifle grip.



Sitting position



Even though the position of the body can vary greatly, the position of the rifle basically remains the same.

Position of the Rifle

6. Butt of stock is positioned against shoulder so rifle sight is at eye level.

Getting Into Position

Follow these steps to get into the sitting position:

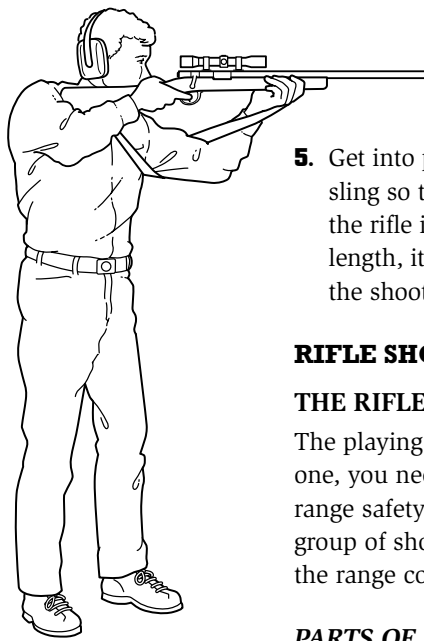
1. Holding the rifle in both hands, move to the firing point.
2. Turn your body to the right of the target.
3. With the rifle in your left hand, sit down.
4. Extend your legs (or pull your legs close to the body), crossing the left ankle over the right.
5. Place your elbows forward of your knees.
6. Raise the rifle to eye level and position it against your shoulder.

Align Position With Target

1. Vertical adjustments can be made by moving your left hand forward (lowers rifle) or to the rear (raises rifle) on the forearm.
2. Horizontal adjustments can be made by rotating the position left or right around the buttocks.

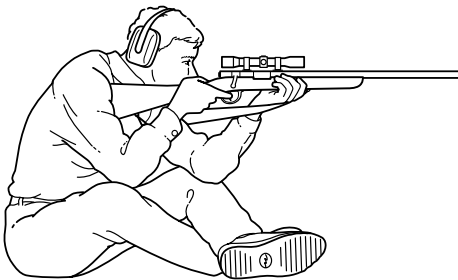
USING THE RIFLE SLING

When shooting, any type of rest supporting the rifle's forearm will aid the shooter greatly in the difficult task of holding the rifle steady. In the prone, sitting, and kneeling shooting positions, a sling is recommended to support the rifle, so the shooter won't have to rely on arm muscles. All formal target shooting in these positions is done with a sling to produce the highest possible stability and scores.



Hasty sling. Some rifles have a sling designed primarily to allow the rifle to be carried conveniently. If this carrying sling is used as a “hasty sling,” it can add some support to make the position steadier. As its name implies, it can be brought into position quickly. To use a sling in this manner:

1. Place your upper left arm between the sling and rifle.
2. Swing your hand and forearm in an outward, circular motion to wrap the arm around the sling and place your hand under the rifle's fore-end.
3. Bring the rifle to eye level and position it against your shoulder.



Loop sling. A second type of sling, called the “loop sling,” is commonly used in target shooting. It takes longer to put on but provides more support than the hasty sling. Here's how to use the loop sling:

1. Open the sling's loop.
2. Twist the loop clockwise, one-half turn.
3. Place the loop high on your left arm; then tighten the sling keeper to your arm.
4. Wrap your arm around the sling using a clockwise movement so that the sling comes across the back of your left hand and forearm.

5. Get into position with the sling loosened. Tighten the sling so that it, rather than your muscles, supports the rifle in position. (Once the sling is adjusted for length, it should not need to be readjusted each time the shooter gets into position.)

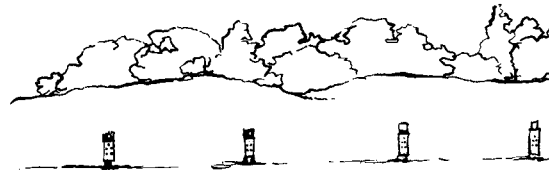
RIFLE SHOOTING ACTIVITIES

THE RIFLE RANGE

The playing field for shooting is called a *range*. To use one, you need to know something about ranges and range safety rules. When shooting on a range with a group of shooters, you must also understand and follow the range commands given by the range officer.

PARTS OF THE RANGE

A range has a preparation area, a firing line, firing



points, target holders, and a backstop. Shooters use the preparation area behind the firing line to get their equipment ready and await their turn to shoot. Shooters take their positions on a firing point just behind the firing line. The target is hung on a target holder the correct distance (50 feet, 10 meters, 25 feet, or 5 meters) from the firing line. The backstop catches the bullet just after it goes through the target so there will be no danger to people or property around the range.

The lane used by one shooter for his target and shooting area is called a firing point. A range can be a one- or two-firing-point range in your own basement or backyard, or it can be a larger range belonging to a club or school, with firing points for several shooters.

RANGE OFFICER/RANGE COMMANDS

Whenever you shoot on a range with other shooters, one person will be in charge of the range. That person is called the *range officer*. To make sure the range is operated safely, the range officer uses a series of range commands, which must be followed at all times. (Note: These commands may be slightly different depending on the range officer and type of shooting being done.) Range commands and what to do are described below.

Move to the firing line. Carry your equipment from the preparation area to your firing point. Shooters are normally divided into relays (or groups) and are called to the firing line in relay order.

Your preparation period starts now. Pick up your rifle and get into position. The preparation period usually lasts three minutes. You may not load the rifle, but dry firing is permitted.

Load. Load your rifle.

Commence firing. Begin shooting. After your first shot, continue shooting until you have finished your target. In match shooting there will be a time limit.

Cease firing. Stop shooting immediately! If you have not finished shooting, stop, open the action and unload your rifle. (BB guns and air rifles must be unloaded by shooting them into the backstop. The range officer will tell you when to do this.) The range officer will check all rifles to be sure they are unloaded.

The range is clear; you may leave the firing line. When the range officer has checked all rifles, he will announce that the range is clear and you can pick up your rifle and carry it back to the preparation area. The rifle action must be open when it is taken from the firing line.

SAFETY RULES

Whenever you are on a range, follow these safety rules:

1. Know how the rifle operates.
2. Be sure your rifle and ammunition are compatible.
3. Carry only one caliber of ammunition when shooting.
4. Be sure of your target and what's beyond. Be sure you have a safe backstop beyond the target.
5. Wear eye and ear protection as appropriate.
6. Don't mix alcohol or drugs with shooting.
7. Obey all range commands from the range officer and other rules established for the safety of the range.

SCORING PAPER TARGETS

The results of a shooting activity or competition are determined by scoring paper targets. A shooting score is the total number of points from a series of shots. The score you receive on each shot is determined by the highest scoring ring touched or broken by the bullet hole.

AIR GUN SHOOTING

All of the fundamentals of rifle shooting can be learned using air rifles or BB guns. These rifles are even more inexpensive to buy and shoot than .22 rimfire cartridge firearms, and their lower power and noise levels allow the setup of an air gun range practically anywhere. Air guns can be valuable training tools and are a lot of fun.

All of the safety rules that pertain to cartridge firearms should also be observed while using air guns. Air guns are not toys and must be treated with the same care and respect as any firearm.

Air guns must be cleaned and maintained as are cartridge firearms, but they require different techniques than those used for cartridge firearms. Refer to the air gun's owner's manual for the manufacturer's recommended cleaning and maintenance procedures.

There are three types of air rifle competitive shooting programs: international, precision, and sporter. The international air rifle program is an Olympic event shot from only the standing position. Precision air rifle is a three-position (prone, standing, and kneeling) tournament event shot in the United States using the same rifle and equipment as international air rifle. Sporter is a low-cost three- or four-position (sitting added) event shot in the United States using a low-cost rifle and bare essentials in equipment. The precision and sporter events are shot by the National Guard and the American Legion as association national championships.

SHOTGUN SHOOTING

THE FUNDAMENTALS OF SHOTGUN SHOOTING

Learning to shoot is like mastering any other skill. Your introduction to shotgun shooting must begin with an appreciation of what needs to be learned and the basic skills required to hit a moving target. Accordingly, the instruction begins with a discussion of the fundamentals of shotgun shooting. Five steps are involved here. Once you've mastered the fundamentals, you can begin to apply them in a variety of shotgun sports.

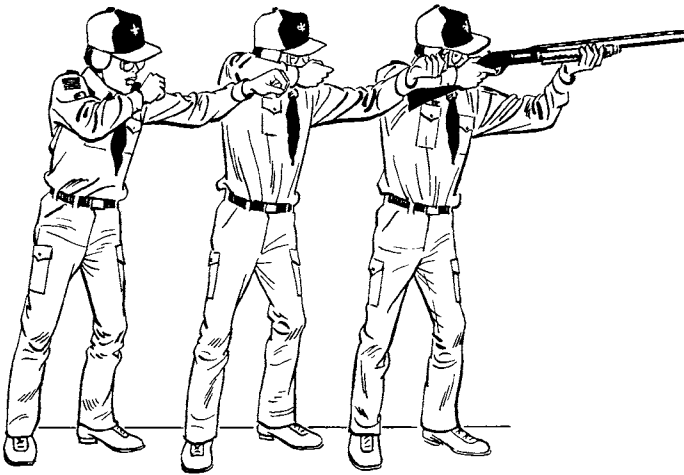
The five fundamentals are:

1. Stance
2. Gun-ready position
3. Swing to target
4. Trigger pull
5. Follow-through

STANCE

Stance is the position of your body in the act of shooting and its relationship to the expected target. Two conditions are essential for a good stance. First, your stance must be comfortable and relaxed. This means attaining as natural a balance as possible without straining your muscles. Imagine yourself in a basic boxing position. Your feet should be about shoulder-width apart and planted firmly on the ground. Your front knee should be bent forward slightly while your back leg remains straight. In shotgun shooting, you're seeking the same position as a boxer's because it provides proper balance and the ability to move.

Aligning your stance with the expected target breaking area is the second essential condition. This will permit you to rotate your body easily as the target moves to the left or right.



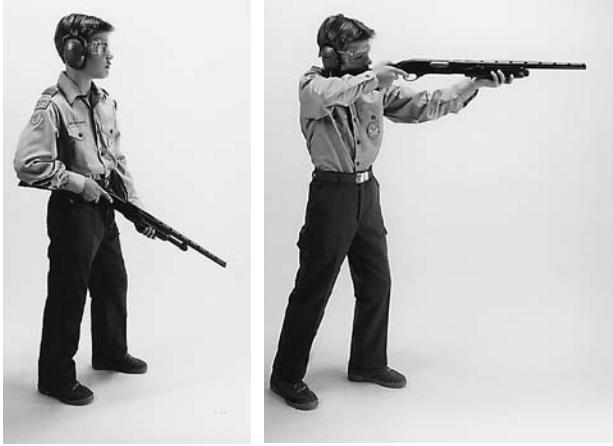
A good shooting stance is very similar to the basic stance of a boxer (left). With slight adjustment of the hand and arm (middle), the shotgun can be added for a correct shooting position (right).



A gun-ready position is relaxed and enhances your ability to see the target area.

GUN-READY POSITION

The gun-ready position is the posture you assume before actually moving your gun to shoot the target. It is intended to make your subsequent "swing to the target" as easy as possible. Maintaining your basic shooting stance, you should hold the shotgun with your nontrigger hand at about the middle of the shotgun forearm. Your grip should be just firm enough to provide control, but not so firm as to create unnecessary strain. The same is true of the trigger hand placed upon the grip of the stock. Bring the stock to your face and place it firmly against your cheek. The trigger hand elbow comes into position about level with the shoulders. Place the butt of the stock firmly against the shoulder. With a correct gun fit, the barrel will be aligned with the anticipated path of the target and in front of your dominant eye. The muzzle is placed slightly below the expected flight path of your target, thus assuring you a clear view of the target area. Both eyes should remain open and focused in the area where you expect your target to first appear.



SWING TO TARGET

On first seeing the target, concentrate your vision on the target and move your gun and body as a single coordinated unit toward the target, pivoting at the waist. The swing to target must be done quickly, yet in a smooth and fluid movement. The smoothness and consistency of your swing are far more important than its speed, as swinging past the target too rapidly leaves you little chance to correct your error and still make a good shot.

TRIGGER PULL

Timing and reflex are essential in the act of *trigger pull*. The trigger pull should take place at the instant when, swinging by the moving target, you see the gun's muzzle touch it. Your pull must be crisp and quick.

FOLLOW-THROUGH

Follow-through is one of the most important and most difficult aspects of shotgun shooting. The shotgun muzzle must move through the target if the shots are to hit the target. The trigger is pulled while the shotgun is moving, and the gun must continue to move after the shot is fired. The shotgun must remain "welded" to the body, especially the cheek. Stopping the motion of the shotgun on touching the target is probably the most common cause of misses by beginning shotgun shooters. **Always continue to keep the gun moving by swinging through!**

Knowing the fundamentals is the foundation of successful shooting. Using them correctly and **consistently** provides successful shooting, whether you're a beginner or an expert. As you're about to discover, the steps involved in commencing actual shooting are methodical, progressive, and equally vital.

FIRING YOUR FIRST SHOTS

KNOW YOUR TARGET

In the exercises to come, you will be building up to your first shots at airborne targets, but first you'll need to know a little about the target itself. The breakable clay target is excellent for learning and is used by the millions in target competition. Clay targets are readily available at most sporting goods stores. They are easily thrown with an inexpensive manual trap and cost very little themselves. On the range, you will notify the trap operator that you want a target thrown with the command, "Pull." Notice how the target moves out from the trap when it is ejected. Get a feel for how fast and where the target flies.

START WITH A STRAIGHTAWAY TARGET

Accomplished shotgun shooters fire from a number of positions and at targets coming or going from many directions, angles, speeds, and distances. But at the outset, you should practice on targets flying in one basic direction. Here, the trap is set so that it will throw the target fairly straightaway in front of you. Initially, each target should follow virtually the same flight path and travel at a relatively slow speed. The background against which the target will be thrown should be clear—an open sky with a low horizon line and no obstructions is ideal. All of this enhances your ability to concentrate and focus on the target—and hit it.

LEARN TO POINT

Before you actually start working with your shotgun, it's advisable to grow accustomed to running through the shooting fundamentals with a target, with your index finger substituting for the shotgun itself. This exercise will teach you to point toward the flying target without having to concentrate at the same time on the necessary body movements required to position the shotgun. This will also enhance your ability to **concentrate on the target at all times**.

Assume the basic "boxer" stance, but with your index finger pointed at a 45-degree angle to the ground. Remember, line up your stance with the expected target breaking area. If your right eye is dominant, point with your left-hand finger. If it's your left eye, point with the right-hand finger. By doing this, when the time comes to add your shotgun, your stance will be correct. Now, focus your eyes on the area where your target will first appear and call, "Pull."

As soon as you see your target, immediately and smoothly move your finger to the target and pass through its line of flight. Practice this motion several times. Notice: You looked at the target all the time, not the finger you were pointing with. This is an important concept in shotgun shooting—**shotguns are pointed**, not aimed. The difference is that your eyes must always remain focused on the target, never the shotgun barrel or beads. When you begin to feel comfortable with this pointing exercise, add a sound effect.

When the target is released, again move your finger to it smoothly. At the instant your finger “touches” the target, simulate pulling the trigger by saying “Bang!” Remember to swing through. This may sound somewhat juvenile, but there’s a distinct purpose in this. In shotgun shooting, it is imperative to be able to time your shot so that you pull the trigger as soon as the muzzle touches the target. By saying “Bang!” you are learning to recognize and develop a mental picture of actions in shooting that should eventually become instinctive.

PRACTICE POINTING WITH YOUR SHOTGUN

Now you can pick up your shotgun. Before doing so, however, remember the basic safety rules. Keep your muzzle pointed in a safe direction at all times and keep your finger off the trigger until you’re ready to shoot. Make sure both the chamber and the magazine are unloaded by opening the action and seeing that no shells remain inside.

Your first actions with the shotgun in your hands should be to complete a total review of the first three shooting fundamentals without a target. Get into the proper stance. Make sure that your stance is balanced and allows you to rotate easily to the left and right of the planned shooting area. Assume the gun-ready position. Check to be sure that your actions are “according to the book.” Take your time and practice.

With the action open, practice calling for and swinging through the target. This teaches you to stay with your gun. Be sure your eyes remain focused on the target all the time.

DRY FIRING

After working on the first three fundamentals, you can add pulling the trigger—with the gun action closed but **unloaded**. This is called *dry firing*. After checking the chamber and magazine, close the action, place the safety in the “off” position, and assume your stance and gun-ready position. Now call “Pull.” This time, pull the trigger the instant your muzzle touches the target.

Now’s the time to really work on swinging through. Doing everything exactly the same as you did the instant you pulled the trigger, practice staying with the gun 2 to 3 seconds after firing. Remember, continue to keep the stock firmly in place against the cheek. Open the action after each shot as if you were ejecting a spent shell.

SHOOTING LIVE AMMUNITION

After you have dry-fired a number of times and are confident in your ability to perform all the shooting fundamentals successfully, you are now ready to begin shooting with ammunition. However, you will need to return your gun to the rack to get prepared. Start with a review of all the firearm handling and shooting rules. Make sure you know them and follow them! Next, put on your eye and ear protectors. Get no more than five rounds of ammunition, pick up your shotgun, and move to the firing station. From here on, it’s a good idea to learn to do each step by the numbers. Learning to do the steps the same way each and every time is the key to “consistent” success in shooting. Follow the seven steps listed below:

1. Move to the station, load the appropriate number of shells (in this case, just one), and place the gun safety in the “off” position.
2. Establish your stance in relation to the target-breaking area.
3. Establish the gun-ready position with the muzzle slightly below the expected target flight path and place your finger on the trigger.
4. Focus your eyes on the area where the target will soon appear.
5. Call “Pull” for the target.
6. On seeing the target, swing to the target, pull the trigger, and swing through.
7. Open the action and unload the shotgun immediately after firing.

How did you do? If you followed the fundamentals you should have broken a target. If not, don’t be too hard on yourself if your untouched target dropped to the ground. This is just the beginning of many eventful days of shooting to come. As in all sports requiring skill and coordination, successful shotgun shooting means ongoing practice. So try again! As you refine your ability to concentrate on the target, you’ll begin to see targets breaking one after another!

ADVANCED SHOTGUN SHOOTING SKILLS

You should learn simple shooting skills before moving on to more complex ones. Up to now, you have been shooting fairly straightaway targets, which were easier to hit, but not just because they were straightaway. Among several things that made them seem easier were that you knew in advance where they were going and what to expect. Also, in the previous exercises, many of the variables normally associated with more advanced shooting were carefully controlled for you and, where possible, were eliminated. The reason was to help you concentrate on one thing—the target. Therefore, as much as possible, the exercise guaranteed the success of your first attempt at shooting moving targets—building your confidence, as well as your skills.

It is now time to move on to more complex or advanced targets. What are some of the variables that make them more difficult? Under various conditions, targets can come from the right or the left of the shooter, from a position in which the target flies toward or away from the shooter, and at various speeds, altitudes, and angles. In addition, in some cases you may receive more than one target at the same time and not know the direction of flight or the exact moment of release.

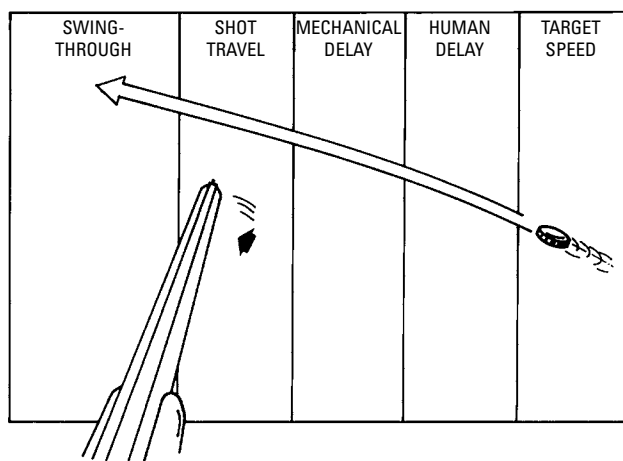
The combinations are endless. However, all of these variables do not change the fundamentals you've just learned. Even though the targets and their flights may change, the fundamentals don't! They are the foundation on which all shotgun shooting is built. But to use the fundamentals successfully on various targets, you'll need additional knowledge and understanding of the overall shooting process. As you begin to study and talk to others, you will find that there are several different methods used for shooting moving targets. Of these, we have chosen to focus on the "swing-through" method.

The swing-through method offers the simplest and fastest road to progress and provides a wider base for overall development of your skills. The name of the method is derived from the fact that you actually swing through the target. This is done by simply coming up behind and accelerating through the target, and again, firing as the barrel touches the target in passing. It's important that you understand how this method works.

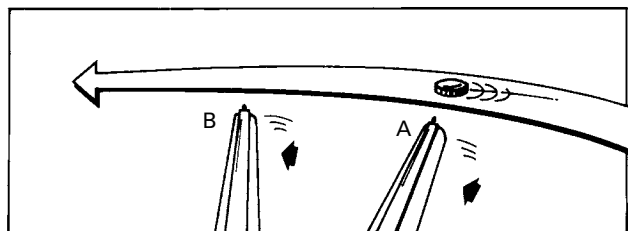
The key lies in understanding the series of time delays that occur in the shooting process. The first time delay is human reaction, the brief span of time between the brain's decision to fire and the actual pulling of the trigger. The second delay is a mechanical delay, the time it takes the firing mechanism to function from the trigger pull to the muzzle blast. The third and last delay is the time it takes for the shot charge to reach the target. Though collectively

these delays occur in what appears to be an instant, what you are doing during the instant they occur can make the difference between hitting or missing the target. Although all fundamentals are important in hitting a target, in this method, firing at the right time and a strong follow-through are essential keys to consistent success.

The swing-through takes care of what is often referred to as lead. Lead is simply the distance between the target and muzzle at the time of firing. In the swing-through method, measuring lead, as required in the other methods, is not necessary because it is automatically taken care of when the shooting method is executed properly. Not having to do this measuring allows you to concentrate on the target and not on the figuring and measuring of the distance between the target and an abstract point.



Time delays involved in the shooting process



The swing-through shooter gives more lead than he thinks. The gun barrel (A) shows where he thinks he shoots on a crossing target. The barrel (B) is where he really shoots if a good swing-through is used.

Remember, while swinging to the target, shooting the target, and swinging through, keep the gun moving.

Having learned the fundamentals, you'll soon want to seek out shooting opportunities that accommodate your growing interest. That's when the excitement really begins!

GUN SAFETY AND GUN CARE

GUN SAFETY

The fundamental rules for safe gun handling are:

Always keep the gun pointed in a safe direction.

Whether you are shooting or simply handling your gun, never point the gun at yourself or others. Common sense should dictate which direction is safest, depending on your location and other conditions. Generally, it is safest to point the gun upward or downward.

Always keep your finger off the trigger until ready to shoot. There's a natural tendency to place your finger on the trigger when holding a gun. Avoid it! Your finger can rest on the trigger guard or, better yet, around the grip of the gun. Trigger guards are designed to prevent the trigger from getting accidentally bumped.

Always keep the gun unloaded until ready to use.

Whenever you pick up any gun, immediately open the action and check (visually, if possible) to see that the chamber is unloaded. If the gun has a magazine, remove it and make sure it's empty. If you do not know how to open the gun's action, leave it alone and get help from someone who does.

When using or storing a gun, always follow these rules:

Be sure the gun is safe to operate. Just like other tools, guns need regular maintenance to remain operable. Regular cleaning and proper storage are a part of the gun's general upkeep. If there is any question concerning a gun's ability to function, a competent gunsmith should look at it.

Know how to use the gun safely. Before handling a gun, learn how it operates. Know its basic parts, how to open and close the action safely, and how to remove any ammunition from the gun or magazine safely. Remember, a gun's mechanical safety device is never foolproof. Nothing can replace safe gun handling.

Use only the correct ammunition for your gun. Only BBs, pellets, cartridges, or shells designed for a particular gun can be fired safely in that gun. Most guns have the ammunition type stamped on the barrel. Ammunition can be identified by information printed on the box and sometimes stamped on the cartridge. Do not shoot the gun if there is any question about the compatibility of the gun and ammunition.

Know your target and what is beyond. Be absolutely sure you have identified your target beyond any doubt. Equally important, be aware of the area beyond your target. This means observing your prospective area of fire before you shoot. Never fire in a direction in which there are people or any other potential for mishap. Think first. Shoot second.

Wear eye and ear protection as appropriate. Guns are loud and the noise can cause hearing damage. They can also emit debris and hot gas that could cause eye injury. For these reasons, safety glasses and ear protection are recommended.

Never use alcohol or drugs before or while shooting. Alcohol, as well as any other substance likely to impair normal mental or physical bodily functions, must not be used before or while handling or shooting guns.

Store guns so they are not accessible to unauthorized persons. Several factors should be considered when deciding on where and how to store guns. Your particular needs will be a major part of the consideration. Safe and secure storage requires that untrained individuals (especially children) be denied access to guns.

Be aware that certain types of guns and many shooting activities require additional safety precautions.

TAKING CARE OF YOUR FIREARM

CLEANING FIREARMS

Ideally, you should make a habit of cleaning your firearm each time it is used. While this may seem burdensome at first, many shooters find that the quiet ritual of cleaning their firearms after use provides a pleasurable aspect to the recreation that they would otherwise miss. A firearm that is cleaned regularly will shoot more accurately and reliably. Cleaning also preserves the finish and value of the firearm.

Cleaning is essential when the firearm has been stored for an extended period or has been exposed to dirt or moisture. Don't use a dirty firearm; make sure it is cleaned thoroughly before use.

As you prepare to clean the firearm, first be sure that the action is open and that the firearm is **unloaded**. To ensure absolute safety, the action should always be kept open during cleaning. It is also best to keep ammunition out of the area where you are cleaning your firearm.

MATERIALS NEEDED TO CLEAN A FIREARM

- 1.** Cleaning rod with bore brush and attachment to hold patches (must be proper size for bore of firearm)
- 2.** Cloth patches
- 3.** Bore-cleaning solvent
- 4.** Light gun oil (synthetic, nonpetroleum oils are best)
- 5.** Clean cloth
- 6.** Small brush



- 3.** Finally, push an oiled patch through the bore. Repeat steps 1 and 2 if the patches do not come out clean.



THE BASIC STEPS IN FIREARM CLEANING

- 1.** Place the bore brush on the cleaning rod, wet with cleaning solvent, and work it back and forth in the bore to loosen residue and fouling.
- 2.** To remove the loosened residue and fouling from the bore, run a series of patches through it until they appear clean.



- 4.** Clean any remaining foreign materials from the firearm, particularly from the action, with a small brush or cloth.
- 5.** Wipe all exposed metal surfaces with a rust inhibitor or a lightly oiled cloth.

To avoid rust formation after the firearm is cleaned, don't touch the metal. Instead, handle the gun by the stock.

Don't neglect your ammunition, either. Sand or dirt collected on the ammunition can damage the chamber or the bore of your firearm. Check ammunition for foreign material before using.



STORING FIREARMS

Several factors should be considered when you decide on where, and how, you intend to store your firearm. Your particular needs will be a major part of the consideration, as will the storage capabilities of your dwelling. Safety and security must also be contemplated rationally. The storage of a firearm requires the exercise of ordinary care after viewing all the circumstances.

Bear this in mind when making your decision. Firearms are attractive items for people to handle.

Assume that an untrained person attempting to handle the gun may not do so safely. Consequently, it is in everyone's best interest that the gun is stored in a place that does not afford ready access by small children or untrained adults. Many fine wooden cases are available for purchase that store firearms with a measure of security and display them attractively. Some shooters who desire even more secure storage capability keep their guns in metal vaults. Others who do not have such facilities elect to lock their guns away, with the keys kept in a place where they are not likely to be found by youngsters or casual visitors.

Firearms kept in storage should be unloaded. When removing the gun from its storage place, make it the first order of business to open the action and be sure no shell has been accidentally left in the chamber or magazine.

Proper attention should also be devoted to storing ammunition, preferably in a cool, dry place. In most cases, it is wise to keep ammunition and guns stored separately.

TRANSPORTING FIREARMS

Many states and municipalities have laws governing the transportation of firearms. You have a responsibility to learn and obey these laws. It is especially important to research any specific regulations in states or cities to which you will be traveling.

Federal law provides that, notwithstanding any state or local law, a person is entitled to transport a firearm from any place where he may lawfully possess and carry such firearm to any other place where he may lawfully possess and carry such firearm if, during the transportation, the firearm is unloaded and the firearm and ammunition are in the trunk of the vehicle. In a case of a vehicle without a compartment separate from the driver's compartment, the firearm or ammunition shall be contained in a locked container other than the glove compartment or console.

Guns should be packed and stored where they will be safe and will not attract the attention of someone who might steal them. Some jurisdictions may require that they be separate from the ammunition.



FURTHER SHOOTING OPPORTUNITIES

MERIT BADGES

The Boy Scouts of America merit badge series has more than 100 subjects to challenge the interest of youth members. As the team participates in this shooting sports activity, consideration should be given to earning the Rifle Shooting and Shotgun Shooting merit badges. For variation, encourage the team members to use the muzzle-loading option for firing.

SHOOTING PROGRAMS IN OTHER ORGANIZATIONS

Several national youth and educational organizations have youth shooting activities. These include physical education classes in junior high and high schools, summer camp shooting, marksmanship Exploring posts, 4-H shooting sports projects and clubs, and Jaycee shooter education programs. In addition, the Civilian Marksmanship Program (CMP) lends .22-caliber rifles and provides ammunition for junior shooting programs offered by affiliated clubs and associations.

PRESIDENTIAL SPORTS AWARD

The President's Council on Physical Fitness and Sports offers awards for participation in sports. The awards can be earned in 43 different sports, one of which is rifle shooting.

To obtain this award you must be 15 years of age, keep your own personal fitness log, and meet the following standards:

1. Fire a minimum of 2,500 rounds. (No more than 50 rounds in any one day may be credited to your total.)
2. Fire required rounds at a minimum target distance of 33 feet for air rifle and 50 feet for .22-caliber rimfire rifle. All shooting practices must be conducted under safe, regulation conditions.
3. Complete requirements within a four-month period.

More information and fitness logs can be obtained at no charge upon request. Send a stamped, self-addressed envelope to:

Presidential Sports Award
P.O. Box 5214
FDR Post Office
New York, NY 10150-5214

NRA QUALIFICATION PROGRAMS

An exciting way to improve your shooting skills and demonstrate your success is to complete one of the many NRA rifle and shotgun qualification awards programs. These programs combine a friendly learning environment with recognition for moving up the shooting skills ladder. They are designed to help you gradually improve your shooting ability by establishing challenging—but attainable—goals for beginning, intermediate, and advanced shooters over specific courses of fire. Once you meet the criteria, you earn an award. Then you can proceed to the next ability level.

In most programs, awards are presented for achievement at pro-marksman, marksman, sharpshooter, expert, and distinguished expert levels. Awards include patches, medals, and achievement certificates. Competing only against yourself and the “par” scores established for each level, you can advance at your own pace. Shooting for these nationally recognized qualification awards also makes your shooting practice a lot more fun.

As an example of NRA qualification requirements, a brief description of the rifle program is listed in the following chart. For more details on any particular program, contact the NRA Education and Training Division, 11250 Waples Mill Road, Fairfax, VA 22030.

NRA RIFLE QUALIFICATION COURSES

15-, 25-, and 50-foot Marksmanship Rifle

These courses can be shot from 15 feet with a smooth-bore, spring-type air rifle; from 25 feet with a CO₂ gas, pneumatic, or spring-type (rifled barrel) rifle; or from 50 feet with a .22-caliber rimfire rifle.

Outdoor Rifle

This course is shot from 50 and 100 yards (Dewar Competition Course) with a .22-caliber rimfire rifle that meets NRA Smallbore Rifle Rule 3.2.

American Rifleman

This course is shot at 50 yards with a .22-caliber rimfire rifle that meets NRA Smallbore Rifle Rules 3.1 or 3.2 (metallic sights only).

Sport Shooting

This course is designed especially for lighter, sport-type rifles. It can be fired at 50 feet with any .22-caliber rimfire rifle that weighs less than 7 pounds, including sights, or from 50 yards with any caliber centerfire rifle that weighs less than 8 pounds, including sights.

Highpower Rifle

This course can be fired at 100, 200, 300, or 600 yards with any caliber centerfire rifle (no telescopic sights).

Collegiate

This course is designed for collegiate teams, clubs, physical education classes, and individuals. It is fired from 50 feet with a .22-caliber rimfire rifle according to NRA Smallbore Rifle Rules.

Light Rifle

This course can be fired at 50 feet or 50 yards with a .22-caliber rimfire rifle that weighs less than 7 pounds.

JROTC Rifle

Designed for Junior ROTC shooters, this course is shot from 50 feet with a .22-caliber rimfire rifle that meets NRA Smallbore Rifle Rules 3.1 or 3.2.

FORMAL COMPETITIVE SHOOTING

As a new shooter, you may not be thinking too much about competing in tournaments. You may not be ready for the Olympics, but that doesn't mean you can't experience the thrill and challenge of competition right now. NRA competitive shooting programs let you test your skills against others at your level of ability.

NRA-sanctioned competitions normally divide shooters into classes according to their ability so that shooters compete against others with similar skill levels. After participating in your first matches, you'll receive a national classification card that will identify your skill level as a marksman, sharpshooter, expert, or master. Some tournaments have a class or competes as an unclassified master for shooters shooting their first match.

Shooting offers extensive opportunities to train and compete at all levels of competition—local, state, regional, national, international, and ultimately the Olympic Games. The Olympics is a type of international competition, as are the world championships.

A schedule of local to national and international competitions is listed in *Shooting Sports, USA*. This periodical for competitive shooters also has many feature articles. Subscription information is available from the NRA.

RIFLE COMPETITION

Rifle shooting is a college sport, sanctioned by the National Collegiate Athletic Association, with an NCAA national championship held annually. Collegiate All-American shooters are honored each year by the NRA. Athletic scholarships for rifle shooting are available from many institutions of higher learning. For further information on collegiate shooting, contact the NRA competitive shooting division.

The most popular competitive rifle shooting activities in the United States today are:

BB gun. For young shooters up to the age of 15, BB-gun events have prone, sitting, kneeling, and standing position shooting at 5 meters.

Air rifle. There are three types of air rifle competitive shooting programs: international, precision, and sporter. The international air rifle program is an Olympic event shot only from the standing position. Precision air rifle is a three-position (prone, standing, and kneeling) tournament event shot in the United States using the same rifle and equipment as international air rifle. Sporter is a low-cost, three- or four-position (sitting added) event shot in the United States using a low-cost rifle and bare essentials in equipment. The precision and sporter events are shot by the National Guard and the American Legion as association national championships.

Smallbore position. In these events, .22-caliber rimfire rifles are fired at 50 feet indoors or 50 yards or 50 meters outdoors in three positions (prone, standing, kneeling) or four positions (sitting added). The 50-meter, three-position rifle event is one of the championships in the Olympics and World Championships.

Smallbore prone. In these events, .22-caliber rimfire rifles are fired at 50 yards, 50 meters, and 100 yards outdoors in the prone position. The national prone event in the United States includes shooting with metallic and telescopic sights at all three distances. International prone is an Olympic event of 60 shots fired at 50 meters.

Highpower rifle. This is the most popular style of rifle shooting today. This event began as a military training activity for service rifles but has become a sports competition for both service rifles (M1 and M14) and highpower bolt-action target rifles. The highpower "National Match Course" has shooting at 200, 300, and 600 yards in standing, sitting, and prone positions, with both slow fire (10 or 20 shots in 10 or 20 minutes) and rapid fire (10 shots in 60 or 70 seconds). Special highpower rifle competitions, known as palma, are also fired in the prone position at 800, 900, and 1,000 yards. Palma is the oldest existing type of competitive shooting in the world. Highpower rifle championships began in the NRA in the 1870s.

300-meter rifle. Highpower rifles are fired at 300 meters in the prone, standing, and kneeling positions.

Silhouette rifle. Metal silhouettes of game animals are shot with highpower or smallbore rifles in the standing position from four different distances (highpower: 200, 300, 385, and 500 meters; smallbore: 40, 60, 77, and 100 meters). Rifles are limited in weight (10 pounds, 2 ounces) and telescopic sights are permitted. Shots count as hits when a target is knocked down.

Running target. A paper target is shot with air rifles at 10 meters as it crosses an opening in front of the shooter. The event may also be fired with .22-caliber rifles at 50 meters. This event was designed to imitate game or hunting rifle shooting.

Special competition events. There are several other special target events that call for rifle shooting skills:

- In muzzleloading rifle shooting, blackpowder rifles are used to reenact earlier forms of shooting and competition.
- The biathlon is a winter Olympic event combining cross-country skiing and shooting (.22-caliber rifles).
- In bench-rest shooting, centerfire rifles are fired at varying distances from bench rests. The winner is the one who shoots the smallest five- or ten-shot groups.

SHOTGUN COMPETITION

Shotgun competition is mainly divided into two types: trap and skeet. Both games have United States and international versions, with rules that differ slightly. Competitions in the international style are administered by USA Shooting; the United States versions for trap and skeet are governed by the Amateur Trapshooting Association and the National Skeet Shooting Association, respectively. The address of the Amateur Trapshooting Association is 410 West National Road, Vandalia, OH 45377. The National Skeet Shooting Association address is 5931 Raft Road, San Antonio, TX 78253.

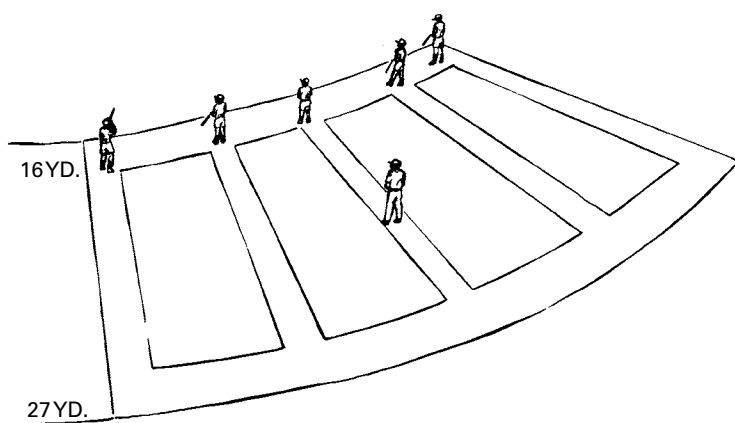
Trap is a shotgun game in which the shooters fire at targets generally flying directly away from the shooters. Shooters fire from behind a trap house from which the clay targets are launched at various angles. Shooters can shoot three different events. The single event places all shooters at 16 yards. In the handicap event, shooters

stand at different distances from the trap house. The doubles event launches two targets at one time. (One round of trap consists of 25 targets.)

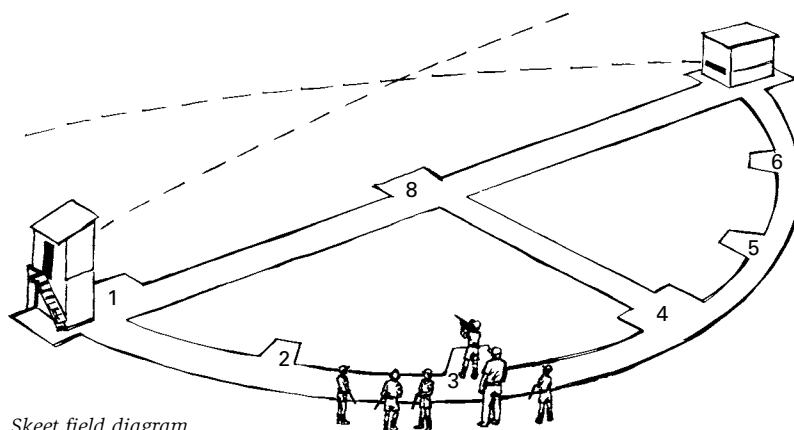
Shooters do not know the direction of the target flight in singles shooting, but they do know the direction in doubles.

Skeet is a shorter-range shotgun game in which the shooters move around an arc with seven shooting positions along its perimeter and one at the midpoint of a line between the two “houses.” Targets are launched from a high or low house located at each end of the arc. Singles and doubles are always part of a round of skeet, which, like trap, consists of 25 targets. A great variety of angles of flight are encountered in skeet shooting, including shots at station eight, which must be made almost directly overhead.

Sporting clays is a shotgun game growing very fast in popularity. Each course is different with its own set of



Trap field diagram



Skeet field diagram

challenges. You might think of it as a shotgun game built like a golf course.

LEAGUE SHOOTING

For many years, NRA-sanctioned leagues have been the primary means of attracting new shooters and providing a means of allowing groups and individuals to compare their performances over a series of matches with the same conditions. The league can be made up of individuals or teams representing organizations.

Just how formal the league will be is determined by the members. It may be a league with the emphasis on the degree of improvement made by the competitors or it may be a league organized to determine the most skillful shooter under stringent regulations and strict enforcement of rules.

NRA-sanctioned leagues are fired under the same general conditions that govern NRA-sanctioned tournaments, and the scores obtained are reported to NRA for classification.

Postal/home range matches offer the shooter a chance to shoot against other competitors without leaving home. Scores are fired on the home range and the results are sent to the NRA for comparison and ranking. These are several types of postal matches in air rifle and smallbore rifle such as the American Legion, National Guard, Junior ROTC, and Boy Scouts of America.

GLOSSARY OF SHOOTING SPORTS TERMS

Action. The group of parts involved in loading, firing, and unloading a gun.

Air gun. Any gun that uses compressed air or CO₂ gas to push the bullet through the barrel.

Aperture. The circular opening in a sighting device that is lined up with a target to aim a gun.

Barrel. The metal tube through which the projectile (bullet or wad and shot) passes when a rifle or shotgun is fired.

Bolt. That movable part of a rifle or shotgun action that encloses the rear of the chamber, sealing it so that the gun can be fired safely.

Bore. The hollow inside of the barrel through which the projectile passes.

Breech. The rear of a barrel, where the chamber is located on modern firearms.

Bullet. The single projectile fired from a rifle, typically made of lead.

Bull's-eye. The round, black center of a paper target, sometimes called the aiming bull or bull. Also, a term used to indicate striking the target in the highest scoring ring or ten ring.

Butt. The portion of a gun stock that is placed against the shoulder when firing.

Buttstock. The stock of a gun in the rear of the breech mechanism.

Caliber. (1) The diameter of a bullet; or (2) the diameter of the bore of a gun.

Cant. To tilt a gun inward while it is being aimed and fired.

Cartridge. A single complete round of ammunition for a rifle, composed of a case, priming compound, powder charge, and bullet. Often incorrectly termed bullet, which actually refers only to the projectile portion.

Case. The container, usually of brass or other metal, into which the components of a cartridge are assembled to create a finished cartridge.

Centerfire. A cartridge in which the priming compound is contained within a separate structure, located in the center of the base of the case.

Chamber. That portion of the barrel into which the cartridge or shot shell is placed in order to fire it. It is shaped to accommodate precisely only the correct ammunition for the particular firearm.

Cheekpiece. A raised area on the stock against which the shooter's face can fit with comfort.

Choke. A narrowed area of the bore near the muzzle found in some shotguns that concentrates the shot charge to create a denser pattern and a greater effective range.

Classification. A skill-level designation based on average match scores.

Click. A unit of movement in a rear sight.

Course of fire. The number of shots at each distance, and/or in each position, that make up a match.

Dry firing. Aiming and pulling the trigger of a cocked but unloaded gun.

Fore-end. The part of a gun stock under the barrel forward of the trigger.

Gauge. The means by which the bore diameter of most modern shotguns is expressed. It was originally derived from the number of lead balls of bore diameter that could be cast from a pound of lead—the smaller the gauge, the larger the bore diameter. The .410-bore shotgun is the sole exception to this system of measurement.

Grooves. Lines engraved onto the interior of a rifle's bore to help stabilize the projectiles being fired.

Group. A series of shots fired at a target with a constant point of aim and sight setting.

Handicap. Extra points to be added to the actual fired score of some shooters to allow them to compete on an equal basis with more experienced shooters.

International. Courses of fire or shooting programs based on the rules of the International Shooting Union.

Jacket. A covering of a hard metal, such as copper, over a lead bullet to improve its performance, minimize bullet deformation during its path through the rifle's bore, and reduce fouling of the rifling by soft lead being stripped off a bullet traveling through the bore at high velocity.

Lands. The raised edges in the rifle bore created when the grooves are cut into the bore's surface. They make contact with the bullet and impart a stabilizing spin to it as it travels through the bore.

Magazine. A container into which multiple cartridges can be placed to allow multiple shots to be fired in succession without manual reloading. Magazines can be fixed or detachable. Often magazines are incorrectly called "clips."

Mat. A thin pad used for comfort and cleanliness in the prone, kneeling, and sitting positions.

Match. A complete competition. Scores from several matches are sometimes combined and called an aggregate match or tournament.

Metallic sight. A mechanical device, devoid of any optical system, that guides the eye in aiming a gun.

Muzzle. The opening through which the projectile leaves the barrel when a shot is fired.

National. Courses of fire or shooting programs that are shot only in the United States and are based on the rules of the National Rifle Association or USA Shooting.

Offhand. Another name for the standing position.

Pattern. The impact area covered by the spread of shot fired by a shotgun. Patterns are typically measured at a distance of 40 yards and expressed by the percentage of shot that strikes within a 30-inch diameter circle at that range.

Pistol grip. The small part of the gun stock, just behind the trigger guard, where the hand holds the gun while shooting.

Preparation area. The designated area behind the firing line where the upcoming relay of shooters gathers.

Priming compound. A chemical compound that explodes when struck by a firing pin, igniting a powder charge.

Qualification. A skill-level award earned by reaching predetermined scores.

Recoil. The kickback of a gun upon firing.

Relay. The group of shooters scheduled to fire at the same time in a match.

Rib. A flat, grooved bar of steel along the top of a shotgun barrel to aid in sighting.

Rifling. The lands and grooves in a rifle's bore that work together to impart the spin to the bullet as it passes through the bore.

Rimfire. A cartridge in which the priming compound is an integral part of the case, located within the rim of the base of the case.

Round. (1) A single cartridge or shot shell; or (2) the normal single course of fire in trap or skeet shooting that consists of 25 targets fired upon from various positions.

Safety. A mechanical device whose function is to block the normal action of the trigger to assist in preventing accidental discharge of a firearm. Its use is never a substitute for proper gun handling procedures.

Score. The total value of the shots fired in one match.

Shot. The multiple-round projectiles fired from a shotgun, usually made of lead or steel.

Shot shell. A single complete round of ammunition for a shotgun. It is composed of a case, priming compound, powder charge, wad, and shot.

Sighting shots. Shots taken at designated sighting bull's-eyes to check sight settings before firing record shots.

Sling. A fabric or leather strap used to hold the rifle in the prone, kneeling, and sitting positions.

Sling swivel. A metal loop, fastened to the stock, through which the sling passes.

Smallbore. A .22-caliber rimfire cartridge or a rifle designed to shoot it.

Spotting scope. A small telescope used to observe hits on a target from the firing line.

Stock. The handle (usually, but not always, made of wood) by which a rifle or shotgun is designed to be held and fired.

String. A series of shots, usually five or 10, fired at one target as a part of a match.

Telescopic sight. A mechanical device, using an optical magnification system, that guides the eye in aiming a gun.

Wad. A plug or cup of plastic, cardboard, or fibrous material used between the shot and the powder charge in a shot shell to provide an air-tight seal within the shotgun's bore when the shotgun is fired. This ensures that none of the powder gases escape around or through the shot, which would reduce their velocity and range.

X-ring. A smaller circle within the 10 ring on some competition targets. It is used to break ties in the event of identical scores for two or more shooters. The larger number of X's wins.

Zero. The sight adjustment that causes the bullet to hit the exact center of the target at a given distance.

BOY SCOUT STANDARDS



Boy Scouts are permitted to fire .22-caliber bolt-action, single-shot rifles, air rifles, shotguns, and muzzle-loading long guns under the direction of a certified instructor, 21 years of age or older, within the standards outlined in current Scouting literature and bulletins. BSA policy does not permit the use of handguns in the Scouting program.

RIFLES

The following standards are established for rifles to be used in Boy Scouting:

1. Breech-loading will be single-shot, bolt-action of the .22-caliber rimfire type only. They may be chambered for the .22-short or .22-long rifle, but not for the .22 WRF (which is a more powerful cartridge). Air rifles are also permitted.
2. Semiautomatic rifles will not be permitted.
3. Repeating rifles having a tubular magazine will not be permitted.
4. Repeating rifles having a removable clip-type magazine will be permitted but must be used as a single-loader.
5. No rifle will be used that has less than a 3-pound trigger pull.
6. Shooting safety glasses and ear protectors are required.
7. All training and shooting activities must be supervised by a currently NRA-certified rifle instructor or coach who is 21 years of age or older.

MUZZLE-LOADERS

The following standards pertain to use of muzzle-loading long guns in training by members of the BSA:

1. Muzzle-loading rifles must be recently manufactured, percussion only. A .45- or .50-caliber is recommended. Rifles made from kits must be checked by an expert gunsmith.
2. Recommended loads of .FFFg blackpowder are not to exceed 1 grain per caliber. One half of this amount is frequently sufficient for target shooting.
3. Shooting safety glasses and ear protectors are required.
4. All training and shooting activities must be supervised by a currently certified NRA or NMLRA (National Muzzle Loading Rifle Association) muzzle-loading rifle instructor 21 years of age or older.
5. Each Scout must have one instructor or adult coach under instructor supervision when loading or firing.

RESOURCES

NRA SALES DEPARTMENT

The NRA sales department offers tournament supplies, rule books, and training materials. Many books on guns, hunting, and shooting are offered. Book lists, catalogs, and order forms with current prices are available from the NRA sales office: NRA Sales Department, P.O. Box 5000, Kearneysville, WV 25430-5000; or call toll-free 800-336-7402.

Of particular interest to junior shooters:

Qualification Awards—Available for qualification achievement recognition.

NRA Shooter's Diary—A preprinted diary with a three-ring binder and rifle insert. Order inserts separately.

NRA Collegiate Shooting Sports Directory—Designed as a resource guide listing the names and addresses of colleges and universities and the person in charge of the school's shooting sports program. A brief description of each school's program is included.

NRA rifle rule books

1. *NRA Smallbore Rifle Rules*
2. *NRA International Rifle Rules* (includes smallbore and air rifle)
3. *NRA Highpower Sporting Rifle Rules*

4. *BB Gun and 10-Meter 4-Position (air rifle) Rules*

5. *NRA Position Air Rifle Rules*

6. *NRA Silhouette Rifle Rules*

NRA LICENSED TARGET MANUFACTURERS

The NRA has licensed a number of companies to print official NRA targets. These target manufacturers have agreed to follow NRA standards for official targets. Licenses are renewed regularly.

Listed below are those companies currently licensed to produce official NRA targets, along with their address and telephone numbers. Where available, a Web site and e-mail address is also given. Please note that not all manufacturers provide all targets.

If you would like a printed list of manufacturers and the targets they provide, write to:

NRA Target Coordinator
Competitive Shooting Division
National Rifle Association
11250 Waples Mill Road
Fairfax, VA 22030
E-mail: competitions@nra.org

The National Target Company
4960 Wyaconda Road
Rockville, MD 20852
Telephone: 301-770-7060 or 800-827-7060
Fax: 301-770-7892

Speedwell Division of Rockwood Corp.
136 Lincoln Blvd.
Middlesex, NJ 08846
Telephone: 908-560-7171 or 800-243-8274
Fax: 908-560-7475

Alco Target Company
2048 Central Ave.
Duarte, CA 91010
Telephone: 626-358-4814
Fax: 626-301-9084
Web site: <http://www.alcotarget.com>

Danf Target Co.
58 Harbor North
Amityville, NY 11701
Telephone: 800-969-3263

Little Sales Company
20815 West Chicago Ave.
Detroit, MI 48288
Telephone: 313-273-6889
Fax: 313-273-6889

American Target Company
1328 South Jason St.
Denver, CO 80223
Telephone: 303-733-0433
Fax: 303-777-0311

Blount Inc./Outers Laboratories, Inc.
Box 39, RR 2
Onelaska, WI 54650
Telephone: 800-635-7656

Hill Printing
1621 Hennepin Ave.
Minneapolis, MN 55403
Telephone: 612-328-1241

U.S. Target Co.
16620 Industrial
Roseville, MI 48066
Telephone: 810-445-3131
Fax: 810-445-3166

Hoppe's Penguin Industries, Inc.
Airport Industrial Mall
Coatesville, PA 19320
Telephone: 610-684-6000

Eagle Target Co.
92 Highlands Plaza
Highlands, NC 28741
Telephone: 800-680-9707 or 704-526-0619
Fax: 704-526-0619

Central Target Co.
1800 Portland Ave.
Louisville, KY 40203
Telephone: 888-672-1863
E-mail: central_target@msn.com

Irris Telemetry Corp.
2208 Camino Ramon
San Ramon, CA 94583
Telephone: 510-901-0533
Fax: 510-901-0534
E-mail: irris@irris.com
Web site: <http://www.irris.com/wats441.html>

Dave Zimmerman Target Barn
Box 352454
Toledo, OH 43635-2454
Telephone: 419-841-4770

The Target Shop
9 Walsh Road, Box 72B
Lansdowne, PA 19050-0278
Telephone: 610-284-8304
Fax: 610-259-8304

COMMUNITY RESOURCES

There are a great many community resources available to assist you in pursuing your interest in shooting. Local law enforcement agencies are often a good source of information on local range facilities, shooting education programs, and, of course, local laws and regulations governing firearms. Area offices of your state's department of natural resources or fish and game agency may also be a source of information about the availability of shooting ranges and state-sponsored firearms and hunter education programs.

Local sporting goods or gun stores make logical contacts for information about equipment and facilities. Employees of such businesses are often aware of local shooting clubs, certified instructors in the area, and other facilities that could be helpful to your team. Local sportsmen's clubs are almost always willing to provide help to a group of interested shooters, which may include access to club range and classroom facilities, provision of instructors and coaches, and assistance in conducting matches or league activities. You may obtain lists of affiliated NRA clubs and NRA-certified firearms instructors in your area directly from the NRA.

Many Army National Guard units have range facilities that can be made available, and many are directly involved in that organization's program to promote rifle shooting activity.

To promote participation in rifle shooting, the Civilian Marksmanship Program (CMP) sells surplus rifles to CMP clubs or state associations and affiliated organization members. The World War II vintage M-1 Garand rifle is available for sale as are other rifles while supplies last. Ammunition, ammunition components, and spare parts are also available. Some items offered for sale are only available to CMP-affiliated clubs and associations, and the amount authorized for annual purchase is determined based on the participation of club members in annual qualification firing.

ACKNOWLEDGMENTS

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SNOW CAMPING

BACKGROUND



The Scouting program introduces basic winter camping techniques. This Varsity program expands on those basic skills to help campers develop the expertise to survive and have an enjoyable camping experience in below-freezing conditions. Many Scouts may be familiar with the Okpik high-adventure program, and some of them may have participated in this program in Maine or Minnesota. Those team members can become instructors for this program. Several councils around the country offer programs similar to Okpik. If your council does not, this is an opportunity for your group to have many positive cold-weather experiences.

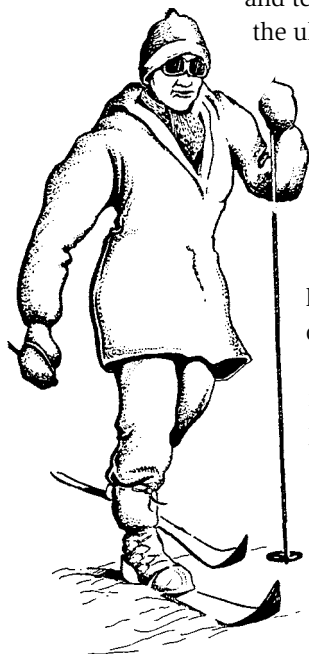
Like all the Varsity programs, this program is designed to challenge participants. There will be a series of skills and techniques to learn in preparation for the ultimate adventure.

This adventure could be a long weekend or even a week in a winter camping situation, which could be planned for a school vacation.

Take time to prepare for this ultimate adventure. Make sure to master each skill level and have the knowledge to deal with a challenging situation.

This chapter prepares team members to use the decision-making process to develop mental fitness. It introduces proper clothing and equipment—layering, footwear, sleeping bags—to food and food preparation techniques, and to cross-country skiing.

These techniques are designed to teach the correct way to go camping when the temperature is below freezing—and to have a fun experience.



PROGRAM FIELDS OF EMPHASIS

The following are some suggested ideas that will help you plan a well-rounded program. Program managers carry out these ideas with help from a team committee member.

ADVANCEMENT

- Review each Varsity Scout's advancement status.
- Conduct a merit badge clinic for Emergency Preparedness, Camping, and/or Wilderness Survival.
- Monitor the team advancement chart regularly.

HIGH ADVENTURE/SPORTS

- Program manager outlines or updates the team's annual special high-adventure event (Philmont, Florida Sea Base, etc.).
- Conduct a snow camping activity.

PERSONAL DEVELOPMENT

- Encourage all team members to earn the religious emblem of their faiths.
- Devote a team meeting to a leadership skills workshop.

SERVICE

- Plant food for wildlife. Get advice and assistance from the soil conservation district or your state conservation department.
- Identify a disadvantaged family and complete a service project for them.

SPECIAL PROGRAMS AND EVENTS

- Conduct a coed ice-skating or roller-skating party. Start at the rink and end up with refreshments at your team meeting place.
- Arrange for Varsity Scouts to spend a day or part of a day at a business office. Have each member talk with a person in a different vocation or profession. At the next team meeting, have each member share an experience.

YOUR BODY AND THE COLD

MAINTAINING BODY HEAT

The body is a complex machine that depends upon chemical and muscular activity to sustain life. It works best when it is regularly fed, rested, and kept at a steady temperature of 98.6 degrees.

Understanding how the body reacts to slight internal temperature differences will enable you to respond more quickly to changes in your comfort. The body is always giving signals that tell you if you are too warm, too cold, or just right. If you are attuned to these, you can respond appropriately and remain comfortable for long periods of time, even in extreme conditions.

HOMEOSTASIS

Homeostasis is the medical term for the process that controls the equilibrium of the body's temperature. To function properly, the body must maintain an even temperature (98.6 degrees) around the vital organs within the torso. A few degrees too high or too low can cause serious illness and, if unchecked, death.

The homeostatic process functions like the body's thermostat, using arms and legs like the cooling vanes on an automobile radiator. When the body is producing more than enough heat to maintain a core temperature of 98.6 degrees around the vital organs in the torso, the homeostatic process dilates the blood vessels in the arms, legs, hands, and feet to permit full blood flow to the skin surfaces of the extremities, where excess heat can radiate away.

When cold threatens body temperature equilibrium, the homeostatic process decreases blood flow to the extremities, constricting blood vessels in the arms, legs, hands, and feet. Blood flow to the fingers and toes can be cut back as much as 99 percent or more. This is why your hands and feet get numb when you're cold and why they're particularly vulnerable to frostbite.

Since the brain needs oxygen to function, the body can't cut off the flow of blood to the head to conserve heat. Consequently, as much as 50 percent of the body's heat can be lost through an uncovered head and neck. Wearing a hat can keep the hands and feet warm, because when the hat reduces the loss of body heat through the head, the body can afford to send more body heat to the extremities. This helps to prevent hypothermia and frostbite.

HOW THE BODY LOSES HEAT

Radiation. This is a leading cause of heat loss in almost any situation, and the head is the most efficient portion of the body's radiator system. So rapid is the radiation

from the head in a cold situation that heat loss from an unprotected, uncovered head can be enormous. An unprotected head can lose up to half of the body's total heat production at 40 degrees; up to three-quarters of total body heat production at 5 degrees. Remember the maxim, "when your feet are cold, put on your hat." Parkas with attached hoods or balaclavas are essential for protection against this dramatic heat loss in cold, windy, and wet situations.

Conduction. Ordinarily, only small amounts of body heat are lost by conduction. But winter campers lose more in this way than others because they carry metal tools (saws, axes, shovels) and often rest by sitting on ice, snow, and cold rock.

Conduction of heat from skin to metal is extremely rapid and can produce an actual cementing of skin to metal by instantly freezing the skin's surface moisture to the metal, with subsequent frostbite or loss of skin. Wearing thin silk or cotton gloves when handling metal protects against this freezing hazard. Climbing without gloves over cold rock is another way heat is lost through conduction.

Handling gasoline or other liquid fuels is especially dangerous at low temperatures. Gasoline stored in a metal canister outside of the tent during a storm will supercool to the lowest temperature attained during the storm. Even covered with an insulating blanket of snow, it cannot rewarm, so when it is dug up its temperature may be as low as 20 to 40 degrees below zero. Spilling such supercooled fluid on your hands will cause instant frostbite, not only from the conduction of heat by the cold liquid, but also by the further cooling effect of rapid evaporation of the liquid as it hits the skin.

Convection. Convection to the air from the body surface is an active avenue of heat escape in the outdoors. The body continuously warms (by radiation) a thin layer of air next to the skin to a temperature nearly equal to that of the skin. If this warm air layer is retained close to the body by clothing, you remain warm. However, if this warm layer of air is constantly being removed by a brisk wind (convection), you feel cool and have to put on more clothing.

In short, the primary function of clothing is to retain a layer of warm air close to the body. In conditions of severe cold and wind, you need garments of high insulating quality.

Evaporation. The evaporation of sweat from the skin, and the evaporation of water from the skin and lungs, accounts for a substantial loss of body heat. But there is very little that can prevent this loss.

In fact, those in the outdoors are well-advised to help, rather than hinder, the process of evaporation by wearing

fabrics that “breathe.” If water vapor cannot pass freely through the clothing, it will condense and freeze.

Respiration. Inhaling cool air and exhaling warm air account for a significant amount of heat loss. This is especially true at high altitudes, at low temperatures, and during heavy exertion. But little can be done to prevent this type of heat loss. Breath will help to warm a tent or a snow cave, but that’s about the extent of its thermal value.

Insulation. Any material that traps air and doesn’t allow it to move around freely is insulation. This trapped air is known as “dead air.” An example of an insulator is a vacuum bottle. It insulates by trapping layers of air between the outside wall and the inner vessel (which holds the fluids), and can keep cold fluids cold and hot fluids hot. It is important to understand that insulation doesn’t differentiate between hot and cold—it retains either temperature. And insulation doesn’t generate any heat. You must be active enough to generate the heat necessary for your garments to keep you warm. As a result, the more active you are, the less insulation you require. A T-shirt may be adequate for strenuous outside work in the fall. But a shirt and sweater may be required indoors for a less energetic activity such as reading.

We have seen that insulation, as we use it in cold-weather camping, is the ability to hold “dead air.” This ability is affected by several factors. Moisture is the greatest concern, since we lose heat to moisture 240 percent as fast as to dry air. Since many items of clothing hold moisture, the following points may prove helpful.

Most natural products are proteins (cotton, wool, etc.) and they are hydrophiles (water-loving, water-gathering). That is, they absorb water in the cell structure of their fibers. Cotton absorbs a great deal more than wool. This lesser degree of absorption prompts the saying “wool is warm even when wet.” However, nothing is warm when frozen! Most synthetics used as winter clothing insulation are nonhydrophilic; they are hydrophobic. Hydrophobic means that they have no ability to combine with or dissolve in water. Polypropylene, an excellent moisture “wicker” used primarily in underwear, absorbs less than one percent of its weight in moisture, as do many piles, Dacrons, etc. This is about one-sixth the absorption of wool. These synthetics are generally much easier to dry since they only hold water on the outside of the fiber, not in the cell structure. The holding of moisture or dead air on the fibers is called capillarity.

Perspiration. This is the greatest cause of moisture buildup in clothing. Outside moisture such as rain, sleet, and snow should be taken care of with proper clothing.

COLD-WEATHER HEALTH PROBLEMS

DEHYDRATION

Dehydration is a condition that results from excessive loss of body water, either from too little intake or too much output, or from a combination of both. Water is taken into the body through the mouth and absorbed from the gastrointestinal tract. It is lost from the body through the lungs, skin, gastrointestinal tract, and kidneys. The maintenance of the body’s water level depends on regular intake of water. Under normal conditions water intake is easily regulated by the “thirst mechanism.” In cold environments, however, the thirst mechanism is not a dependable indicator of body-water needs.

With the onset of dehydration, one of the first things to happen is that the ability to reason is impaired, making decisions difficult. The color of the urine will darken. As the dehydration process continues, the color of the urine will become even darker. Therefore, the color of the urine is a much better indicator of impending dehydration than the thirst mechanism in a cold environment.

When considering body-water balance in cold regions, the phenomenon of cold diuresis (passage of abnormal amounts of urine) deserves mention. The increased diuretic effect during cold exposure is important in considering the implications of dehydration as related to the incidence of cold injuries. Medical records indicate that victims of cold injuries such as frostbite and hypothermia are usually dehydrated to some extent.

Prevention. To prevent dehydration, drink at least two quarts of water a day (not including other beverages) and avoid dehydrating foods and fluids. Fluid intake (water) should be increased at the first sign of changes in the color of the urine, i.e., darker yellow.

Symptoms. A body water deficiency of one to five percent of body weight results in increased pulse rate; loss of appetite or nausea; dark urine color or constipation; irritability, fatigue or sleepiness; or thirst (may not be noticeable in cold weather).

A body-water deficiency of six to 10 percent of body weight results in headache or dizziness; labored breathing; tingling in the extremities; absence of salivation; inability to walk; or cyanosis (skin is bluish or grayish color).

A body-water deficiency of 11 to 20 percent body weight results in a swollen tongue and the inability to swallow; dim vision; deafness; shriveled, numb skin; painful urination; delirium; unconsciousness; or even death.

Treatment. Mild cases of dehydration can be treated by oral intake of fluids. More severe cases require professional medical treatment. In any case, the victim should be kept warm and get plenty of rest.

Prognosis. With early detection and treatment, dehydration should not result in disabling after-effects. However, undetected and untreated cases are prime candidates for developing severe cold injuries such as hypothermia and frostbite.

HYPOTHERMIA

Hypothermia is the lowering of the temperature of the inner core of the body. It can and usually does happen above freezing in temperatures of 30 to 50 degrees. The victim may not recognize the signs and symptoms, and may not be able to think clearly enough to counteract hypothermia. Injury or death may result if hypothermia is not treated.

Predisposing factors include poor physical condition; inadequate nutrition and water intake; a thin build; nonprotective clothing; getting wet (even from drizzle or snow, not just rain); inadequate protection from wind, rain, and snow; and exhaustion.

Symptoms. As with dehydration, one of the first symptoms is the loss of ability to reason. Various factors prevent the body's heat production from keeping up with heat loss. As the body begins to cool at the skin surface, shivering occurs to release heat by increasing metabolism through contraction and relaxation of the muscles.

Shivering may become intense, but if heat loss continues it will cease. The body will try to protect vital organs by cutting off the blood supply to the "nonessential" parts, such as hands, arms, feet, and legs. If heat loss continues, body functions are progressively impaired, blood thickens, the heart is overtaxed, respiration may cease, or cardiac arrest may occur. This is sometimes described as freezing from the inside out.

Signs of hypothermia observed by others include slowing of pace, drowsiness, fatigue, stumbling, thickness of speech, amnesia, irrationality, poor judgment, hallucinations, loss of contact with the environment, blueness of skin (cyanosis), dilation (enlargement) of pupils, decreased heart and respiratory rate, and stupor.

Symptoms that the victim may feel include fatigue; drowsiness; exhaustion; an unwillingness to go on; a feeling of deep cold or numbness; poor coordination; stumbling; poor articulation of words (thickness of speech); disorientation; a decrease in shivering followed by rigidity of the muscles; blueness of skin (cyanosis); and a slow, irregular, or weak pulse.

Treatment. If the victim is unconscious, obtain and maintain an airway. Then check for pulse and respiration, and begin artificial respiration or CPR as needed. Reduce further heat loss as your circumstances allow:

- Shelter the victim from wind and weather.
- Insulate the victim from the ground.
- Replace wet clothing with dry clothes or blankets.
- Put on windproof, waterproof gear.
- Increase exercise, if possible.
- Put the victim in prewarmed sleeping bag or blankets (a cold one will just rob more heat and add to the problems).
- Feed the victim hot drinks followed by candy or high-sugar foods.
- Apply heat from hot stones or hot canteens of water (be careful not to burn the victim).
- Huddle to provide body heat from others.
- Place the victim in a tub of 105-degree water (never go above 110 degrees or you may injure the victim). After the victim is warm from soaking in the tub, dry the victim thoroughly.

Prevention. Don't let this serious condition develop. Get good rest and nutrition before the cold-weather activity, and continue intake of food (particularly sugars) and water during the activity. Wear waterproof and windproof clothing (some of which should be wool). Have emergency bivouac (camping and shelter) equipment, and make camp early in a storm, or if lost, injured, or tired. Exercise to keep up the body's heating function.

Appoint an experienced person to watch others in the group for signs of hypothermia, and always adhere to the hypothermia watcher's decision. Don't let anyone go out on a winter activity without proper clothing, footwear, and emergency equipment. If signs or symptoms of hypothermia are spotted, start corrective action immediately.

FROSTBITE

Frostbite is tissue injury involving actual freezing of skin and underlying tissues. Recovery is slow, normally taking weeks or months. Severe frostbite may lead to gangrene and necessitate amputation of the affected parts. Once exposed, the patient is predisposed to frostbite in the future.

When frostbite occurs, the capillary beds constrict. In later stages, they become damaged. The blood thickens like sludge. The body needs heat elsewhere and redirects the blood flow to protect the internal organs.

Circulation slows. Ice crystals form in skin cells, drawing off moisture and dehydrating them. The skin then can't get the oxygen, nutrients, and liquids needed and can't eliminate wastes, further damaging the tissue. As exposure continues, damage grows deeper in the skin until the full thickness of the skin, including the bone, freezes.

Predisposing factors include prolonged exposure to temperatures 32 degrees or below (15 degrees and below is even more likely to cause frostbite); brief exposure to extremely low temperatures—25 degrees below zero and lower; wind, humidity, rain, or snow (exposed flesh can freeze in 30 seconds at 30 degrees with a 30 mph wind); exposed body parts; restriction of circulation; fatigue, poor nutrition, poor liquid intake, or poor physical condition; previous case of frostbite or other cold injury.

Symptoms. The symptoms of frostbite vary according to the severity of the injury.

First Degree (Frostnip)

Warnings include redness, pain, burning, stinging, or a prickly sensation. Then pain disappears and there is a sudden blanching of the skin (it turns white, gray, or waxy looking). This may happen almost instantaneously in very cold weather and high wind. Occasionally, the skin may look mottled. The skin is firm to the touch but resilient underneath. Later (on thawing) there is aching, pain, brownness, skin may peel off, and the affected part may remain cold for some time.

Second Degree (Superficial Frostbite)

Symptoms include those of frostnip, but there may be no pain; the part may feel dead or "like a stump." With the numbness, the part may be immobile or very hard to move. The tissue is hard to the touch, including the underneath layers. Later there will be pain, large blisters, sweating, and black or discolored skin that sloughs off, leaving tender new skin.

Third Degree (Severe Frostbite)

In third-degree frostbite, all layers of the skin are affected. On thawing, there will be aching and throbbing after the first week for two to five weeks. Swelling and sweating will occur. Black, hard scabs will appear, surrounded by blisters that slough off, leaving ulcers that heal in about 60 days.

Fourth Degree (Severe frostbite)

In fourth-degree frostbite, the bone is affected as well. Later (on thawing), skin becomes black and shriveled or mummified; gangrene may develop, and amputation may be necessary.

Treatment. Frostbite is handled differently, depending on the degree of injury and whether you are in the field or in camp headquarters or another suitable facility. Treatment in the field follows.

Frostnip—Rewarm, cover, and watch closely. Do not rub with snow, hold over fire, or use cold water. Exercise the part. Place hands in armpits or crotch, blow warm air on nose, or place the victim's foot inside your shirt against chest. Make certain that insulation is adequate to prevent recurrence or further injury. Check for hypothermia.

Frostbite—Cover and insulate to prevent further injury. Do not rub with snow, hold over fire, use cold water, or massage. Do not attempt to thaw frostbitten limbs in the field; it is less harmful for the victim to walk out on a frostbitten limb than to thaw it in the field. Once an injury is thawed or partly thawed, the victim must become a stretcher case. Partial thawing may occur while walking, but the victim should continue to walk out to avoid refreezing the part. Check for hypothermia.

Once in camp headquarters or other suitable facility, rewarm rapidly using water at a temperature of about 105 degrees. Be sure not to exceed 110 degrees or you may harm the victim. Thaw frozen boots, gloves, etc., while on the part, and then gently remove them or cut them away carefully. Gently wash the area with soap and dry it thoroughly. Discontinue warming when the part becomes flushed. Place gauze pads or cotton between fingers and toes, then dress the entire part with suitable bandages. Provide bed rest and elevate the frostbitten part. Check for hypothermia and treat for it. Make sure the person is transported to a hospital or seen by a physician as soon as possible.

Prevention. Prevent heat loss with proper insulation—cover exposed skin. Guard against windchill and moisture (dry clothing is 240 times better than wet clothing). Maintain good nutrition, drink water, and keep a good metabolic rate and core temperature. Use the buddy system to check face, nose, and ears for frostnip and frostbite. Periodically make faces, exercise the ears with the hands; keep feet and hands moving. Don't use restrictive clothing; dress in layers.

Remember, when the pain goes away, you are in danger of severe injury from frostbite. If you haven't corrected the problem by then, you are in trouble and need to correct it immediately.

CHILBLAINS

Chilblain has been described as trench foot of the hand, though it may also occur on the lower extremities. The lesions are most frequently located on the back of the fingers, between rather than over the joints. Although any portion of the back of the hand may be affected, the thumbs are relatively safe. Any portion of the lower extremities may also be affected, though the shin, especially in women, is probably the most common location. Skin that has previously been damaged in any way is particularly susceptible to chilblains.

The disease is provoked by cold, above freezing, that is experienced intermittently over long periods of time. It is observed chiefly in climates characterized by moderate cold and a high degree of humidity. The subjects are usually young persons, whose hands are likely to be colder than normal, and sometimes deeply colored, all year round. The majority give a history of daily exposure in a cold, moist atmosphere. As a result, the injury of the preceding day has not been compensated for before there is the insult of added exposure on the succeeding day, and one lesion thus tends to develop over another.

The typical chilblain first appears as a red, swollen, tender lesion, which is usually warm or hot to the touch. The only symptom at this time is itching. When the lesion becomes chronic, the swelling may increase and the tissues may become tender. The color of the skin becomes a deep purple or reddish purple. Blisters may develop and ulcerate. Chilblains may disappear within a few days or may assume a chronic form and last for weeks and months. In the chronic form, itching is replaced by tenderness and pain.

TRENCH FOOT

Symptoms. Trench foot is a thermal injury that results from exposure to cold, short of freezing, in a damp or wet environment. It commonly occurs in temperatures between 32 and 50 degrees. Partial causes include immobility of the limbs (legs and feet down as in sitting or standing), insufficient clothing, and constriction of parts of the body by boots, socks, and other garments. This type of cold injury is almost identical to gradual frostbite, which might be expected, since the primary causes are the same except for differences in the degree of cold. In the early stages of trench foot, feet and toes are pale and feel cold, numb, and stiff. Walking becomes difficult. If preventive action is not taken at this stage, the feet will swell and become painful. In extreme cases of trench foot, the flesh may die or become infected and amputation may be necessary. Because the early stages are not painful, individuals must be constantly alert to prevent the development of trench foot.

Treatment. In treating trench foot, handle the feet very gently. They should not be rubbed or massaged. If necessary, clean them carefully with plain white soap and water, dry, elevate, and allow them to remain exposed. While it is desirable to warm the patient, the feet should always be kept at room temperature. The victim should be carried and not permitted to walk on damaged feet.

Prevention. To prevent trench foot, keep the feet dry by wearing waterproof footgear and by keeping the floors of shelters dry. Clean and dry socks and boots at every opportunity, preferably daily. Dry the feet as soon as possible after getting them wet. They may be warmed by the hands. Apply foot powder and put dry socks on. If it becomes necessary to wear wet boots and socks, exercise the feet continually by wiggling the toes and bending the ankles. Never wear tight boots.

SNOW BLINDNESS

Snow blindness occurs when the sun is shining brightly on a expanse of snow, and is due to the reflection of ultraviolet rays. It is most likely to occur after a fall of new snow, even when the rays of the sun are partially blocked by a light mist or fog. The risk is also increased at high altitudes. In most cases, snow blindness is caused by negligence or failure to wear sunglasses. Waiting for discomfort to develop before putting on sunglasses is unwise. A deep burn of the eyes may already have occurred by the time any pain is felt. Putting on sunglasses is essential to prevent further injury, but the damage has already been done. Symptoms of snow blindness are a sensation of grit in the eyes, pain, and increased pain on exposure to light. First-aid measures consist of blindfolding, which stops the painful eye movement, or covering the eyes with a damp cloth, which accomplishes the same thing. Rest is desirable. If further exposure to light is unavoidable, the eyes should be protected with dark bandages or the darkest available sunglasses. The condition heals in a few days without permanent damage once unprotected exposure to sunlight is stopped.

CARBON MONOXIDE POISONING

Carbon monoxide poisoning is a constant threat during all cold-weather operations. Carbon monoxide is created by incomplete combustion of fuel because of insufficient air supply. Any shelter that is heated is a danger, particularly a vehicle with a personal heater. Carbon monoxide is odorless, colorless, and tasteless; it can kill instantly. The first symptom of the poisoning is a tightness across the forehead, followed by a headache and pounding of the heart. Weakness and unconsciousness follow in a very short time.

Treatment. Fresh air, oxygen, warmth, and rest are the treatments for carbon monoxide poisoning. Artificial respiration may be a lifesaver.

Prevention. All heated shelters and vehicles must be ventilated. Windows or doors must be left open to allow fresh air to circulate, regardless of the temperature.

THE OKPIK CLOTHING SYSTEM

The illustrations show samples from a clothing system based on layers that work well in most cold weather camping, whether there are cold-wet, cold-dry, or Arctic-like conditions. Layers are important, since they supply the insulation necessary to keep the body's warmth controlled. They can also be adequately ventilated to control the buildup of perspiration within the clothing. This clothing uses layers that fit loosely, one over the other, and without constriction. The outer garments should be water repellent, or in areas of extreme wet during cold-wet times, a breathable waterproof garment may be important.

The following is a description of the garments illustrated:

1. *Parka (outer)*, wind- and water-resistant or water-repellent.
 - a. A hood is necessary on any well-designed winter garment. Adjustments should include the face closure.
 - b. A covered storm flap using either zipper, hook and pile, snaps, etc., should be a minimum of 18 to 22 inches in length, easily sealed for weather protection, and easily opened for ventilation.
 - c. Sleeves should be cut to maximize the use of layers worn underneath.
 - d. A sleeve closure, preferably of hook and pile or snaps, should not constrict clothing or circulation in the wrist area.
 - e. Pockets should be large enough for easy access and covered for protection from snow and rain. A kangaroo-type pouch over the front panels of the overparka works very well.
 - f. Waist adjustment.
 - g. Bottom drawcord or adjustment.

- h. Kangaroo pocket area.
 - i. Length should be to mid-thigh or below, covering all inner layers.

2. *Parka Liner (inner, insulated)*

- a. The hood must be sized to fit the outer hood of the parka.
- b. A ventilating flap should be sealed by hook and pile, zipper, etc.
- c. Fixed or removable sleeve to fit outer parka.
- d. Sleeve closure.
- e. Sleeve closure device.
- f. Length of sleeve should be 2 to 3 inches short of the outer parka length.
- g. Sleeve connection to jacket.
- h. Large open area under the arm is for ventilation.
- i. Length should be 2 to 3 inches short of the outer garment.

3. *Removable Sleeves (letter C of Parka Liner)*

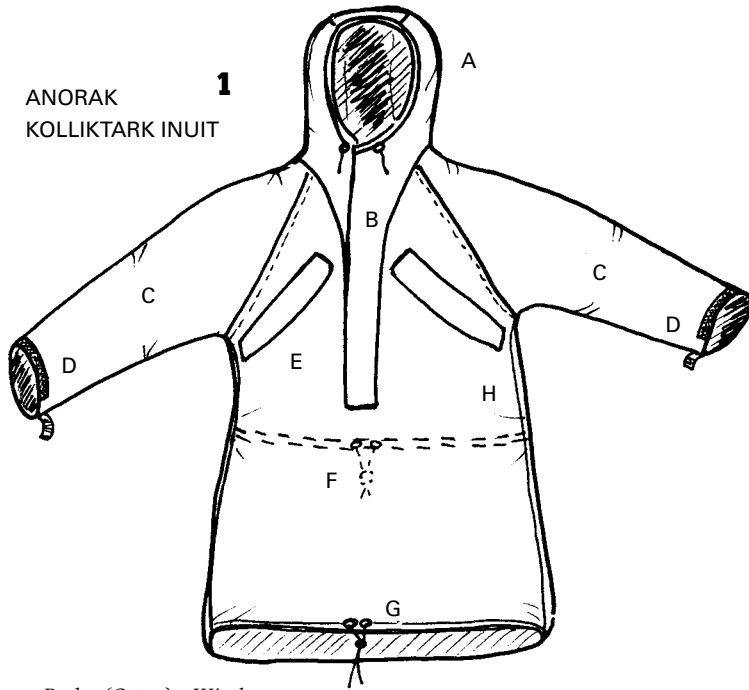
These sleeves can be used for emergency mittens, emergency foot covers, etc. Emergency mitten from sleeve:

- j. Tab for neckcord.
- k. Thumb.
- l. Palm made from corduroy, etc.

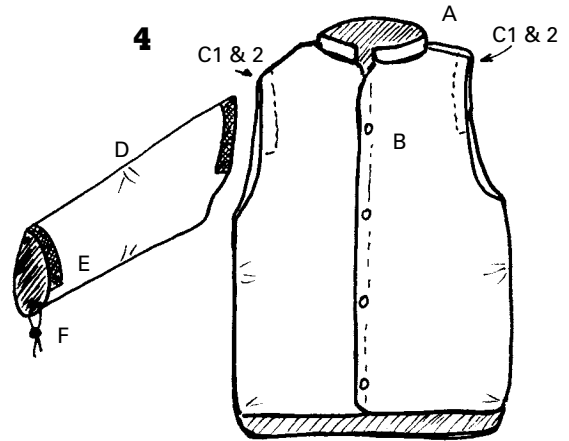
4. *Vest (with or without removable sleeves as described before)*

- a. Collar.
- b. Fastening can be hook and pile, snaps, buttons, zipper, etc.
- c. Sleeve connection.
- d. Sleeve.

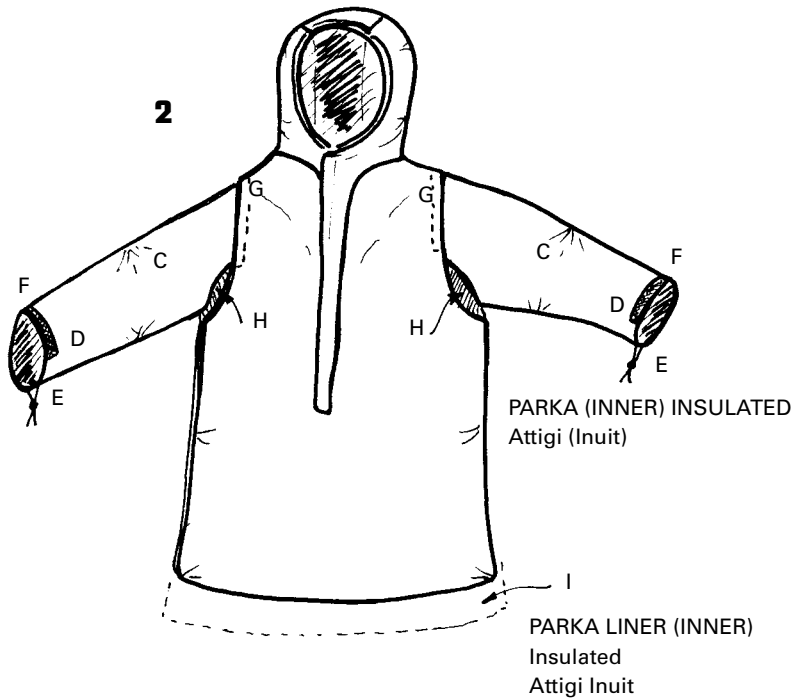
ANORAK
KOLLIKTARK INUIT



*Parka (Outer)—Wind
and Water Resistant*

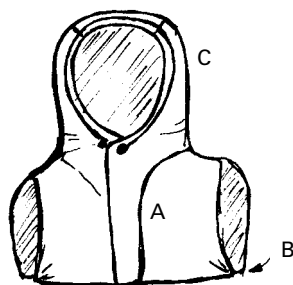


Vest (With or Without Sleeves)

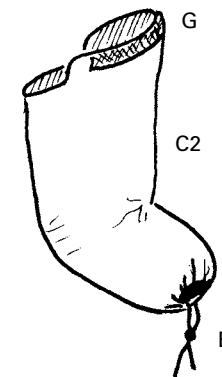
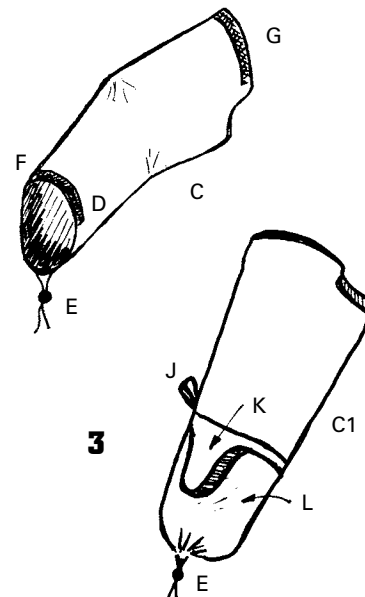


PARKA (INNER) INSULATED
Attigi (Inuit)

PARKA LINER (INNER)
Insulated
Attigi Inuit



Hood



Removable Sleeve

5. Trousers.

- a. Back pocket.
- b. Suspender cord.
- c. Belt loops.
- d. Covered pocket front.
- e. Cord for tying around leg.
- f. Front fly.
- g. Loops for attaching straps from cargo pocket at (e) for controlling ventilation, etc.
- h. Pull cord at cuff.
- i. Cargo pocket.

6. Wind Pants

- j. Slit to reach through pocket.
- p. Adjustment for waist sizing.

7. Trousers Liner

- q. Buttonhole attachment to trousers (No. 5).

8. Wind Pant Liner

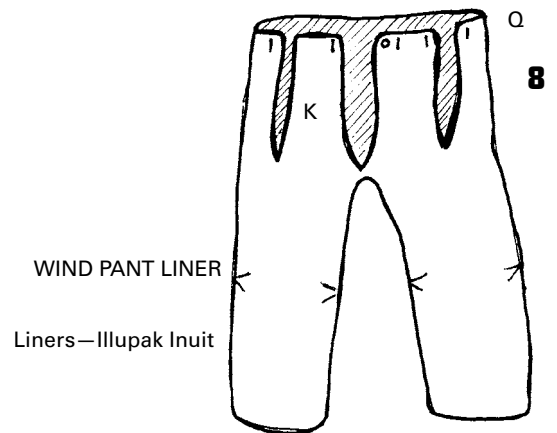
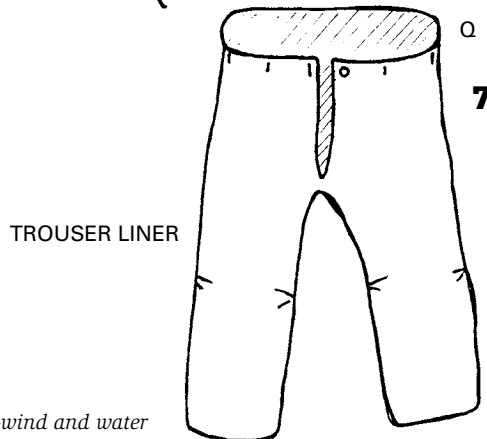
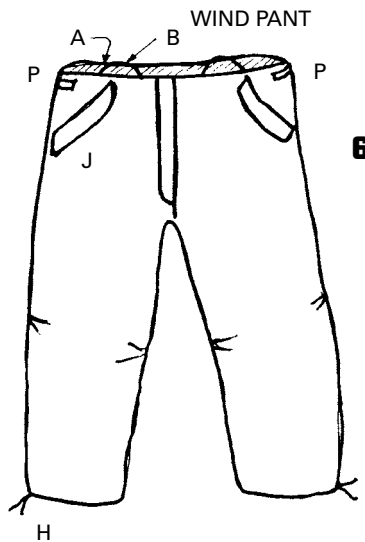
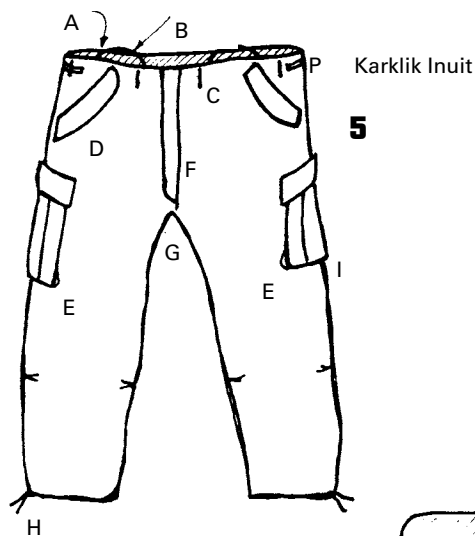
- k. Slit for pocket use.
- q. Button attachments for wind pant (No. 6).

9. Liner Trousers (Can take the place of trouser liner, No. 7).

These convertible pants can be used in a sleeping bag for feet and lower leg protection.

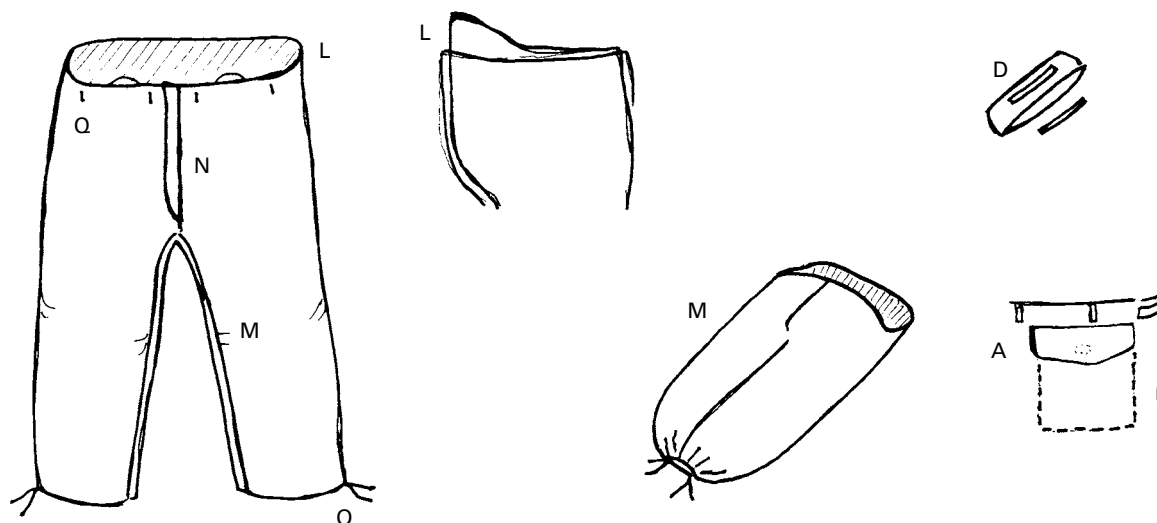
- l. Higher kidney protection in back, if preferred.
- m. Openings so that inseam can be attached to convert to a sack.
- n. Fly.
- o. Cuff or bag closure.

These items make up the Okpik clothing system and are used in conjunction with various footgear, including the mukluk with foam or conventional liners; upper body protection to include cheek protectors, hats or caps, balaclava, scarf, headcover, etc.; and hand protection with gloves, wristlets, mittens, and protective overmittens.



Parka (outer)—wind and water resistant trousers

9



CLOTHING—THE KEY TO COMFORT

Headgear. This is a matter of personal preference, but it is always a good idea to have at least one stocking cap or knit cap for use under a parka hood or in the sleeping bag. Soft, insulated caps with ear flaps are good but should be loose-fitting.

Eye Protection. Goggles are best, but sunglasses and homemade snow shields will reduce glare from sun off the snow, a situation that can cause painful problems and even snow blindness.

Scarf. Wool or synthetic fiber makes an excellent cold weather protector, but make sure the scarf is plenty long.

Parka. The anorak or pullover parka should be windproof, reach almost to the knees, and be large enough to fit over all the other garments. It should have a hood.

Hand Covering. This is a matter of personal preference that can be made up of any loose-fitting combination of the following: wool gloves, wristlets, wool mittens, foam mittens, Dacron mittens, leather overmitts, or wind and waterproof expedition mitts.

Jacket. A lightweight jacket used in combination with other outer garments makes a better "layering" system than one thick, heavy jacket. A hood for extreme cold is a welcome addition.

Vest. This insulated garment keeps the vital organs, heart, and lungs warm. The best style has a flap in back to protect the kidneys. Detachable sleeves convert a vest to an insulated jacket.

Sweater. Wool or wool synthetic sweaters will keep you warmer.

Shirts. Wear full-cut, loose wool or wool and synthetic fiber.

Long Underwear. This can be wool, wool and cotton, wool and synthetic fiber, or synthetic fiber. Keep a spare set for emergencies and to sleep in.

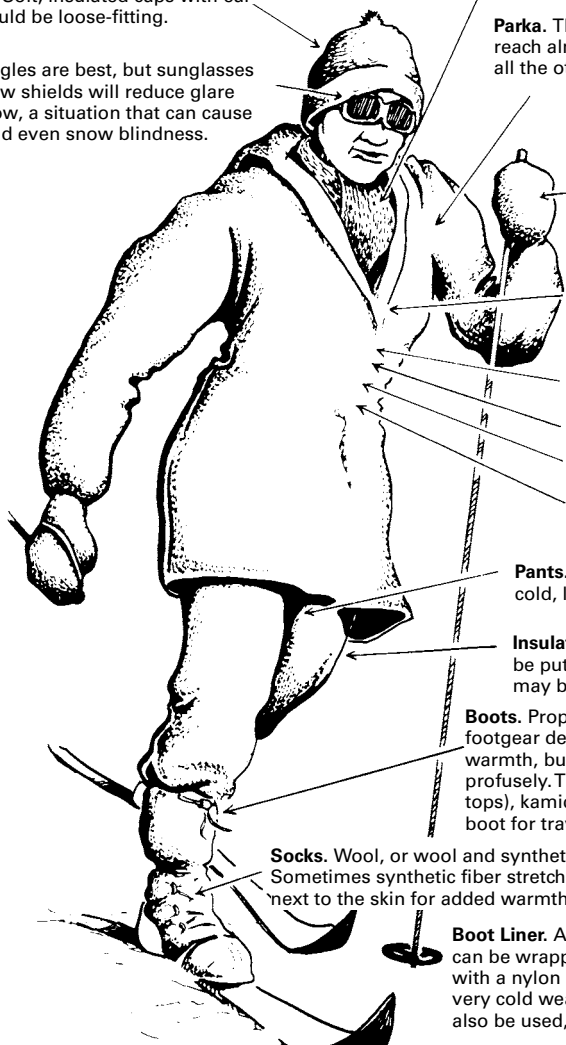
Pants. Wear full-cut pants, preferably with suspenders. In extreme cold, lightweight, windproof pants may be worn over everything.

Insulated Chaps. Equipped with snaps down the inseam, they may be put on or taken off without removing the boots. Taken off, the legs may be zipped together to form a half bag inside the sleeping bag.

Boots. Proper footgear is essential. The Okpik program uses a variety of footgear designed for different needs. A boot should fit somewhat loose for warmth, but the adage "cool is comfortable" is true; the feet should not sweat profusely. The boots used are rubber, rubber-bottom pacs, mukluks (high tops), kamiks (low tops), moccasins, and ski boots. A combination of a light boot for travel and a thickly insulated boot for camp sometimes is used.

Socks. Wool, or wool and synthetic, is good. Sometimes synthetic fiber stretch socks are worn next to the skin for added warmth.

Boot Liner. A specially cut piece of 1-inch foam can be wrapped around the foot, held in place with a nylon sock, and used with the mukluk in very cold weather. Quilted, synthetic liners can also be used, as well as left liners.



WHAT KEEPS YOU WARM?

When you really study what keeps you warm, it becomes clear that it is you. Your body produces all the heat you need. Your clothing is designed to hold in whatever heat you need to feel comfortable under a variety of conditions. Cold-weather clothing should be loose, because tight clothing constricts the flow of blood so that body heat cannot move around, just like when a faucet is turned off. That is why tight boots mean cold feet and a tight belt means cold legs.

COLD is an easily remembered key to keeping warm.

C

Keep yourself and your clothes **Clean**. Dirt and body oils that build up on clothing destroy its insulating properties.

O

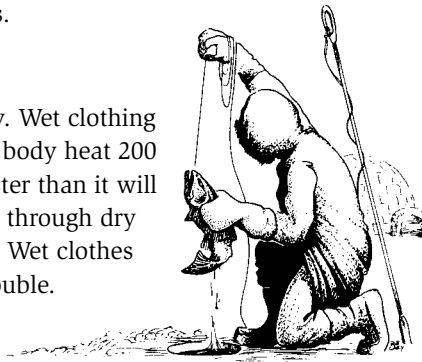
Avoid **Overheating**. Clothing is designed to be taken off or added to in layers to maintain an even body heat.

L

Wear clothes **Loose** and in **Layers**.

D

Keep **Dry**. Wet clothing removes body heat 200 times faster than it will dissipate through dry clothing. Wet clothes mean trouble.



Ventilation. To regulate the amount of heat, yet not get overheated and wet with perspiration, adjustments can be made to loosen clothing at the waist, the cuffs, and the neck opening, allowing more heat to escape.

Wet, Windy, Cold. This is the combination that spells danger to the winter camper. You can avoid it by keeping dry, getting out of the wind when possible, and wearing the correct clothes.

YOUR SLEEPING SYSTEM

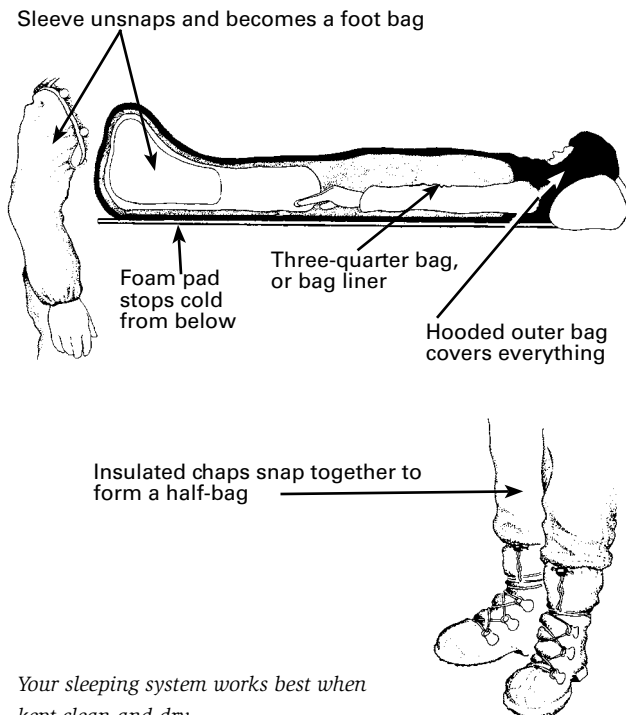
Essentially, you are sleeping in four layers of insulation, with a fifth layer underneath you to insulate you from the frozen ground. It is important to first make sure that your feet are warm. The sleeves in your parka are made to unsnap so they can be pulled over your feet like boot liners when you crawl in for the night. The insulated chaps can be unsnapped and converted from individual leg coverings to a single bag that further protects the feet and lower extremities in the sleeping bag. The third layer is the three-quarter bag, which comes up to the armpits and has a drawstring that allows it to be tightened slightly to capture heat. The outside layer is a hooded sleeping bag, which covers the entire system from feet to head and has a drawstring that allows the opening to be pulled snug around the face to prevent loss of body heat.

Fire as a Heat Source. Nowhere in the information on winter clothing or sleeping systems will you see any provision for fire to provide body heat. Fire in the winter is a “false god” in regard to warmth. The body itself is like a big furnace. You stoke your furnace with good food; it burns the food and provides the heat that your heart circulates through your body. Layers of insulation determine how much of that heat is retained and how warm you will feel. Fire is useful for turning snow into water, for its cheerful glow, and for heating water in an emergency. Extreme care must be taken around an open fire not to get too close with synthetic fiber garments; they can shrivel or melt just from reflected heat.

Types of Bags. Inner bags and outer bags may be made of synthetic fiber that can be rolled up compactly for travel. These are particularly tailored for long-distance trips in the winter. The cold weather foam outer bag is very warm and, while somewhat bulky, can be laced down and compacted into a serviceable size for travel.

Temperature. This indicates how much of the system you will need. In warming situations, only part of the system may be needed. The winter camper adds or takes away individual items to maintain personal comfort. In extreme cold, with the entire system in use, clothing, plus a knit cap, also adds warmth inside the bags.

Sleeping Pads. These are essential for insulating the body from the cold ground. They come in three types: closed cell foam; open cell foam used with a closed cell pad; and insulated air mattress.



Your sleeping system works best when kept clean and dry.

LAYERED CLOTHING

It is a very old idea to wear lots of clothes when you are cold and remove them layer by layer as you get warm. While layering is an old idea, its use today with modern garments gives you a versatile, thermally efficient, and convenient way of dressing for all outdoor activities. It is useful to classify clothing in four layering categories, according to principle function:

- The underwear layer maintains a comfortable microclimate next to your skin.
- The clothing layer absorbs moisture and provides some insulation.
- The insulation layer provides additional warmth.
- The shell layer protects against wind, rain, snow, and sun.

The human body is most comfortable when its heat production is balanced by its heat loss. Twenty-six centuries ago, Lao Tsu wrote, "Movement overcomes cold. Stillness overcomes heat." This is one-half of the equation. The other is choosing the right layers of clothing.

UNDERWEAR LAYER

While the underwear layer provides some insulation, its primary function is to control moisture on the skin. Warmth is provided by the middle layers: clothing and insulation.

The underwear layer works to keep your skin comfortable. In hot weather, most people prefer loose, absorbent clothing. Air can flow freely next to the skin, cooling and drying, while perspiration is absorbed by the material. Cotton, silk, and even lightweight wool feel comfortable in heat.

In cool weather you want the warmth of dry, snug-fitting garments against your skin. If your perspiration rate is low, it doesn't matter whether this layer is made of cotton, wool, silk, or synthetic fiber. All perform well, each with its own special advantages. However, if you are active and perspiring, fibers like plastic polypropylene can keep your skin drier than the absorbent natural fibers.

Rather than absorbing moisture like the natural fibers, polypropylene and other synthetics work by repelling water. Therefore, to function effectively, polypropylene must be thin and in close contact with skin so that sweat can be physically forced through it. Polypropylene is even more effective if you add a top layer to absorb the transferred moisture.



CLOTHING LAYER

The shirt, sweater, and pants you wear over your underwear are important parts of your layering system. This layer provides more insulation, some protection from the elements, and it absorbs perspiration. For most fibers, warmth results from trapping air and keeping it from swirling around, so there is no transfer of heat. The air between layers gives additional warmth, so the fit and closure of your clothing are important for temperature regulation.

Sweat transported by the inner layers either evaporates or is absorbed by outer clothing. The amount depends on the materials and fit of the garments. A snug-fitting, absorbent clothing layer is most comfortable for active use.



INSULATION LAYER

Thickness is warmth. By varying your selection and the closures on your insulation layer, the many moods of the weather can be matched. Remember that in severe conditions, you need complete protection; be sure to insulate your legs and extremities as well as your body.

The two most important factors are insulation efficiency and reliability. Nylon fleece, polyester pile and batting, goose down, and wool all have the same thickness and are not saturated with water. The exceptions to this rule are some high-density foams and synthetics, such as Thinsulate. These give almost twice as much insulation per inch of thickness because of their unusually short radiation path lengths. If comparisons are made by weight, however, goose down is still unmatched as an insulator.

For active use, insulation reliability when wet is especially important. Synthetics are superior in this regard, because they retain more of their loft and insulation while absorbing less water.

SHELL LAYER

Outer shells are designed to protect you from wind, rain, snow, and even sun. A shell may be your most important garment in a layering system. Measurements show that in still air, windshells add 10 to 25 degrees to the warmth of any garment. In windy weather, windshells increase warmth by 50 degrees or more.

Three basic types of cloth are used in constructing shells:

1. Cloth that is windproof, but not waterproof, and allows water vapor to evaporate (uncoated nylon, cotton, or blends of these fabrics)
2. Cloth that is both windproof and waterproof, and does not allow water vapor to evaporate (urethane-coated nylon)
3. Cloth that is both windproof, and waterproof, and allows water vapor to evaporate

If you do not expect rain, you may be most comfortable with a type 1 shell that is lightweight and windproof, but not waterproof. In rainy conditions you will want to choose between types 2 and 3.

Some shells are made of fabrics with tiny holes small enough to keep water droplets out while allowing water vapor to evaporate. They work well if the rate of perspiration is low, there are significant temperature and relative humidity differences between the two sides of the material, and the outer fabric surface is not coated with a layer of water.

No material is absolutely waterproof. If you are working hard outside in pouring rain, you will get wet no matter what you wear. While it may be impossible to keep dry, it is possible to be comfortable (even though damp) by adjusting your clothing.

FINAL TIPS

As you combine these layering suggestions with ideas of your own, keep these points in mind. To layer effectively, consider the whole body. Sweaters can't compensate for the heat lost through bare legs; pants won't keep the head warm. Remember, too, that wind, dampness, and fatigue reduce comfort levels. Give yourself some margin for error by taking extra clothing. With just a little planning, layering can keep you comfortable for all outdoor activities.

FOOTWEAR

Hiking or backpacking boots are one of the most important items of outdoor equipment you can own. You want the right boots for your needs. This part of the chapter will help you in making the right choice by explaining some of the construction features and methods used in bootmaking. It will also help you determine which boots are best suited to your hiking and climbing needs.

DIFFERENT BOOTS FOR DIFFERENT USES

There are four major types of boots, each designed for a specific use. You will probably want either a hiking boot or a backpacking boot. Mountaineering and rock climbing boots are probably beyond your needs. If you are interested in these, check them out with a store that sells them.

Hiking Boots. Intended primarily for those who hike by day or make short backpacking trips on fairly easy terrain, hiking boots are lighter than their backpacking and mountaineering cousins. They are flexible and easy to break in, and they usually have shallower lug outsoles. Uppers are leather and either fabric or the increasingly popular fabric-leather combination. There is a trend toward lighter boots because they decrease hiking fatigue. Buy the lightest boot that will meet the conditions you will generally face.

Backpacking Boots. Ruggedly built for sustained backpacking trips, these are heavier, stiffer, and stronger than hiking boots. The upper is cut higher for ankle support. Extra midsoles and thicker, stiffer uppers support the foot and provide protection. Outer soles have deeper lugs to grip on steeper trails.

Wet Weather Boots. Wet weather boots need to provide protection from moisture entering the boot and be breathable to allow body moisture to escape. Old-fashioned galoshes with felt liners do a pretty good job. Creating a vapor barrier works for a short time only and tends to cause trench foot. The alternative is to buy expensive boots that often are not any more effective than galoshes.

Most of the time, hikers and backpackers should avoid trekking in wet weather, especially during the spring melt. Traveling on wet, muddy trails tends to create very high impact that can be avoided by scheduling a trek for another time that is likely to be drier.

SOLE CONSTRUCTION

Shallow lug soles are lighter, flex easily, and give good traction on easy to moderate slopes. They are generally coupled with lightweight hiking and backpacking boots.

Midsoles. Sandwiched between the outer sole and insole of a boot are midsoles to provide support and extra protection. Two leather midsoles and one rubber midsole is the combination for most mountaineering and backpacking boots; hiking boots usually have one rubber midsole. Foam rubber midsoles found in some lightweight hiking boots are cushioned and are sufficient for easy trails.

Steel shank. Between the midsole and insole of most boots is a steel shank to make sure the sole flexes at the ball of your foot. Half-length shanks are used in hiking and backpacking boots; mountaineers usually need three-quarter or full-length shanks for rigidity. Plastic mountaineering boots, which have inherently rigid, molded soles, do not have shanks.

CARE AND MAINTENANCE OF LEATHER

To prolong the life of your boots, treat them with care. Brush off dirt and caked mud as soon as you return from a trip. If boots should get soaked, stuff them with newspaper and store them in a cool, dry place; never attempt to dry them near a heater, stove, or open flame. As soon as they are dry, apply waterproofing and seam sealer.

SLEEPING BAGS

TO SELECT A BAG

Before you purchase a sleeping bag for cold-weather camping, examine your needs and select one of the following categories. Then check the fills of bags in that category. Finally, check the construction features of the bags.

SLEEPING BAG CATEGORIES

The **camping bag** is designed to be carried in a car. It is usually designed more for comfort than for thermal efficiency. The bag is most often rectangular, heavy or bulky, and not easily compressed. It can be used in temperatures above 32 degrees.

The **backpacking bag** is designed to fit in a backpack. This bag is usually a modified mummy bag, a thermally efficient shape. The fill is typically made of fibers that are compressible yet resilient. The bag should weigh less than 5 pounds and have a temperature comfort rating of 30 degrees or lower.

The **winter expedition bag** should have a temperature comfort rating of 0 degrees or lower. It must fit on a pack frame and be of the highest quality because of the often life-threatening situations of its use. This bag will be heavy; to increase warmth we must increase weight.

FILLS

There are many fills for sleeping bags, ranging from wool batts, to many types of polyester, to goose down. The fill has a great deal to do with the size and warmth of the bag. When investigating sleeping bags in a store, be sure to check on whether the fill will shift during use, making cold spots in the bag. The amount of loft is also important. It indicates the insulation factor.

What happens if your sleeping bag gets wet? If your bag is completely soaked, it will lose insulation and be wet for hours. A synthetic bag will lose about 10 percent of its warmth while gaining 60 percent in weight. Synthetics drip dry in less than a day.

If your bag is down-filled and watersoaked, it will lose more than 90 percent of its warmth, gain 128 percent in weight, and take more than a day to dry. This becomes a major concern if you plan to use your bag in wet or humid conditions.

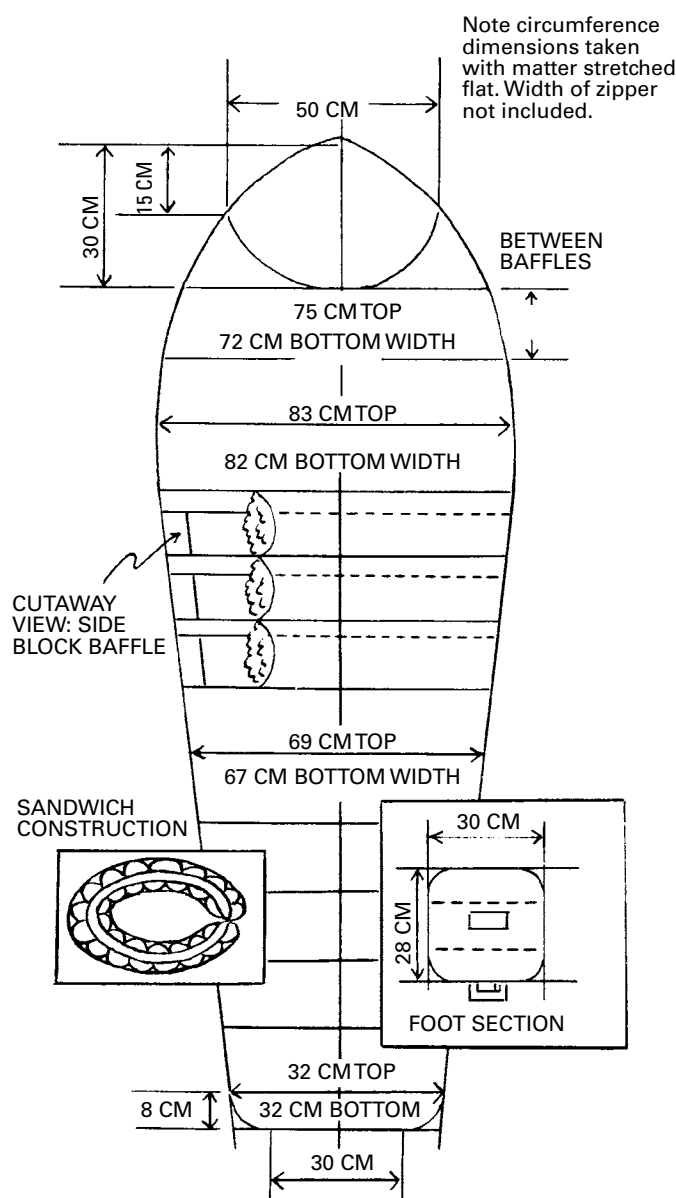
Carry your bag in a waterproof sack and sleep in a waterproof tent to minimize wetness problems.

CONSTRUCTION

Check out the construction of the bags. The interior construction is hard to check except by asking questions at the store. External construction is easier to examine. Here are a few things to check for:

- Start with the stitching. If you can snag it with your fingernails, it's suspect.
- The shell should be of a fabric that does not allow the insulation to filter through. Uncoated fabrics are best so that body moisture can easily pass through.

- Turn the bags inside out to see how they are finished. In better bags, inside seams are stitched to seal fabric edges.
- Check the diameter and length of the draft tube. It should be longer and larger than the zipper it is covering.
- Check for zipper stiffener, a webbing strip running the length of the zipper to prevent snagging.
- Take off your shoes and climb into the bag. It should be cut generously enough to allow elbows, shoulders, knees, and feet to move without compressing the loft. Though you need to move, you don't want too much room. Excess room increases air flow and reduces the bag's thermal efficiency.
- Draw the hood closed to make sure that the air hole is near your mouth.



THE COMFORT RATING SYSTEM

Good sleeping bag manufacturers list a comfort rating on each bag. These will range from a summertime temperature to an Arctic condition. Pick the bag that has a comfort rating comparable to the coldest temperature in which you will be sleeping.

You should be comfortable sleeping outside at the bag's minimum temperature. But, you may have to partially unzip a bag or wear an extra sweater if conditions are different from those specified.

DO YOU HAVE TROUBLE KEEPING WARM?

Your body metabolism affects how warm or cold you are when you sleep. Physically fit people and those with more muscle tend to sleep warmer, but anyone can improve comfort and warmth while sleeping by remembering the following tips:

- Sleep on a pad. Sleeping pads provide insulation and comfort. Air mattresses, while soft and comfortable, offer virtually no insulation.
- Drink plenty of water, even in cold weather. Dehydration from lack of liquids results in poor circulation to the extremities, causing them to become cold or even to freeze.
- Eat before going to bed. Hot foods are especially helpful.
- Go to bed warm. Exercise to raise your body heat before sleeping.
- Wear a hat to bed to control heat loss from the head and neck area.
- Wear dry clothing for sleeping, and the more the better, up to the point where you're constricted. Waterproof clothing adds lots of warmth but will cause some condensation of perspiration.
- Use tents, shelters, or sleeping bag covers to get out of the wind. Wind reduces the insulation effectiveness of sleeping bags just as it does with clothing.
- Place a bottle of hot water in your bag.
- Sleep close to another person.
- Sleep on your side in a fetal position, with extra clothing under your shoulder and hip.
- Buy a warmer bag than you think you will need.

CARE AND CLEANING

Synthetic sleeping bags insulated with polyester fill can be hand or machine washed. A mild soap works well. Always rinse thoroughly; never use detergents or dry clean a synthetic-filled sleeping bag.

Use only the oversize, commercial, rotating drum washer; do not use a domestic, top-loading agitator. Use warm or cold water.

When drying a synthetic bag, use the lowest possible heat setting. Better still, line dry—it only takes 24 hours to dry most synthetic bags at room temperature.

Down sleeping bags should be hand washed. A mild soap will suffice. Never use a detergent, as this will wash out the oils and destroy loft.

A down bag can be washed in a sink or bathtub using warm water. Hand washing will not remove stubborn stains, but the final result will be a clean bag with a surprising amount of loft. You may wish to soak heavily soiled items for several hours.

Gentle squeezing is all the agitation required; more rigorous action may cause seams to rip because down absorbs a great deal of water and becomes much heavier. Drain the water from the tub, pressing gently on the bag to remove excess water. Refill the tub with fresh water and agitate gently. After a thorough rinsing with at least three water changes, gently squeeze out as much water as possible.

Hang bag to air dry, remembering to support it evenly. After two to four days, the bag can be machine dried. Sleeping bags should not be dried in household dryers; only a large, commercial dryer has enough room. Use low heat and toss in a clean pair of tennis shoes; these help break up clumps of matted down.

Down bags can be dry cleaned, but it is imperative that the cleaning fluid used is Stoddard's solvent. Conventional dry cleaning fluids will remove the oil from the down and destroy the loft.

You don't need to clean your down bag often. Try to keep your bag clean in the first place and wash it only when the loft has noticeably decreased or when it is noticeably soiled or sweaty.

STORING THE BAG

To receive the best performance from your sleeping bag, it is essential that it be stored properly. A bag that is stored compressed (in a stuff sack) will lose its loft and its insulating ability. All fibers have a "memory." If the fiber is compressed for a long period of time it will "set" and remain compressed when released. To prevent this, all bags, synthetic or down, need to be stored in large storage bags or hung up by the foot. The more the bag is allowed to loft, the better it will serve you.



FOOD, WATER, AND SANITATION

Food, water, and sanitation are important considerations for cold-weather camping. Food should be easy to prepare and provide the calories and bulk necessary to provide you with heat and energy, as well as supply needed nutrients. Plans should be made to collect and purify water as needed. Finally, eating and drinking necessitate plans for sanitary waste elimination.

NUTRITION

Except under survival conditions, well-clothed, sheltered, and trained campers use little more food in the cold than in moderate temperatures. However, caloric intake in cold weather increases for two reasons. First, the extra activity required by dressing and the hampering effect and weight of that clothing increases energy needs. Second, the stimulus of the cold gives you a ravenous appetite. However, because the body "fires" burn somewhat hotter in cold weather and because food affects morale, you will want to supply your group well.

Foods come from animal and vegetable sources, and serve three functions in the body:

- Serve as fuel to provide heat energy or calories.
- Provide materials for building, repairing, or maintaining body tissues.
- Help regulate body processes.

Calories measure the amount of energy in the food you eat. They are furnished by carbohydrates, fats, and proteins.

Carbohydrates. Carbohydrates are the main source of energy. They are grouped together as starches, sugars, and celluloses. Starches and sugars are quick-energy foods because they provide only energy. Starches are found in bread, cereals, flour, and potatoes. Sources of sugar in the diet include ordinary white or brown sugar,

milk, and fruit. During digestion, starches and sugars are turned into simple sugars, which are then oxidized to give energy. The body does not digest cellulose (dietary fiber), but fiber helps move food wastes through the digestive tract, making them easier to pass. The best sources of fiber are whole grain cereals and breads, nuts, seeds, fruits, and vegetables.

Fats. Fats are the highest-energy food, providing about 9 calories per gram. Carbohydrates and proteins each provide about 4 calories per gram in metabolism. They also furnish the natural sources for the fat-soluble vitamins A, D, E, and K. Fats can be either animal or vegetable in origin. Fats give a diet its “staying” qualities, helping to satisfy your appetite.

Fats and carbohydrates are called “protein spacers” since their presence prevents the body from having to burn its protein (blood and muscle) to give energy. The body selects carbohydrates to burn first, then fat, then protein, because of their relative ease of metabolism. A diet consisting of 40 percent fat, 40 percent carbohydrates, and 20 percent protein appears to be best in cold weather, for a number reasons.

Protein. Protein is the most common substance, other than water, in your body. Its main function is the growth and maintenance of body structures. Supplying energy is a backup function for protein. Carbohydrates and fats have the primary responsibility for supplying energy. Protein serves this function only if not enough of those nutrients are available to meet the body’s energy needs. Protein can be either of animal or vegetable origin. Proteins are made of building blocks called amino acids. Most of the amino acids can be manufactured in your body, but some cannot, so these essential amino acids must be supplied by the foods you eat. Protein from animal sources (meat, fish, poultry, milk, and eggs) supply all of the essential amino acids. Protein from vegetable sources (beans, peas, whole grains, and nuts) may have several of the essential amino acids, but rarely all of them.

Protein has another remarkable property: the specific dynamic action by which protein, in its own digestion and oxidation, increases body metabolism by 30 percent. This is a source of heat in addition to that normally produced by the muscles and the liver. In the cold, protein is an additionally protective food. Because the byproducts of protein metabolism are dependent on the kidney for excretion, water intake must be kept up to prevent damaging hard-worked kidneys when increased protein is eaten. This liquid can be in almost any form (water, fruit drinks, hot thin soups), except coffee. Not only does coffee increase nervous tension in cold climates, but it also causes excess dehydration by stimulating kidney function. This decreases the body’s ability to handle protein excretion.

PROVISIONING

Using *Best and Taylor’s Physiological Basis of Medical Practice* as a reference, the best average temperate-climate diet follows, along with a recommended cold-weather diet.

Food Element	Temperate Climate	Cold Weather Climate
Carbohydrates (4.1 calories/gram)	53 %	40 %
Fats (9.2 calories/gram)	35 %	40 %
Proteins (4.1 calories/gram) (first-class proteins: meat, milk, eggs)	12 %	20 %

The number of calories required per day is based on many factors and should be matched to the individual and the circumstances.

The quantity of calories utilized in winter programs depends on many factors: weather, temperature, type of activity, etc. The following example of a day’s ration is designed to be adjusted from between 3,000 and 4,000-plus calories per day.

This ration should be consumed along with 2 to 3 quarts of water per day. The amount of water can be increased depending upon the amount of work, the temperature, etc.

BREAKFAST

Breakfast should provide a moderate amount of energy but enough fat to satisfy your appetite. A good breakfast might include:

- Hot cereals—Oat, wheat, rice, corn, grits, etc.
- Cake bar or granola bars.
- Fruit—A single item like raisins or mixed fruit. Sauce can be added to make a fruit soup.
- Fruit juice—A pure fruit juice, not a fruit-flavored drink as is used for lunch and dinner. The primary purpose of this juice is to provide liquid, sugar for energy, and vitamin C.
- Hot drink—Can be cocoa but should not be limited to this product alone. Other good hot breakfast drinks include tea, eggnog, and spiced hot cider.

Breakfast Preparation. Hot cereals can be either cooked or instant. A variety of preparation methods can be used, including use of a fireless cooker for overnight cooking. Cereals should be sweetened with honey or brown sugar, with refined white sugar being a last choice. Wheat germ can be added to any cereal to increase its nutrient value. The fat for breakfast comes mainly from butter or margarine added to hot cereal. Corn oil margarine is a good choice.

Dry fruit can be eaten as is or made into fruit soup by adding a sauce and hot water. Cake bars are high in carbohydrates and supply needed energy in the morning. They can also be broken up and added to cereal.

Fruit juice can be consumed either hot or cold. If it is to be served hot, add the mix to hot, but not boiling, water. Boiling destroys vitamin C. Prepare the hot drink according to instructions, remembering that the hotter the drink is, the more likely your body will sweat to cool itself. A warm drink is better than an extremely hot drink.

LUNCH

Lunch should provide high-carbohydrate energy with a minimum of preparation. A good lunch will include:

- Hard, fortified crackers or Hudson Bay Bread
- Spread for crackers—peanut butter, honey, jelly, etc.
- Fruit drink, hot or cold
- Hot soup or other hot dish—baked beans, etc.
- Fruit—applesauce, etc.
- Trail snack

Lunch Preparation. Lunch items should be prepared ahead, or require little or no preparation, so they can be eaten during the morning and early afternoon as well as at a specific time. At a midday halt, a hot drink or soup can be prepared. Retort baked beans and applesauce are excellent lunch items. Place individually packaged spreads between clothing layers to thaw before pausing for lunch.

DINNER

Dinner should provide adequate calories and the highest amount of protein of the day. This provides warmth and promotes tissue repair during the night's rest. A dinner menu should include the following:

- Hot main dish—Can be a one-dish meal, a retort meal, or a freeze-dried dinner, and should include a starch (rice, noodles, or potatoes), a sauce (meat broth, gravies, etc.), and a meat (chicken, beef, or ham).

Hudson Bay Bread

Hudson Bay Bread is a year-round favorite, serving as the basis of a high-energy lunch or snack. Start by mixing together the following ingredients:

1½ lbs. margarine or butter	2 teaspoons maple flavoring
4 cups sugar	Then mix in:
⅔ cup corn syrup	1½ cups ground nuts
⅔ cup honey	19 cups oatmeal

Spread the mixture in a large sheet pan. Press it down into the pan. Bake at 325 degrees in a wind oven for 15 to 18 minutes. As soon as the bread is taken from the oven, use a spatula to press it down (to keep it from crumbling). Cut the bread while it is still warm.

For home preparation, cut the recipe at least in half. A conventional oven requires a longer baking time.



- Freeze-dried or fresh vegetables are served separately or added to the main dish.
- Crackers—Can be less “durable” than those eaten at lunch, but should still be high in nutritional value.
- Fruit drink—Same as lunch item; 8-ounce serving.
- Hot drink—Same as at breakfast; a 1-cup serving.
- Dessert—Can be one that requires preparation and cooling, such as a pudding, or an already prepared item. A hot sauce goes well with either.
- Extras—Sugar or sweetener, milk powder, cream powder, salt, pepper, your favorite spices, butter or margarine, honey, maple sugar, fruit soup mixes, flavored teas, instant hot soups and bouillons, special soups, extra snack items such as fruits and nuts. Adults may want coffee and tea. Don't forget paper towels and matches!

Dinner Preparation. Dinner is, by far, the most complicated meal of your winter camping day. At-home preparation makes it easier. If you plan to make a meal on the trail from scratch, make certain you have at least practiced it at home on the stove.

Most one-pot dishes begin by boiling lightly salted water. If you use fresh meats or vegetables, cook them in the boiling water before adding the starch. Otherwise, add the starch (rice, noodles, or potatoes) to the boiling water and cook until done. Package directions are good guides for the preparation of rice and pastas. Doneness can be checked by mashing a small sample with a fork or by tasting. Next, add the sauce mix

and, after blending, add freeze-dried or retort meats and dried vegetables. Remove the pot from the heat, cover, and allow to stand for about five minutes on a heat-resistant insulated surface (a wooden snow shovel works well). Serve.

Note: The main dish can be prepared at home, spread in a shallow pan, and frozen. (Prepare the dish with less water than usual so that water can be added on the trail.) To use the frozen dish on the trail, break the frozen food into smaller pieces and add it to hot water.

Preparation of rice depends upon the type used. Uncooked rice can be started in boiling or in warm water, brought to a boil, and covered. Polished rice cooks in about 20 minutes. Brown rice takes about 40 minutes. Instant rice, which needs only to be rehydrated, is added to boiling water, then removed from the heat. Some seasoned rice mixes are browned in butter prior to adding water.

The starch in your evening meal could be instant mashed potatoes. To prepare, simply follow package directions.

Many varieties of cooked desserts can be prepared for winter camping. Those calling for preparation in the refrigerator are especially appropriate for camping below 38 degrees. Puddings, cheesecake, and gelatin desserts are all good and can be enhanced with a warm sauce.

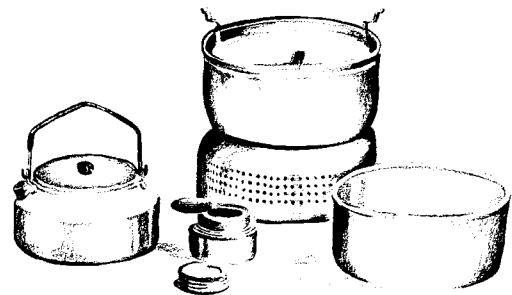
COLD-WEATHER FOOD PREPARATION TIPS

- Use stainless-steel containers for cooking whenever possible. They are easy to cook with and to clean.
- Use insulated plastic cups, bowls, and spoons, if possible. Wooden cups and spoons are also good for winter camping as there is much less heat loss than with metal.
- A small camp stove is usually a great help.
- Rice is one of the best items in your “cupboard” for any camp menu. It can be used in many different ways for main dishes, breakfasts, or desserts, takes a small amount of space, and is easily prepared.
- Fats are important in the winter to release heat and energy slowly. A good source of vegetable fat is corn oil margarine, which can be used in almost anything. Fats give energy of about 9 calories per gram, compared to carbohydrates and protein, which yield about 4 per gram.
- In provisioning for winter camping, use 40 percent carbohydrates, 20 percent protein, and 40 percent fats. This is not a hard-and-fast rule, but a guide in choosing your foods. Half of the protein should be from high-quality proteins: milk, meat, and eggs.

- Substituting caffeine-free coffee or tea for those containing caffeine helps to combat dehydration and prevent headache.
- When making trail biscuits, use whole-wheat flour, which provides more protein, nutrients, and fiber than white flour.
- Peanut butter and honey make a very good spread. Mix them together at home and package the mixture in individual servings.

COOKING EQUIPMENT

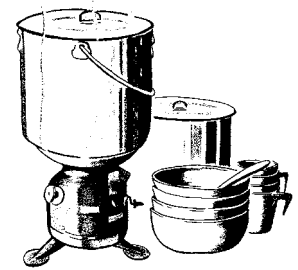
These stoves work well with a 3- or 4-quart pot. The only utensils needed for a group of three to four are the pots, a couple of cooking spoons, and a cup, bowl, and spoon for each member of the group.



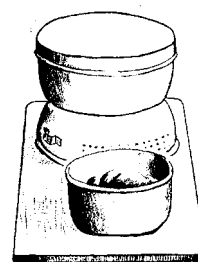
An alcohol stove and cooking set. These cooksets are excellent for groups of three to four people in cold-weather camping.



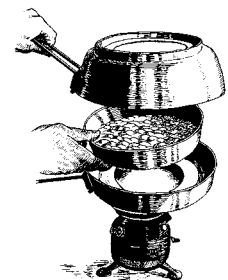
Coleman Peak I stove set on an insulating cover



Cookset for three or four persons



Cooking on a Coleman Peak I stove using a BSA Trail Oven



An alcohol stove used in cold-weather camping, set on a wooden snow scoop for insulation

BACKPACKING STOVES

The use of backpacking stoves is encouraged. They may be helpful throughout a trek, particularly on wet mornings when you want to start cooking and trekking early to avoid warm afternoon temperatures.

Purchase quality backpacking stoves. Plan to bring one backpacking stove per four campers. The proper use of stoves should be part of your pretrek training. Practice lighting your stove before your trek. Teams should transport their stoves **without fuel** and purchase fuel (commercial lantern or stove fuel) locally.

All liquid-fuel containers should be spun aluminum or hard bottles designed to carry fuel. A small pour spout or funnel is important to avoid dangerous spillage.

Backpacking stoves are used with adult supervision and **never** in or near tents.

HANDLING CHEMICAL FUELS

Knowledgeable adult supervision must be provided when storing chemical fuels, handling chemical fuels in filling stoves or lanterns, or lighting chemical fuels. The use of liquid fuels for starting any type of fire is prohibited.

GUIDELINES FOR SAFELY USING CHEMICAL STOVES AND LANTERNS

- Use compressed- or liquid-gas stoves or lanterns only with knowledgeable adult supervision and only where and when permitted. Operate and maintain them according to the manufacturers' instructions.
- Keep all liquid fuels in well-marked, approved containers (never in glass containers), stored in a ventilated, locked box at a safe distance (a minimum of 20 feet) from buildings and tents. Keep all chemical fuel containers away from hot stoves and campfires, and store them below 100 degrees.
- Let hot stoves and lanterns cool before changing cylinders of compressed gases or refilling them from containers of liquid gas.
- Refill liquid-gas stoves and lanterns away from tents and a safe distance from any flames, including other stoves or campfires. For safety and performance, use a commercial camp stove fuel. Pour fuel through a filter funnel. Recap both the device and the fuel container before igniting the device.

- **Never fuel a stove, heater, or lantern inside a cabin; always do this outdoors.** Do not operate a stove or lantern in an unventilated structure. Provide at least two ventilation openings, one high and one low, to provide oxygen and exhaust for lethal gases. **Never fuel, ignite, or operate a stove, heater, or lantern in a tent.**
- Place a stove on a level, secure surface before operating it. On snow, place an insulated support under the stove to prevent the snow from melting and the stove from tipping.
- Periodically check the fittings on compressed-gas stoves and on pressurized liquid-gas stoves for leakage, using a soap solution before lighting.
- To avoid the threat of fires, locate gas tanks, stoves, etc., below any tents; a heavy leakage of gas will flow downhill the same as water.
- When lighting a stove, keep fuel containers and extra canisters well away. Do not hover over the stove. Keep your head and body to one side. Follow the manufacturer's directions to light and maintain the stove flame.
- Do not leave a lighted stove or lantern unattended.
- Do not overload a stovetop with heavy pots or large frying pans. If pots larger than two quarts are necessary, set up a separate grill with legs to hold the pots, and place the stove under the grill.
- Bring empty fuel containers home for disposal. **Do not place in or near fires.** Empty fuel containers will explode if heated and should never be put in fireplaces or with burnable trash.

STOVES

Stoves are now considered a necessity for backcountry travelers. Many of the more popular camping destinations no longer have adequate supplies of firewood, and some areas have regulations banning natural fuel fires. Stoves have a minimal impact on the wilderness. As is said, "Fires last a night, fire rings last a decade." During ascents on snow-covered peaks, the only available water comes from melting snow; stove reliability is of paramount importance.

You can choose from three types of stoves—butane, white gas, and kerosene—and choosing the best one for you depends on how you intend to use it.

THE POPULAR BUTANE CARTRIDGE STOVE

Butane cartridge stoves are easy to light, flame control is very good and as simple as turning a knob, and tales of mechanical malfunctions are almost nonexistent. The cartridges are bulky, but they burn a long time compared to most white gas or kerosene stoves.

The principal disadvantages of butane stoves are their poor performance in cold weather and the decreased heat output that occurs as the amount of fuel in the cartridge decreases. The butane inside the pressurized cartridge is in liquid form, burning into a gas when released. As fuel is consumed, the pressure decreases and the gas is expelled at a slower rate. Do not shake the cartridge before using, as this may cause flare-ups.

Cold weather also decreases the pressure in the cartridge. At sea level, butane will not vaporize at temperatures below freezing. Winter campers with butane stoves must sleep with their cartridges if they expect hot tea in the morning. Stove efficiency is somewhat better at higher altitudes where the atmospheric pressure is lower.

Butane cartridges—or any fuel for that matter—should not be subjected to heat above 120 degrees. They should never be stored in the trunk of a car where temperatures frequently exceed 120 degrees.

HIGH-OUTPUT WHITE GAS STOVES

White gas is a highly volatile fuel, an attribute that is both good and bad. Spilled white gas evaporates readily and with little odor, but it is dangerously flammable.

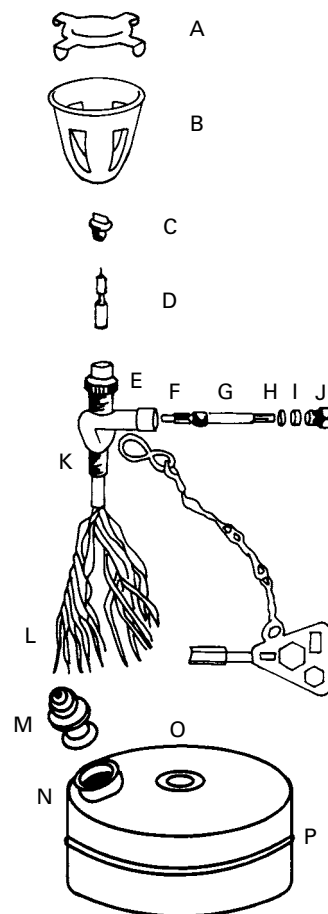
White gas, or naphtha, is a very pure petroleum product containing no additives and no tetraethyl lead. Lead is not only highly poisonous but it also will clog the stove burners beyond repair. Unleaded automotive fuels are not recommended for use in white gas stoves, as they contain other additives that will clog burners and may cause safety valves to release and possibly explode.

White gas is not readily available outside the United States and Canada; travelers in Europe report the use of low-lead automotive fuel in stoves, but this practice invariably leads to less efficient stoves.

White gas stoves are generally termed “high output” as they tend to burn hotter than butane. This is excellent for melting large amounts of snow or cooking quickly.

One potential hazard is that they consume oxygen at an extremely rapid rate. The user must ensure that there is adequate ventilation for both the stove and himself or herself. The danger of suffocation is more real than many would suspect.

In addition all stoves produce carbon monoxide—a deadly killer. Carbon monoxide is the result of incomplete combustion. Lack of oxygen in an enclosed shelter or from impeded airflow to the burner could cause serious problems for the unwary.



A. Burner plate, B. Burner head, C. Burner nipple, D. Cleaning needle, E. Vaporizer, F. Valve spindle, G. Valve stem, H. Metal ring, I. Graphite packing, J. Stuffing box, K. Vaporizer, L. Wick, M. Tank lid, N. Filler cap, O. Priming cap, P. Fuel tank, Q. Key

KEROSENE STOVES FOR SIMPLICITY

Kerosene is usually available throughout the world. It is not highly volatile, so additional fuel must be carried for priming. Some people use white gas for priming, but others prefer alcohol. While it does not burn as hot as white gas, it burns cleaner and with less odor. Spilled kerosene will not readily ignite, but neither will it evaporate, and it has a disagreeable odor. Kerosene stoves are less complicated than white gas models, and consequently they have fewer mechanical difficulties. Because of this simplicity, optional fuels such as diesel oil, home heating oil, and Stoddard's solvent can be used successfully in some kerosene stoves with little danger of clogging.

Kerosene is less expensive than butane; however, fuel cost is usually a minor concern of backpackers who use the stove for only a few hours each year.

PREHEATING OR PRIMING

Most white gas and kerosene stoves must be preheated, or primed, by burning a small amount of volatile fuel such as white gas or alcohol in the priming cup at the base of the vaporizer. Not much heat is needed to start the fuel vaporizing. On a hot day, the heat of the sun or the warmth of your hands on a white gas stove may force enough fuel out of the nipple for priming, thereby eliminating the need for an eyedropper or a priming fuel container.

Pumps do not vaporize fuel; their purpose is to create the pressure in the fuel tank and improve performance in cold or windy weather. However, they are handy for priming. One or two strokes on the pump will create enough pressure so that fuel will spurt from the nipple when the key is turned. This fuel is allowed to dribble down the vaporizer into the priming cup; then it is lit.

Many stoves must be primed with an auxiliary fuel bottle, eyedropper or auxiliary pump. A small amount of priming fuel will provide enough heat to vaporize fuel in the main line.

Because all stoves vary in operation, be sure to read the operating instructions carefully.

TROUBLESHOOTING

The following is a list of some common problems with stoves and their solutions. Some problems can be remedied easily; others require bringing the stove in for repair.

The vast majority of stove problems are caused by using improper fuel or by leaving fuel in the tank over a long period of time. Fuel left in the tank will form gums that impair the stove's performance. (This does not apply to butane cartridges.)

The following recommendations do not apply to all stoves, but they do apply to several of the most popular stoves on the market today.

Failure to operate or weak flame

- Clogged. Stove should be disassembled and cleaned. Some parts may need replacement.
- Leak in safety valve in tank cap. Replace cap.
- Low vapor pressure. Pump up pressure; insulate from cold.
- Improper fuel.

Stove surges and has a dirty, yellow flame

- Nipple enlarged by improper cleaning. Replace nipple.
- Wick burned. Replace wick.
- Automotive fuel in tank. Replace with white gas.

Stove stays lit for 30 seconds, then goes out

- Slow pressure leak in tank cap.

Stove will not build up pressure when primed

- Tank is overfilled. Stove tanks should not be filled more than two-thirds full to allow proper pressure buildup. Remove some fuel.
- Blown safety valve. Replace tank cap. If stove has ever caught fire, the safety valve might have blown then. Once blown, a safety valve will not hold much pressure. Do not attempt to repair a blown safety valve. Always replace the entire cap assembly. Safety valves are factory set and should not be altered or adjusted.
- Hardened tank lid gasket. Replace gasket.
- Hardened graphite in stuffing box will not seal spindle. You will see flame coming out around stuffing box. Replace graphite.
- Pump leather has dried out. Oil pump leather.

For more information on how to operate or repair an individual stove, refer to the manufacturer's instructions included with the original purchase.

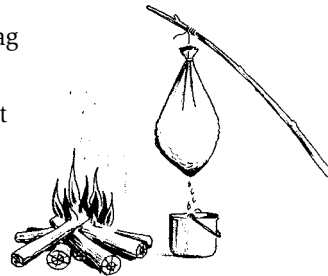
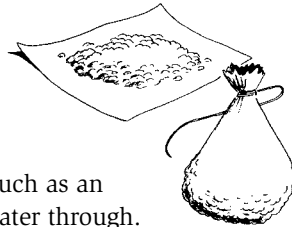
WATER COLLECTION

Several methods can be used to collect and heat water on the trail. However, it is important to remember that all water collected must be purified before use.

THE WATER MACHINE

This is a simple method to get liquid water from snow.

- Use a clean piece of cloth, such as an old bedsheet, that will let water through. The cloth should be 4 to 5 feet square.
- Pile snow in the middle, and tie the sheet like a bag of laundry.
- Hang the bag about 3 feet from the fire.
- Catch the water as it drips from the bag.
- Purify the water before using it.



WATER BOTTLE

Use a wide-necked plastic pint jar or vinyl pouch. The plastic jars in which jam, jelly, or ice cream toppings are purchased work well. The Okpik program also uses a

wide-necked vinyl pouch in which snow can be placed. It is worn between layers of clothing so the snow is melted by body heat. A 1-pint jar or pouch is just the right size:

Smaller containers don't hold enough, and larger ones are too heavy.

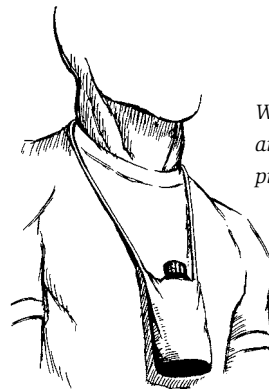
Remember to wear the water bottle between the layers of clothing so that

the bottle stays warm.

Take the bottle to bed with you at night. This allows you to have a drink during the night if you get thirsty, and provides water to start breakfast in the morning.



Water Bottle

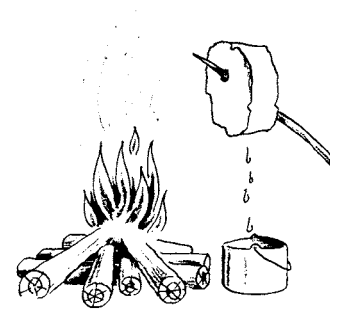


Water bottle slung from neck and held next to body to prevent freezing.

THE FINNISH MARSHMALLOW

This is a simple way to get a small amount of water in a hurry.

- In an area with packed or crusty snow, cut a block of snow with your snow knife.
- Suspend the block from a stick.
- Hold it close to the flame.
- Catch the water in a cup or other container.
- Purify the water before using it.



Finnish Marshmallow

Note: Since snow shrinks when melting, the “marshmallow” will stay on the stick as long as it is not too close to the fire.

THE CATHOLE

To leave no trace, use catholes. Dig a cathole in organic soil about 6 to 8 inches deep. Find a tree well in the snow or remove the snow to unfrozen soil if possible. Cover the cathole after use.

Dig a new cathole for each subsequent use. Locate each cathole at least 200 feet from a water source, trail, or campsite. Keep your toilet paper bagged in plastic at the campsite, and take a roll out to the latrine when needed.

Although human wastes disintegrate rapidly through bacterial and plant activity once warm weather comes, toilet paper does not degrade as fast. Cover toilet paper with a layer of turf and twigs under a snow cover or carry it out in double plastic bags.



SNOW SHELTERS

Shelters are an important consideration in planning for any type of cold-weather outing. Your first winter camp-out should be in a cabin or other fixed shelter. The next time you may want to try a tent or, if in snow country, a “thermal” or snow shelter. You should even consider shelters for cold-weather hikes. Crew equipment, different from that used in mild-weather camping, must also be considered.

TYPES OF SHELTERS

You can choose from a variety of shelters when you go winter camping. Possibilities include cabins, tents, thermal shelters, and other natural shelters.

CABINS

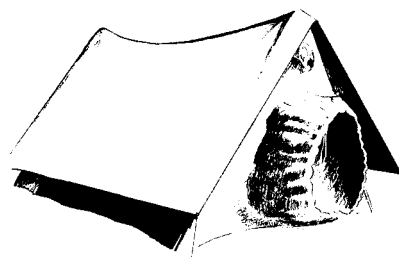
Your first cold-weather camping should be done at a camp or other location where cabins are available. A cabin can be small or quite large, like the lodge of many camps. The size is not the important consideration. The important part is how it helps you train for more extensive cold-weather camping. The Okpik sleeping cabin (with front and rear doors) designed by the BSA Engineering Service is available for use where small cabins are needed.

TENTS

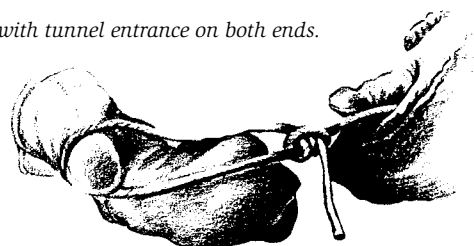
Many types and styles of tents are available. The BSA Supply Service is a good resource for tentage. Most styles of tents work in cold weather. You may want one a little larger than the one you use in the summer, since cold-weather clothing and bedding take up more room. Your tent should be large enough so that you can sit up in it.

If you camp in the mountains, you may prefer a mountaineering tent. A tent design that works well for cold-weather snow camping is the “A” style tent. This tent is a BSA design made by the National Supply

Division and developed by the Northern Tier National High Adventure Program as a year-round tent. It can be used with a self-supporting frame. The double entrances work well for weather protection and make zippers unnecessary. The tent will usually accommodate four campers, is large enough to dress in, and is spacious enough for extra equipment. The tunnel doors can also be used for storage. A vestibule can be attached to either end, extending the storage space available. A frost liner can be constructed to fit the inside of the tent to provide more insulation. This also helps to keep the tent frost-free in extreme low temperatures.



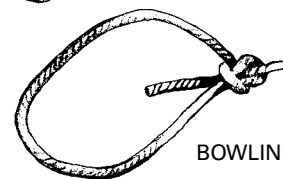
“A” style tent with tunnel entrance on both ends.



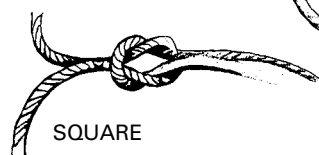
TAUT-LINE



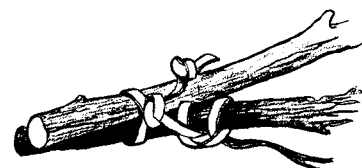
SLIP KNOT



BOWLINE



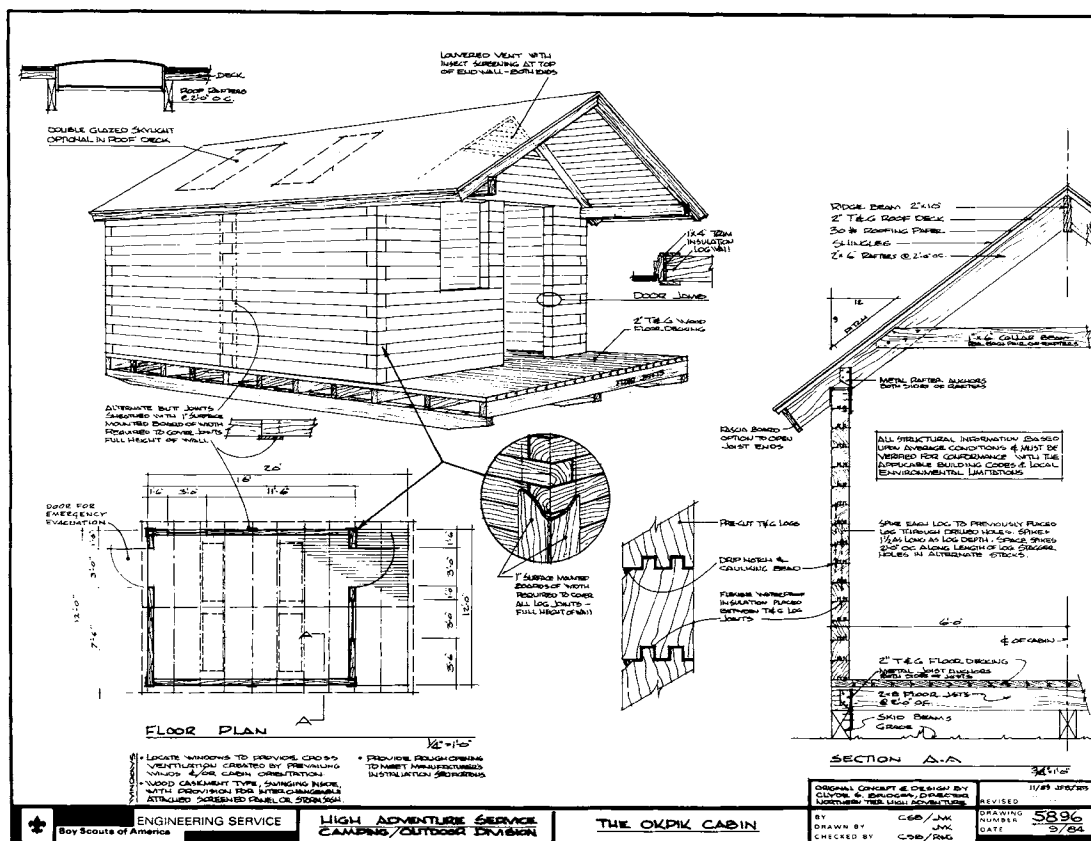
SQUARE



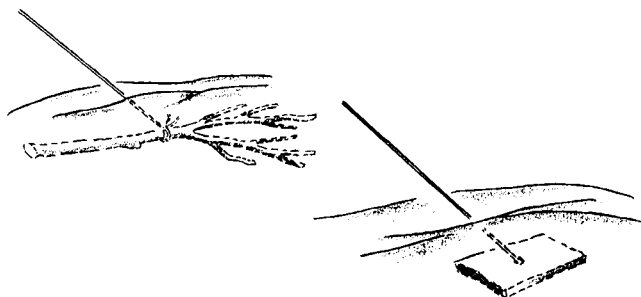
CANADIAN SHELTER

Knots to Use in Cold-Weather Camping

The Canadian shelter knot can take the place of lashing in cold weather. It is really nothing more than two overhand knots, finished with a couple of half hitches. It is generally tied using the outer cover of the nylon 550 cord.



BSA drawing from Engineering Service—No. 5896—The Okpik Cabin



Two methods of holding down the tent ropes in the snow



BSA Tunnel Tent

Some North American Indians used a form of frost liner, usually referred to as a dew cloth, in their shelters. A frost liner for a tent is nothing more than a lightweight inner tent. It can be made of almost any lightweight, porous material—worn bed sheeting works very well. It should be suspended inside the tent with about 2 inches of space between it and the tent walls. The frost liner provides insulation and protection from wind, helping hold heat in a smaller area, less affected by air currents.

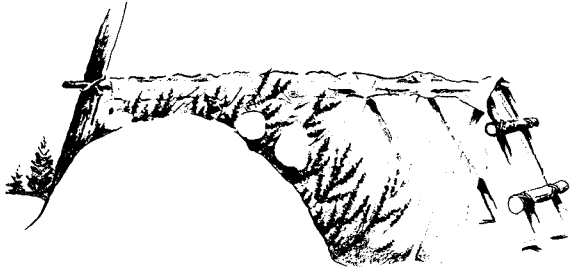
The warm, moist air inside the frost liner passes through the porous material and forms frost on the outside of the liner.

Each morning, the frost liner can be taken out and the frost removed. It should be packed separately from the tent, dried as often as practical, and replaced inside the tent every evening.

CAUTION: Open flames should not be used in any tent.

NATURAL SHELTERS

The use of natural shelters is encouraged as your group becomes more acquainted with cold-weather camping. When using natural materials, do so in accordance with the policies of low-impact camping and of your local council.



This shelter is constructed of a framework covered by fabric and then either boughs or straw. The shelter is finished by piling loose snow over the framework. Notice that the doorway has been identified. This will be closed with the same style of closure as used with the other snow shelters. A vent will be placed in the side of the shelter.

Many references on the construction of natural shelters are available. Use the ones that show shelters that are appropriate for your area and climate. Trying to learn to build a cut-block igloo in the Midwest is really not practical since you do not have the packed, wind-blown snow required.

Snow shelters, except in the mountains and the high Arctic, are usually of the snow dome-type called quinzees. The thermal shelters shown in this chapter are good in almost any area where there is snow.

Cold weather demands a tighter closing of structures than mild weather does. This necessitates more attention to proper ventilation. Review the liquid fuel policy as well as the policy in your local area regarding the use of natural materials before you consider means for staying warm. Carbon monoxide is a product of inefficient burning of fossil fuels. It is colorless and odorless, and it can be deadly. Carbon monoxide is a threat in any camp, but is a greater problem in cold weather.

THERMAL SHELTERS

A thermal shelter is any natural shelter that, through insulation, uses the heat coming from the earth to warm it. In temperate climates the earth is continually giving off 12 degrees to 16 degrees of heat. This may not seem very warm, since 32 degrees is freezing, but it makes a difference when the air temperature is well below freezing, or even below zero.

With a good, insulated thermal shelter at 20 degrees below zero, the heat of the earth combined with the

body heat of two people warms the shelter to around the freezing point. That is a difference of 52 degrees from the temperature outside!

A shelter can be large or small enough to accommodate one person in emergency or survival situations. The following are several important points about the thermal shelter:

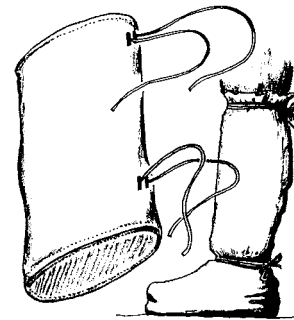
- A door plug must be used, or any heat trapped is immediately lost.
- Each sleeper needs an insulating pad underneath the body. Even though the earth is giving off heat, it is still much colder than body temperature. Unprotected, the body loses heat to the earth by conduction.
- Ventilation holes should be made at a 45-degree angle in the side of the shelter. Since warm, moist air passes through these vents, it is necessary to continually clear them of frost.
- Make the shelter so that you can sit up without touching the ceiling.
- The more insulating snow that is piled on the shelter, the warmer it will be.
- Do not, under any circumstances, use an open flame in a thermal shelter.



BUILDING SNOW SHELTERS

The snow shelters described in this chapter are the cut-block igloo, the molded snow dome called the quinzee, and the popular T-shaped snow cave. Several other shelters are described in the manuals listed as resources for this chapter.

Patience and practice are both necessary to develop skill at building any type of snow shelter. If you are in the mountains, expert instruction is suggested. The mountains have additional hazards that go well beyond the scope of this chapter. Avalanches and extreme temperature fluctuations are just two of the serious mountain conditions that necessitate competent, skilled instruction.



Fotposer—A waterproof foot and leg covering that is helpful in keeping the lower leg dry when building snow shelters.

Snow shelters hold a certain fascination for Scouts, and since they are easy to construct, you will find they work very well. Even in extremely low temperatures, snow-shelter builders usually get wet. Therefore, certain precautions should be taken. In a moist snow shelter, drying clothes is difficult. Follow these guidelines when building a thermal shelter:

- Pace the work on the shelter—let everyone get involved. Stop before perspiration becomes a problem. Remember to ventilate.
- Proceed slower than you think you should to avoid overheating.
- Scouts in the Scandinavian countries use a clothing item called a fotposer to keep legs and feet dry. The fotposer is just a large, waterproof sock that covers the boot and continues up the leg, fastening like a pair of chaps. Another Scandinavian Scout item used in shelter building, the vindsekk, or wind sock, is a small, portable shelter that provides protection when building a shelter.
- Try to keep mitts from getting wet.
- Watch out for snow on garments. Continue to use the buddy system and keep snow brushed off.
- Relax! You are not building a lasting monument. Snow shelters do not survive when warm weather returns.

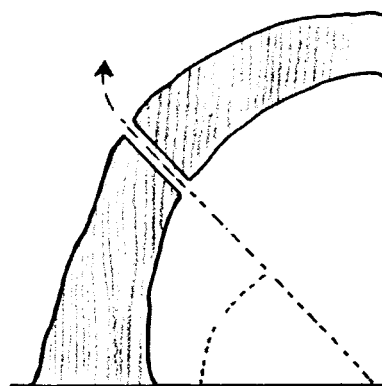
The first time a group builds a snow shelter should be while camping in a cabin or tent. Learn how first, then use the skills to build shelters in which you will actually sleep.

The temperatures in a well-constructed snow shelter will rarely be below freezing when campers are inside. If you leave the door wide open with no closure, the shelter will be the same temperature as the outside air. Ventilation is important in a snow shelter. The vent holes should be at a 45-degree angle. If you place them in the center of the roof, the holes will get larger as the warm air rushes out. Placed at a 45-degree angle in the side of the dome, the vent replaces the slightly cooled air without causing a draft in the shelter.

When planning to construct any type of snow shelter, the following points must be considered:

- Never plan to build or stay in a snow shelter if the temperature is above freezing. Snow provides excellent insulation in below-freezing conditions, but it is cold and wet when temperatures are above freezing.
- Always let the snow set at least one to two hours before starting to dig when constructing a snow dome or quinzee.

- Use the buddy system during snow shelter construction. It is important to have good supervision outside the structure, along with extra scoops and shovels in case of a cave-in.
- Make sure everyone understands that an arched roof is a key factor in snow shelter construction.
- When constructing snow caves in mountainous areas, consult a specialist regarding the proper location for constructing caves.
- When sleeping in a snow shelter, be sure to keep digging tools inside in case an unexpected exit is necessary.



Vent hole for snow and thermal shelters should always be placed at about a 45-degree angle.

IGLOOS

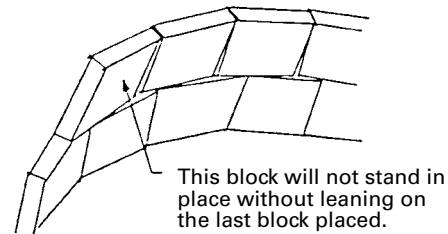
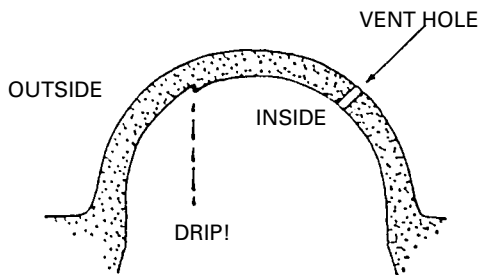
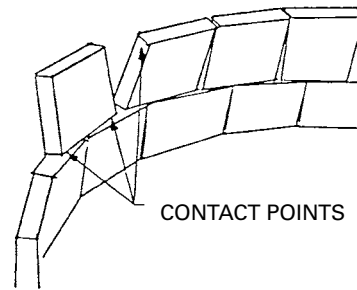
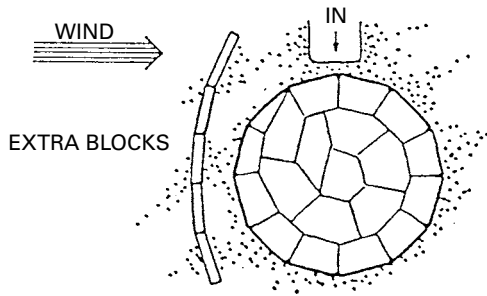
One of the most primitive and most effective shelters ever used by people is the snow house, or igloo, used by the Inuit for centuries. The igloo has endured because of its efficient and simple structural form, ease of construction, and excellent protection from the winter elements. It has been estimated that if properly constructed, the igloo will maintain an inside temperature up to 100 degrees above the 40-below-zero temperatures prevalent in the Arctic.

Considerations for the proper construction of an igloo include size, materials, protection from wind, and wall construction.

Size. The diameter of a snow house or igloo should not exceed 10 feet. A diameter of more than 10 feet would require a theoretically perfect dome construction that is virtually impossible to construct in the field.

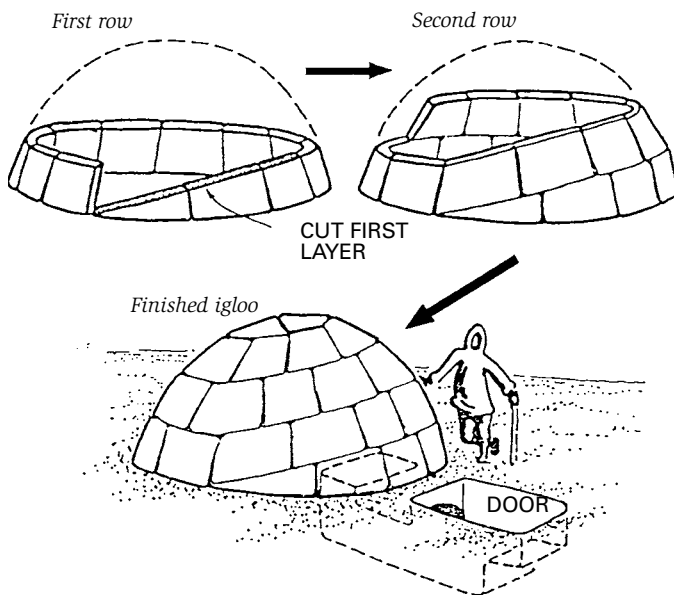
Materials. The igloo is built from blocks of snow cut from the depth where your feet stop sinking. The top layers of dry powder are not satisfactory. You will need a knife or saw blade 14 to 20 inches long, a cord at least the length of the radius of the igloo, and waterproof gloves or mittens.

Protection From Wind. Because for proper ventilation, the igloo entrance is never sealed or closed, the top



Block placement detail

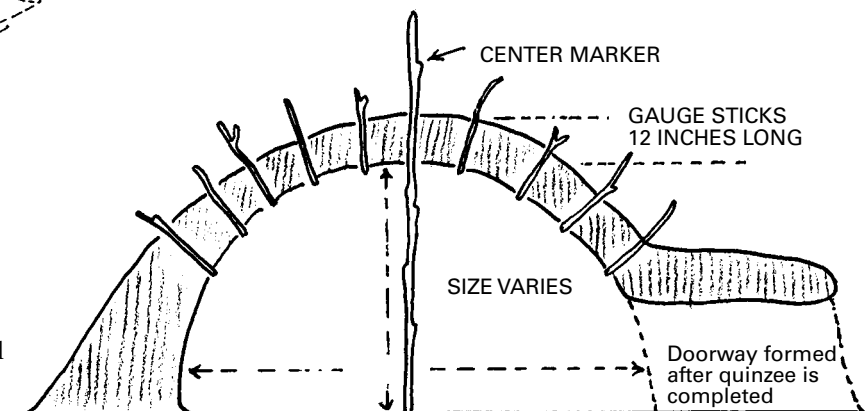
by placing extra blocks of snow at the base on the windward side.



Wall Construction. The wall is made of 8-inch-thick snow blocks with sides of 18 and 30 inches. Snow blocks may be replaced with slabs of clear lake ice for a window effect, if the ice is available. The first layer should be cut as illustrated to start the wall spiral for the dome shape. If building on a slope, set up a level course before starting the spiral course. Proper thickness of the walls is important. If they are too thick, the collected heat inside will cause melting, and if they are too thin, frost forms on the inside surface. Also, any projection on the inside surface will form a point of dripping, which can be corrected by smoothing out the spot. By keeping the interior surface smooth, water will run down within the wall rather than dripping inside.

QUINZEES

of the entrance should be about 18 inches lower than the bed platform to prevent the warmed air from escaping. The entrance should be located so that the wind blows past the opening and does not pile snow into it. Strong winds containing airborne snow and ice particles could cut through at the base of the igloo. This can be prevented



Building a quinzeee: center pole and gauge sticks.

The quinzee is a snow dome that can be constructed without deep or hard-packed snow. Its dimensions, materials for construction, and procedures are given below.

Size. The size can vary, but a good size to start with is a mound of snow about 6 feet high and 12 feet in diameter; this is adequate for three or four campers.

Materials. To construct a quinzee, you will need one pole about 8 feet long (this is the guide pole for the center) and 30 or 40 sticks about 1 foot long (these are the gauge sticks for the thickness of the roof). You will also need a variety of shovels and snow scoops, a tarp or piece of cloth or plastic about 5 feet in diameter for the door plug, a stout staff to stir the snow, and plenty of warm clothing.

Procedure. Follow these steps to construct a quinzee:

- Find a good area with lots of snow.
- Lay out your location and place the center pole in the snow.
- Take the stout staff and stir the snow in your “quarry” area. Stirring the snow breaks down the structure and helps it hold together. Stir an area about 6 or 8 feet in diameter, and then start piling this snow around the center post. Continue this procedure until you have a mound about 6 feet high and 12 feet in diameter. This takes quite a while—but this is the easy part.
- Let the mound settle. This usually takes an hour or two.
- After the mound is settled, carefully put in your gauge sticks.
- Now comes the moment of truth. You start to dig out the entrance. A 24-inch hole is just about right. If the entrance remains firm, continue to scoop out the inside, using the gauge sticks to keep the thickness to 1 foot. Change diggers often to avoid overheating.



Building the quinzee: Shelter almost finished, still showing gauge sticks.



Building a quinzee: Finished shelter.

- Pile the excavated snow around the entrance to form a windbreak. Make a door plug and place it near the door.
- When you have finished the inside, be sure to make vents (usually two or three work best). Let the shelter stay open so the snow will harden.
- After the shelter is hardened, you can move in.

T-SHAPED SNOW CAVE

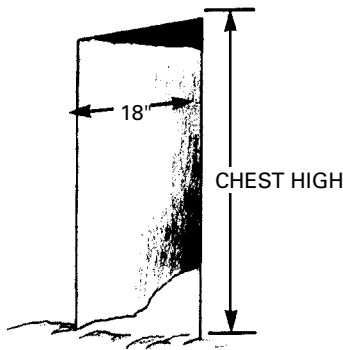
Snow caves are comfortable and practical winter shelters, eliminating the need for carrying a tent. They are not complicated to construct and allow the builders an opportunity to improve while developing their burrowing skills. Snow caves can be fun! However, the traditional, or conventional, snow cave has these critical limitations:

- The people digging the cave usually get wet, either from the snow or from perspiration.
- Only one person can dig; everyone else just waits.
- The cave takes a great deal of time, usually at least two hours, to build.

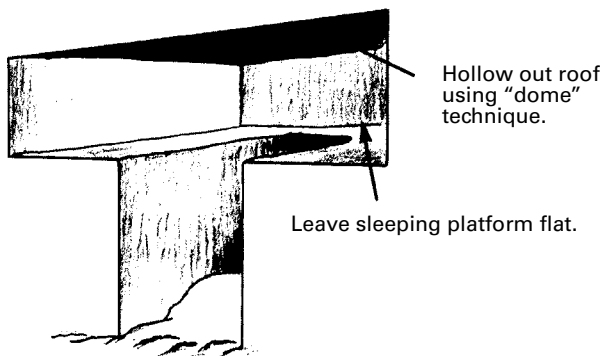
The T-shaped snow cave has these advantages:

- It is completed quickly because snow is excavated directly out a side wall, and digging is in the excavator's normal range of motion. A two-person cave can be completed in half an hour.
- The builders have less contact with the snow and expend less energy, and therefore they stay drier than with standard snow cave construction.
- More efficient use is made of everyone. Every member of the group is active and is protected from the weather sooner. Once inside the cave, the occupants can, as before, make the house into a home.

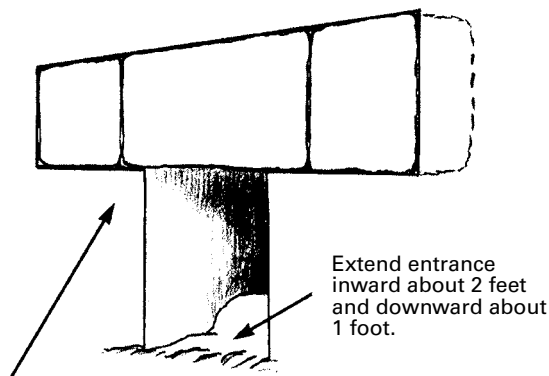
Procedure. When a snow bank is selected, the first camper starts by digging a rectangular entrance platform measuring about 18 inches wide by 5 feet high, extending about 3 feet into the bank. Next, dig a waist-high platform about 4 feet wide centered on the entrance platform. Develop this into a slot 18 inches high and 4 feet wide, extending into the bank. It is through this opening that snow from the enlargement process passes out, thereby eliminating the need for a second person to haul snow. The second person can be cutting or otherwise forming blocks or snowballs to later seal the front portion of the rectangular opening. (Snow excavated from the cave interior can be used.)



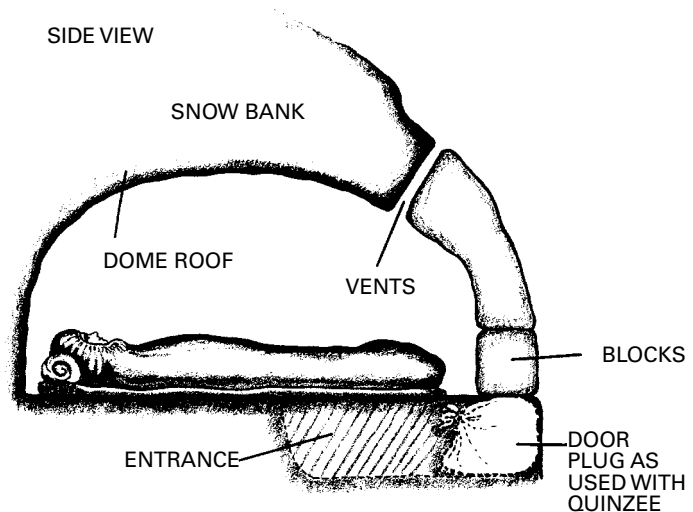
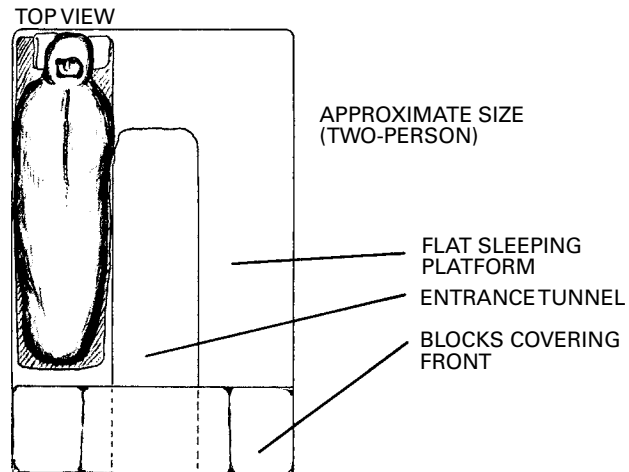
Dig the entrance tunnel 18 inches wide and chest high.



Remove a rectangular portion of snow crosswise to the entrance. Then dig upward and in all directions—leaving the sleeping floor flat.



Cut entrance blocks and place them across the entrance.



Completed two-person snow cave (cutaway view)

Continue to dig from the entrance platform in a standing or kneeling position, expanding the room in all directions (except down), and evacuating the snow through the rectangle. The waist-high platform becomes the floor of the cave. After excavating everything within easy reach, extend the entrance about 2 feet or so into the floor area and about 1 foot downward. Enter the partially constructed shelter: You should almost be able to stand. Continue to excavate out of the wind at that point.

When the first camper has excavated enough to be able to sit on the floor, the second can enter. Continue to expand the cave moderately in all directions until the overall inside dimensions are about 7 feet long, 5 feet wide, and 3½ feet high.

When the interior is near completion, one camper fills in the sides of the horizontal slot with the snow-blocks or snowballs previously constructed. One large block, or two smaller ones leaning against each other,

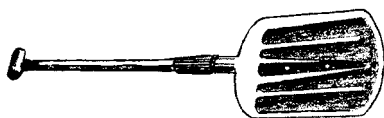
will usually be sufficient to support the upper half of the entrance tunnel. After caulking any remaining holes, the shelter is finished.

When trying this technique for the first time, follow the recommended dimensions closely. It is best not to dig the entrance too far into the bank, but only far enough to be able to enter into a solidly roofed room. However, the depth of the snow, the slope, and various other terrain features may dictate modifications.

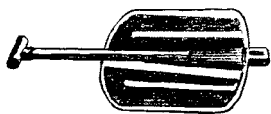
EQUIPMENT FOR BUILDING AND MAINTAINING SHELTERS

A few tools are necessary when camping in a snow-covered area that are not needed during mild weather or wet-cold conditions. These include a snow shovel or scoop, snow saw, snow knife, ice auger, whisk broom, and anaotark.

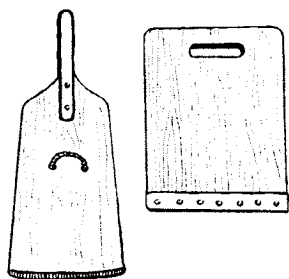
If your group builds shelters, several snow shovels are essential. You can use almost any type of scoop or snow shovel, but be sure to include a few short mountaineering shovels for finishing the inside of a shelter. The wooden scoop is appropriate, and making it is an easy individual project. Each camper will then have a scoop that will move lots of snow.



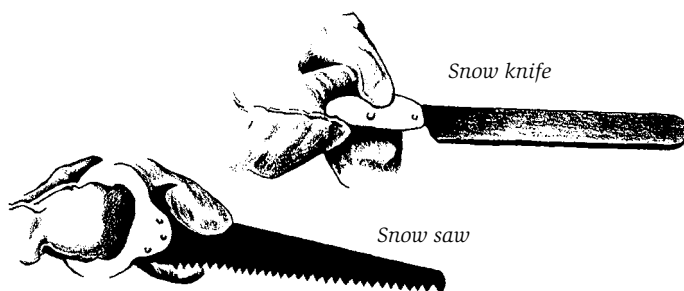
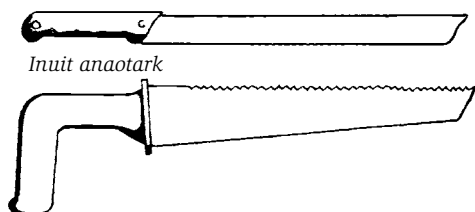
Folding mountaineer shovel



Wooden scoops—These are copies of ones used by the Inuit. They are easy to make and work just fine.



Snow saw and knife combination—excellent tool for the cut-block igloo



The snow saw and the snow knife are used to build cut-block snow shelters.

An auger is necessary if you want to fish in a pond or lake. It is safer and easier to use than an ice spud or chisel. Check with a local fisherman to find out what style is best for your area.

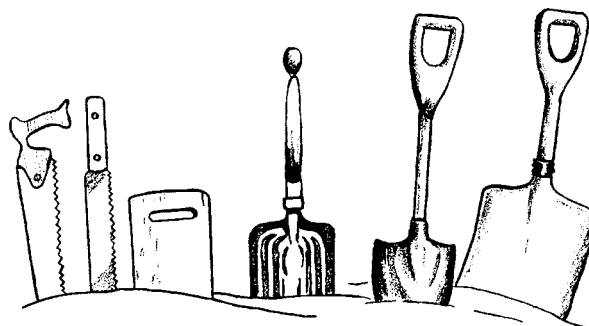


Auger



Ice chisel or "spud"

An anaotark is an Inuit tool used to remove snow from clothing and equipment before entering a shelter. Each camper should have a personal snow removal tool and use it every time a shelter is entered.



Tools for building snow shelters



TRAVEL TECHNIQUES

Traveling in cold weather is the same as in other times of the year, unless there is freezing rain or snow. Proper planning is essential to get the most out of any trip, but there are several things to consider when planning to travel in cold weather. These are:

- Equipment, food, and clothing will be heavier than for most camping.
- Packs and other gear worn on the outside of jackets will have to be sized differently.
- Significantly more energy will be used in carrying the extra weight.
- There are fewer daylight hours.
- Temperature extremes can be dangerous. Temperatures are often above freezing in the late afternoon but below freezing in the morning. Items left out at night will be frozen and must be thawed before use.
- Travel on the water, as on a canoe trip, may not be safe since the water temperature may be too low.

BACKPACKING

Cold-weather backpacking is covered in many manuals and specialty publications. Use BSA manuals and other backpacking literature for equipment and techniques to use in cold weather. Your group members should be experienced mild-weather backpackers; cold-weather backpacking is not a good place for the novice to start. Day hikes with a minimum of equipment will give a good indication of how your group will fare on a cold-weather backpacking trip.

Be sure to have a good plan of action before starting on an overnight cold-weather trip. Since you will be carrying more weight and using more energy, don't plan to travel as far as you would during mild weather. Make sure you make camp early and that your shelter is well prepared for the night.

TRAVELING OVER SNOW

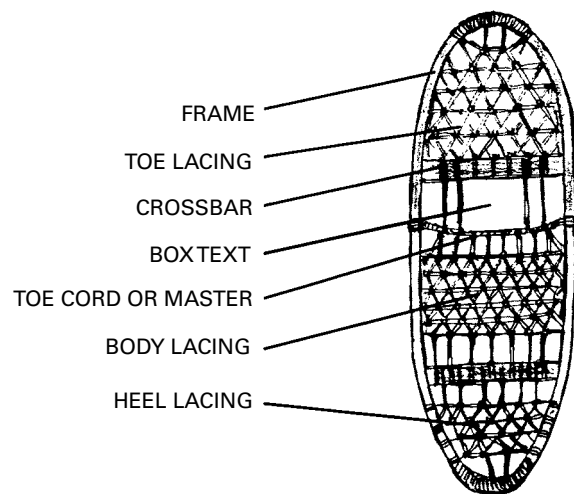
Travel where there is snow on the ground will either be on snowshoes or on skis. Backpacking can be more difficult when using snowshoes or skis, though the snow can be a benefit as well as a hindrance because it acts as insulation in certain circumstances. An alternative to backpacking is to pull a sled that has your gear on it.

Snow camping should be learned one step at a time. Your group's first snow outing should be a hike. A one-night campout will usually be the next step. The national high-adventure bases and several council camps offer excellent instruction in the basics of cold-weather camping. These programs are a good way to learn the techniques necessary for a successful trip. Experience is the key to good cold-weather camping, but it must be acquired gradually and thoroughly.

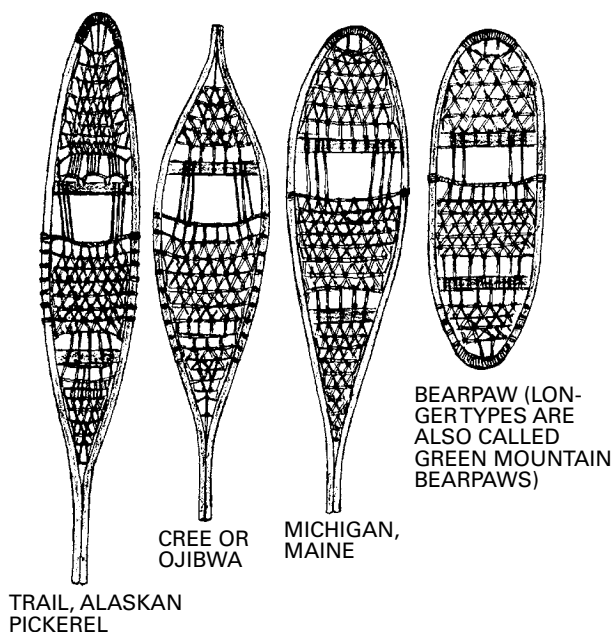
SNOWSHOEING

Snowshoeing is a great way to get out and see the back country. A lot of instruction isn't necessary, since it is relatively easy to learn. Look for books on the subject that will acquaint you with snowshoe equipment and basic techniques.

As you begin to snowshoe, you will notice that different muscles are used than for hiking. Familiarize yourself with snowshoes by taking a few short hikes. This should be done without a pack and with proper clothing for the weather. One of the first things you notice when snowshoeing is how much energy you use. Don't forget that when you use this energy, you need to keep drinking plenty of water. It is also necessary to ventilate properly, or perspiration will wet your inner clothing. Slow down; don't overheat. Pace yourself and keep up a steady, but not difficult, walk.



Parts of the Snowshoe



Some types or styles of snowshoes

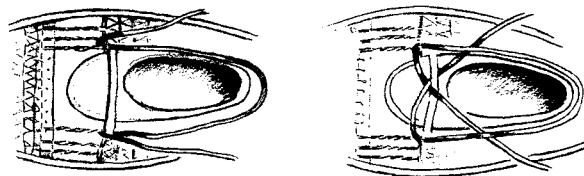
If the snow is very deep, you have to “break trail.” This can be very difficult and takes a lot of energy. If you are by yourself, just take your time. If you are in a group, alternate trail-breaking often, even as frequently as every two or three minutes in deep snow. To alternate, the person breaking trail just steps to the side and the next one in line moves up. The trail breaker rests a minute and then falls in at the end of the line.

When snowshoeing, always walk in single file. This packs down the trail and makes traveling easier. If you return the next day over the same trail, it may have frozen hard enough that you will not even need your snowshoes.

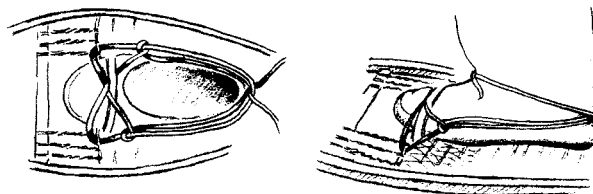


Mukluks being used on snowshoes. The binding is a firm toe piece with an elastic band (inner tube, bungee cord, etc.) behind the heel.

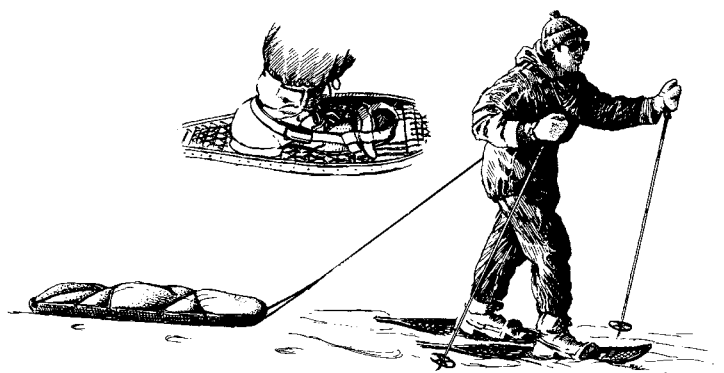
There are many opinions as to what types of snowshoes and bindings are best. Ask a person familiar with snowshoeing to tell you what type of shoe and binding works best in your area. Many areas have snowshoe clubs that can provide you with information. An excellent way to become familiar with snowshoes is to make your own. Kits and instructions are available.



The emergency hitch, or “lampwick hitch,” is an excellent snowshoe binding. It can be used with any style snowshoe and any style boot. This is a must-know for emergencies. A modification of this style of binding can also be used as an emergency binding for skis. This is done by looping the cord around a broken ski binding.



Emergency hitch (“lampwick hitch”)



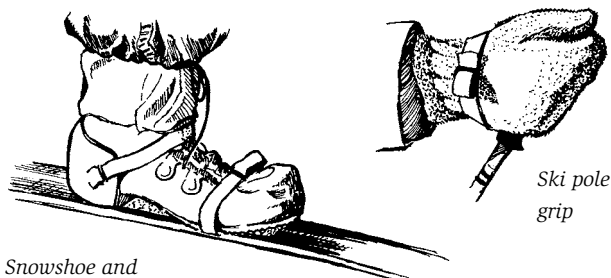
Commercial snowshoe binding

SKIING

It will take some instruction and practice before you and your group are competent enough to use cross-country or touring skis on a camping trip. Skiing instruction is available almost anywhere there is snow. Instructors enjoy teaching others the sport and are usually very helpful to Scout groups.

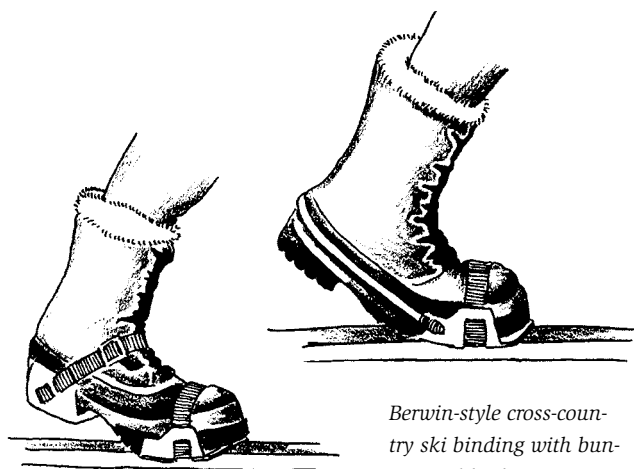
Many manuals are available for beginning skiers. The ones suggested at the end of this chapter have proven reliable for Scouts in the Okpik program for several years. They provide accurate information on

learning the techniques of ski camping. The *Fieldbook* is a good resource for the beginner. *Complete Cross-Country Skiing and Ski Touring*, by William J. Lederer and Joe Pete Wilson, is excellent. It has instructions on how to learn to ski in 60 minutes. It will take longer than that to become a ski-camper, but the book will help you get started.



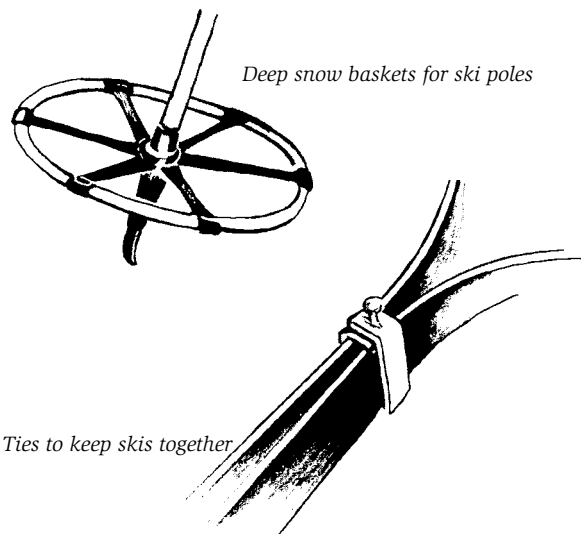
Snowshoe and ski binding

Ski pole grip



Berwin-style cross-country ski binding with heel cup

Berwin-style cross-country ski binding with bungee-cord heel strap



Deep snow baskets for ski poles

Ties to keep skis together

PULLING A SLED

The most efficient way to move camp equipment in snow is with a sled. Carrying something on your back will never be as efficient as letting the snow help support and slide it along. It may take a while to get used to, but in the long run a sled is the best bet.

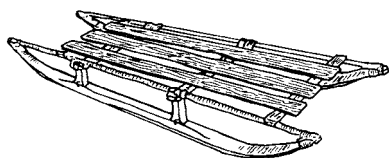
Sleds can be designed to carry all the equipment you need to camp in snow. Pulling a sled will be a little difficult at first, somewhat like the first time you took a canoe trip and learned to paddle and portage your canoe. As with the canoe, you will find that sometimes the going will be easy, but going up hills and even steep downgrades will take both energy and practice. Learning how to travel by sled will make your snow outings a real pleasure.

There are several excellent manuals to get you started snowshoeing, backpacking, and skiing. But there are not many places in this country to learn about sled travel, so this chapter will give you more on the basics of sled travel.

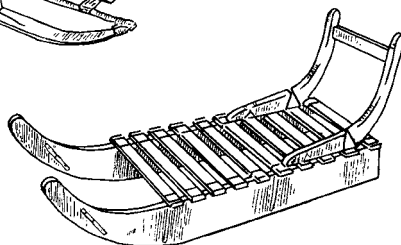
People in northern climates have used sleds of various types, either pulling them themselves or using draft animals to do the work, since before the time of writing. Many pictographs and petroglyphs show that sleds were in use thousands of years ago. All three of the traditional cultures upon which Okpik is based use sleds of some type. The Okpik program combines these into a sled well adapted for camping in the snow.

The Inuit used sleds made of skins, and even of frozen fish, as well as those made of wood. They either pulled their sleds themselves or used dogs. The sleds of the Inuit formed the models for Arctic and Antarctic explorers. Peary, Scott, Nansen, and Amundsen all used Inuit-style sleds for their expeditions. One use of sleds of this type was the Will Steger Expedition to the North Pole in 1986.

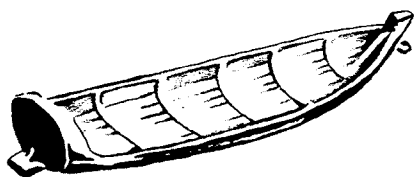




Nansen-style sled



Inuit-style sled called a Komatik



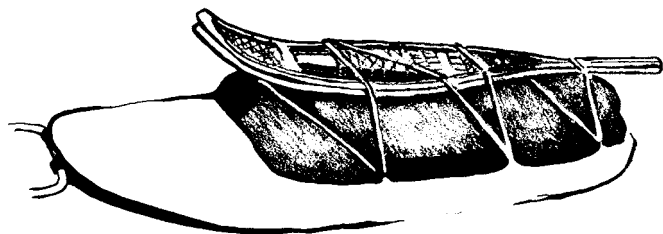
Lapland sled called an Akja. It is from this sled that we get the beginnings of the contemporary trail sled called an ahkio.

North American Indians did not have the wind-blown, packed snow of the high Arctic, so their sleds took more the form of what we call the toboggan. They later used dogs, and even horses, for pulling sleds, but they usually traveled little during the winter months, and when they did, pulled the sleds themselves.

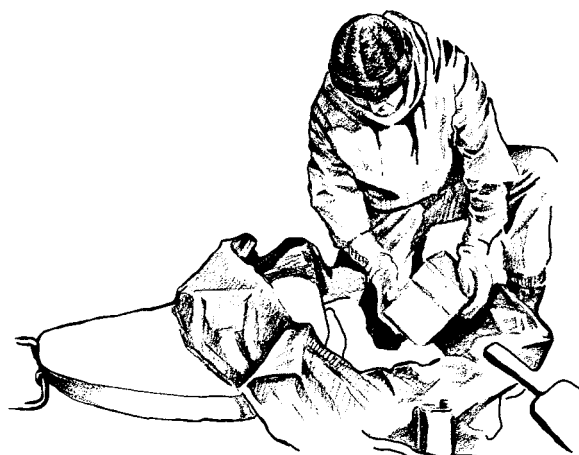
When the North American fur trade was in full swing, toboggans were used for freighting. They got larger and larger, and were usually pulled by draft animals.

The Laplanders' sleds were pulled by their draft animals, the reindeer. These sleds, similar to small boats, were called akjas. Since they are used in deep snow as well as in the high Arctic, akjas represent a combination of the sled styles of the Inuit and American Indian.

A modern adaptation of the akja, called the ahkio, has been used on many modern expeditions. It can be pulled by campers or by draft animals.



Loading the sled—A sled cover can be almost any type of tarp, poncho, or similar cloth. Skis, snowshoes, or tools can be lashed on the top of the sled.



Loading the sled. Heavy items should be packed close to the bottom.

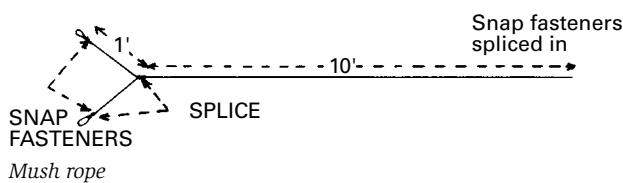
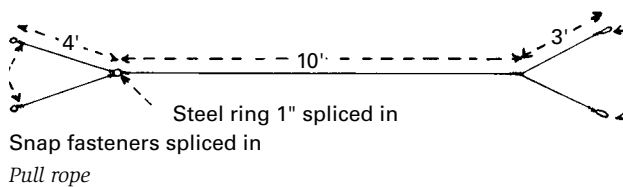
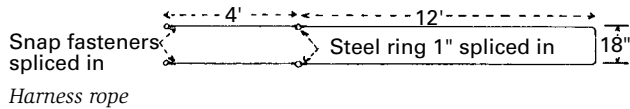
Loading a Sled. When loading a sled, it is important to remember not to overload. The usual weight of equipment for an individual camper is between 60 and 80 pounds. This is a perfect weight for your sled. The equipment will include all materials necessary for you to camp comfortably. It will include your share of the shelter, the cooking equipment, and the food, as well as your personal belongings.

A common mistake is to stack the equipment on the sled so that the center of gravity is very high. To correctly pack the sled, lay each item the full length of the sled, with the heaviest items on the bottom. Try to have the height of the finished load no more than a foot. A waterproof cover such as a poncho will protect the contents from the weather and keep you from losing items as you travel.

In fastening the cover, lace the load so that there is one area where you can keep items you might need en route. After the cover is laced, you can put snowshoes or skis on top. A shovel and other items needed for setting up a camp can also be laced to the top. If you are fishing, your auger will, of course, be on top of the sled.



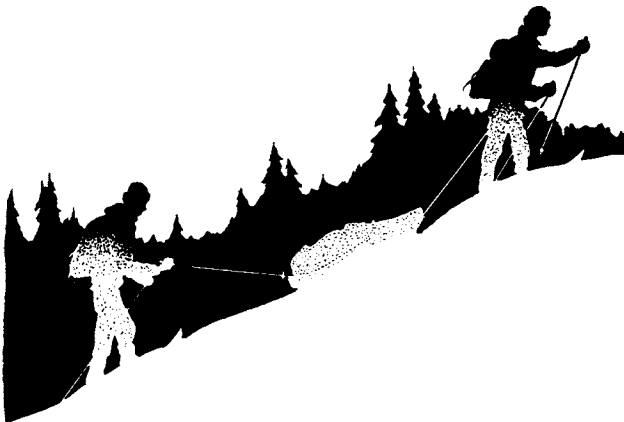
Pulling the Sled. Learning to pull a sled will involve learning a few tricks, and then practicing. After you have mastered the correct techniques, you will find that the sled will be a tremendous help to you. When training for sled travel, use a lightly loaded sled. Just as you would never start out learning to canoe in the rapids, neither should you try to learn the techniques of sled travel by starting with a fully loaded sled. Practice pulling the sled with more than one person as well as alone.



Canadian-style rope harness

The following suggestions will help you learn to pull a sled with ease:

- Make sure that the pulling device (poles or rope) is long enough. Poles should be at least 5 feet long and a rope should be a little longer than that. A rigid pole can be used any time you use skis. The rope can be used with snowshoes, skis, or when hiking. It is a good idea to always have an extra rope for emergencies. The “mush” rope at the back of the sled should be the same length as the pulling rope.

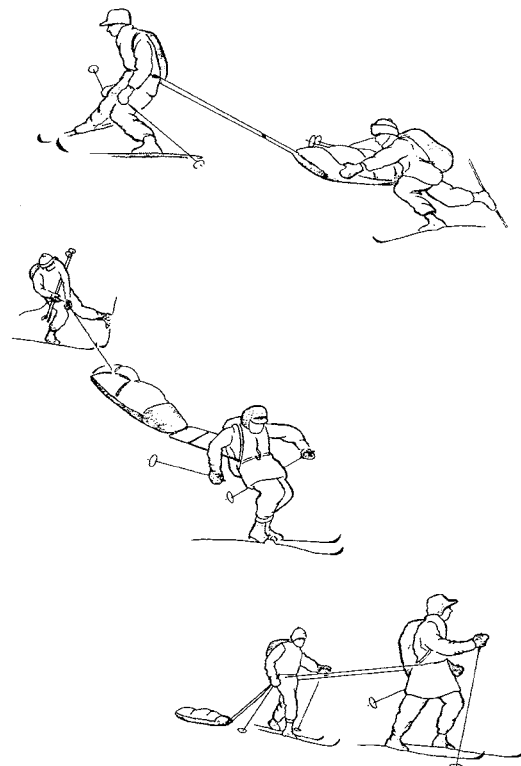


Uphill travel is the most difficult.

- The harness that you wear should be attached to a belt. This is so the pull will be from your midsection. It is necessary to have either a strap over your shoulder or a regular shoulder harness so that a waist belt will be held up when you stop, or when the pulling is difficult. If you use a shoulder harness, you can also shift the weight of the pull to your shoulders from time to time. There are many different harness arrangements, each with good points. Choose one that you feel will be best for you.

Even though you will generally pull the sled by yourself, during uphill travel and other difficult times, two or more persons may be needed to pull a sled. When more than one person pulls a sled, it is still best to stay in single file. The towing devices should be long enough to give plenty of room between pullers. At times you may want someone at the rear of the sled. The person at the rear will control the back of the sled, move the sled from side to side, and provide a brake when going down a steep grade.

For sled travel on level and rolling paths (if the snow is not very deep), wear either snowshoes or skis. For rugged uphill travel or steep downgrades, snowshoes are best. After you have become acquainted with your sled and skis, you may want to use skis for more of your sled travel.



Different pulling techniques with two people

TRAVEL SAFETY

Of course, you need to be conscious of safety when traveling in cold-weather conditions, and always use the buddy system. One danger that you may face is falling through thin ice or into a hole in the ice. The ice awl, a simple, easily made tool, should be part of every cold-weather camper's equipment.

Use of these "lifesavers" is described in the following article, which appeared in the 1927 BSA handbook *Winter Camping*.

"Another mighty good practice that is widely used abroad as a matter of individual precaution is for each member of the party to carry a pair of 'ice awls.' These are ordinary awls such as you can buy for 5 or 10 cents in any hardware store; cut off the points so that only $\frac{5}{8}$ -inch of metal remains protruding from the wooden handle, and file each to a rounded point not necessarily sharp. Drill a hole through the handle, near the top, and fasten a stout piece of cord to each, about the length of your arm.

"The awls should be carried in the breast pocket on the outside of your shirt or mackinaw, with a cord wound around them and fastened to a buttonhole or with a safety pin to the inside of the pocket. The points may be protected by sticking them into corks or into rubber stoppers such as are commonly used on ammonia bottles. A more presentable outfit can be made up with a small case of leather or canvas having a slight piece of metal at the bottom, or a double thickness of material, to protect the points.

"In case of sliding off the edge of ice into open water or going through a large hole, the awls can be quickly withdrawn and, holding them like daggers, can be used as claws to pull yourself out flat on the ice and away from the edge. There is no way your bare hands could get a grip on the smooth ice, and if you attempted to lift yourself out or place your knee on the edge to climb out, your weight would break the edges of the ice and only enlarge the hole and let you in for another ducking. Pull yourself out flat on your stomach and remain that way until you are safely away from the thin ice.

"The next most important precaution is to wear good woolen garments. Equipped in this manner there is no paralyzing breath-taking shock when you hit the water, and sliding into a hole is hardly more serious than jumping feet first into the water in the summer. The serious part of ice accidents, like all other so-called accidents, arises from panic and ignorance mainly due to the fact that you have heard over and over again vague tales of going through the ice and not coming up through the same hole again, and you have mentally pictured the shock of jumping into icy waters as being a thousand times more breath-taking than stepping under an unexpectedly cold shower. Under a shower, the water acts directly on your skin; going into the ice, the water requires pretty near a full minute or more to soak through ordinary winter clothing, and if the material is all wool there is no sudden shock of cold, nor do you feel particularly cold after coming out."

RESOURCES

Many resources are available through the local library. Resource materials include but are not limited to the following.

BSA PUBLICATIONS

Boy Scout Handbook

Fieldbook

Okpik: Cold-Weather Camping

Local council camping programs

U.S. MILITARY PUBLICATIONS

Cold Weather Operations, FM 31-70

U.S. Air Force Survival Training Manual, 64-3

Equipment Support, 64-4

Individual Support, 64-5

U.S. Army Survival Manual, FM 21-76

Other military manuals related to cold-weather teaching techniques

CANADIAN GOVERNMENT PUBLICATIONS

Down But Not Out, RCAF Survival Handbook

Northern Survival, Department of Northern Affairs

Aids to Working in the Cold, Department of Northern Affairs

SELECTED FIRST-AID PUBLICATIONS

Being Your Own Wilderness Doctor, by Russel E. Kodet and Bradford Angier. Stackpole, 1975.

Hypothermia, by William W. Forgey. ICS Books, 1985.

Wilderness Medicine, by William W. Forgey. ICS Books, 1987.

BSA and Red Cross first-aid publications

OTHER PUBLICATIONS

Cache Lake Country: Life in the North Woods, by John J. Rowlands. Norton, 1959.

Cold-Weather Camping, by Ray Stebbins. Contemporary Books, 1979.

Comfort Below Freezing, by Robert McQuilkin. Anderson World, 1980.

The Complete Skin Cross-Country, by Michael Brady. Doubleday, 1982.

New Complete Snow Camper's Guide, by Raymond Bridge. Scribner, 1981.

The Concise Book of Winter Camping, by Terry Brown and Rob Hunter. Vanguard, 1978.

The Cross-Country Skier's Bible, by Erwin A. Bauer. Doubleday, 1977.

Cross-Country Skiing, by Ned Gillette and John Dostal. Mountaineers, 1983.

Hunters of the Northern Forest: Designed for Survival Among the Alaskan Kutchin, 2d ed., by Richard K. Nelson. University of Chicago Press, 1973.

Indian and Eskimo Artifacts of North America, by C. Miles. Outlet Book Co.

Snow Camping, by Nordic World editors. Anderson World, 1974.

The Snowshoe Book, 3d ed., by William E. Osgood and Leslie J. Hurley. Greene, 1983.

Snowshoeing, 2d ed., by Gene Prater. Mountaineers, 1980.

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Varsity Team Program Features

A Guide to Team Program Planning

VOLUME I

Backpacking
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Cross-Country Skiing
Cycling
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