Wade!

This module is designed to help you explore how water affects your life every day. **Wade** is part of the Science category.

1. Choose A, *or* B, *or* C and complete ALL the requirements:
   A. Watch about three hours total of science-related programming that discusses water as it relates to the hydrologic cycle, primary sources, primary users (including wildlife), health, sources of pollution, waste treatment, and related sciences and technologies. Then do the following:
      (1) Make a list of at least five questions or ideas from the show(s) you watched.
      (2) Discuss two of the questions or ideas with your counselor.

      Some examples include—but are not limited to—shows found on PBS ("NOVA"), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), History Channel, the National Academy of Sciences YouTube Channel, and www.waterblues.org. You may choose to watch a live performance or movie developed by a local museum or state or federal agency. You may watch online productions with your counselor's approval and under your parent's supervision.

   B. Read (for about three hours total) about water as it relates to the hydrologic cycle, primary sources, primary users, health, sources of pollution, waste treatment, and related sciences and technologies. Then do the following:
      (1) Make a list of at least five questions or ideas from each article.
      (2) Discuss two of the questions or ideas with your counselor.

      Examples of magazines include—but are not limited to—*Odyssey*, *Popular Science*, *Science Illustrated*, *Natural History*, *Scientific American*, *Nature Conservancy*, *Sage Magazine*, *Smithsonian*, *National Geographic*, *LakeLine,* and *WaterWorld*.

   C. Do a combination of reading and watching (about three hours total). Then do the following:
      (1) Make a list of at least five questions or ideas from each article or show.
      (2) Discuss two of the questions or ideas with your counselor.

2. Choose **ONE** STEM field of interest from the following list. Complete **ALL** the requirements for a Venturing STEM exploration in that field. You should be prepared to discuss the role of water in the area or field you've chosen. (If you have already completed a Venturing STEM exploration in one of these fields, please choose a different field for this award.)

Chemistry	Nature
Environmental Science	Oceanography
Fish and Wildlife Management	Public Health
Fishing	Soil and Water Conservation
Fly-Fishing	Sustainability
Forestry	Weather
Geology	

3. Learn how the volume of water changes as it moves from phase to phase. Do all of the following.
   A. Describe how you would measure the change in volume for the transition of water from liquid to ice.
   B. Discuss with your counselor the effects that floating sea ice and land-based ice have on sea levels when they melt.
   C. Discuss with your counselor the effects that floating sea ice and land-based ice have on water tables when they melt.

4. Prepare two demonstrations of surfactants and present them to a group of Cub Scouts or other youth. Make sure to explain the science involved and how surfactants can be used in oil spill cleanup and recovery. Explain to your counselor the physical concept(s) involved.

5. Water, wetlands, and wildlife. Do ONE of the following options (A or B).
   A. Identify and locate on a map the five largest bodies of water near where you live, and indicate the water flow for each. These could be creeks, streams, rivers, bayous, lakes, bays, estuaries, or oceans. The flow should culminate in the largest water body in your area.
      (1) Identify 10 of the common invertebrates and vertebrates that are probably present in these different bodies of water. Learn what a bioindicator is, and identify any in your system. You may choose to contact a local biology teacher, college professor, nature center naturalist, or state fish and wildlife expert, or you can use resources from your local conservation department.
      (2) Research the services that wetlands perform for water quality, flood control, and wildlife habitat. How can wetlands be used to complement sewage treatment plants? Discuss your findings with your counselor.

   B. Surface water
      (1) Discuss with your counselor the following concepts: a watershed and how it relates to a river basin, runoff, runoff coefficient, infiltration, point source pollution, non-point source pollution, and oceanic dead zones near the mouth of rivers.
      (2) Determine which river basin you live in and research (or estimate) its size. Estimate the total volume of water that falls on this watershed every minute during a 1-inch per hour rainfall.
      (3) Construct a chart that shows the volume of water that runs into the river as a fraction of the total rain falling on the watershed (using composite runoff coefficients). Estimate the rate of runoff in cubic feet per minute for a 1-inch per hour rainfall from your home's lot or a nearby property.
      (4) Discuss with your counselor the implications of these calculations as they relate to the effect of changes in land use on flooding, soil moisture, erosion, and point and non-point source pollution. What are the most common types of water

pollution in your area, and how are these being impacted by land use? How might these be reduced?

Helpful Resources:
The USGS Water Science School – https://water.usgs.gov/edu/) may be helpful in researching these topics.

6. Choose **ONE** of the following options:
   A. Research a disaster involving water, such as the receding Sarichef Island in Alaska, the 2011 Tōhoku tsunami, a hurricane, coral reef bleaching, sea level rise, etc. Determine the causes of the event, the damage caused, and how the area has recovered. Find out about any remediation that has occurred to restore the area to its pre-disaster state or efforts to prevent future damage from similar events. Share the results of your research with your crew and with your counselor.

   B. Research the major functions of a sewage treatment plant. Describe to your counselor how it reduces the impact of sewage on aquatic life. List any pollutants that remain in the water after processing and their potential impact on aquatic life.

   C. Visit a place where water is being processed either by man or by nature (wastewater treatment plant, naturalist center, conservation department, etc.) and discuss the processing with a professional. Discuss with your counselor what you learned, including the aspect(s) of “STEM” that are being used.

7. Discuss with your counselor what you have learned while working on this award, and how water and the science of water affect your everyday life.

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Counselor Guide

Below are guidelines (or additional help) for the counselor who is working with the youth to earn this nova award.

Helpful Links:
Flyover Country® is a National Science Foundation funded offline mobile app for geoscience outreach and data discovery. http://fc.umn.edu

US EPA's Surf your Watershed at cfpub.epa.gov/surf/locate/index.cfm

USGS Watershed Tool at https://viewer.nationalmap.gov/advanced-viewer/ . Turn on the National Hydrography Dataset (NHD) in the Layers list, and the topographical lines will show where water flows. Turn on the Watershed Boundary Dataset in the Layers list, and you can see how large of an area your watershed covers, and other watersheds that are nearby.

Requirement 3:
The Polar Literacy Initiative (https://polar-ice.org/polar-literacy-initiative/) is a good place to start investigating these topics.

Requirement 4:
Oil spills can be remediated in four ways: physically skimming the oil off the surface of the water, burning the oil, using surfactants to break the oil slick down, or doing nothing and letting nature take care of it.

A surfactant is a material that lowers surface tension between two liquids, breaking down the barrier between them. They are used in detergents, dispersants, wetting agents, medicine, and so on.

See
Explainer: why are chemical dispersants used in oil spills?
https://www.chemistryworld.com/news/explainer-why-are-chemical-dispersants-used-in-oil-spills/1017322.article

Oil Spill Dispersants: Efficacy and Effects (2005)
https://www.nap.edu/catalog/11283/oil-spill-dispersants-efficacy-and-effects

One activity could be having scouts try different tools to skim the oil using different tools – a paper towel, wood splint, steel wool, cotton balls, and so on. You could also have them build a physical oil skimmer. Which one collects the most oil and least water?

Another activity could be putting oil and water into a sealed scintillation (or other clear) vial and shaking vigorously. What happens? Then add one drop of dishwashing liquid (Dawn works best), and shake again. What happens this time?

Requirement 5A:

Your state department of conservation or natural resources can be a great place to start.

Requirement 5B:

(1) Discuss with your counselor the following concepts.
The USGS web sites https://water.usgs.gov/edu/watershed.html ,and
https://water.usgs.gov/edu/runoff.html may be helpful here.

A watershed is a geographic area that drains into a common outflow point, which could be a river basin.

Runoff - That part of the precipitation, snow melt, or irrigation water that appears in surface streams, rivers, drains or sewers. It may be described by how fast it appears, or by source.

Runoff coefficient - a dimensionless coefficient that describes the amount of precipitation that runs off an area, as opposed to being absorbed into the ground. It ranges from 0 to 1, with larger values for areas with pavement and steep gradients (roofs range from 0.75 to 0.95), and lower for permeable, well-vegetated areas such as forests and flat lands (woodlands can range from 0.05 to 0.25). A composite runoff coefficient is one that covers an area made up of multiple types of surfaces – for example, a lot that is ½ pavement and ½ asphalt would have a composite coefficient that was proportional to the amount of each surface area.

Infiltration – rainfall or other water that is absorbed into the soil

Point source pollution - water pollution coming from a single identifiable point, such as a sewage-outflow pipe

Non-point source pollution – pollution collected as water washes off a large area. Could include pesticides, soil particles, and so on.

Oceanic dead zones – a low-oxygen area (hypoxic), often found near the mouth of rivers, resulting from "excessive nutrient pollution from human activities coupled with other factors that deplete the oxygen required to support most marine life in bottom and near-bottom water. (National Oceanic and Atmospheric Administration)"

(2) Determine which river basin you live in and research (or estimate) its size. Estimate the total volume of water that falls on this watershed every minute during a 1-inch per hour rainfall.

Example: If the watershed you selected is 10 acre, that is 6.273×10^7 sq in.

A 1 inch per hour rainfall will deposit:

6.273×10^7 sq in * 1 in/hr * 1 hour = 6.273×10^7 cubic inches of rain per hour

6.273×10^7 cubic inches of rain/hr * 1hr/60 minutes = 1,045,500 cubic inches of rain/minute

1,045,500 cubic inches of rain/minute * 0.004329 gallons/cubic inch = 4520 gallons rain/minute

To put that into perspective, an average American shower uses 17 gallons of water, so that is 270 showers worth of water falling every minute over the watershed.

(3) Construct a chart that shows the volume of water that runs into the river as a fraction of the total rain falling on the watershed (using composite runoff coefficients). Estimate the rate of runoff in cubic feet per minute for a 1-inch per hour rainfall from your home's lot or a nearby property.

Type	**Runoff Coefficient**	**% of water that runs off**
Drives, Walks, Roofs	0.90	90%
Lawns, 50% grass	.10	10%
Lawns, 75% or more grass	.05	5%
Street, paved	.90	90%
Streets, Gravel	.25	25%

Sample Calculation:

If your property is 1 acre, that is 6.273×10^6 sq in.

A 1 inch per hour rainfall will deposit:

6.273×10^6 sq in * 1 in/hr * 1 hour = 6.273×10^6 cubic inches of rain per hour

6.273×10^6 cubic inches of rain/hr * 1hr/60 minutes = 104,550 cubic inches of rain/minute

If half the property is house (ie, roof), and half the property is a grass lawn, the amount of runoff would be:

Runoff = (1/2*0.90 + ½*0.05)*104,550 in^3/minute = 49,661 in^3/minute

This is the Rational Method for runoff calculations, and is a quick, simple calculation. Much more sophisticated models and computer algorithms are also available.