
Nova - Splash!

Vincent Meunier

Dec 30, 2020

CONTENTS:

1	Welcome to <i>Splash!</i>	1
1.1	Instructions	1
1.2	Documenting your progress	1
1.3	If you have any question	2
2	Requirement #1: Research and Reading	3
3	Requirement #2: Merit Badge	5
4	Requirement #3: Study Water	7
5	Requirement #4: Visit	10
6	Requirement #5: Water @ Life	12
7	Other Nova modules in this series	14
8	About the author	17

WELCOME TO *SPLASH!*

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

Warning: When completing this Award both the youth and involved adult leaders must obey all rules of [Safe Scouting](#). This includes (1) Completing Cyber Chip training prior to starting this activity and (2) **ALWAYS** involve at least 2 adults in all your communications with a leader, including online. If you send email to your counselor, always add the address of another adult leader or a parent/guardian. Never reply to a message sent by an adult leader unless another adult has been copied on the email. Report any issue to your parents/guardians!

1.1 Instructions

1. Identify a **Nova Counselor** either within your unit, district, or council.
2. This site provides you a platform for learning and you can easily follow all requirements using the navigation menu on the left.
3. Once you have identified a Counselor, you can start working on requirements.
4. The most important aspect in any scientific endeavor is to **properly document progress**. This will be done, here, using a google sheet as described in more details below.

1.2 Documenting your progress

0. You can use the template below to report completion. To work on this Nova Award, you can also use a detailed worksheet provided by the BSA. Click [here](#) to have access. The file below is used to record approval.
1. A template worksheet can be found [here](#). This is a *Google document*. **You will not be able to modify it until you make your own copy as I will now describe for you.**
2. Once you have opened the file on google doc, go to File → Make a Copy.
3. Save the file with the following name: *Nova_splash_FIRSTNAME_LASTNAME*
4. You will use that file to enter your progress and share with your counselor.
5. **You can share your own copy of the worksheet with your counselor using the following procedure.**
 - a) Click on the SHARE button on the top-right.
 - b) Click on “get link”.
 - c) Send the link to your counselor.

Note: This document provides you a guide to complete the Nova award! All requirements are marked with the following symbol: REQ ~>. In addition, a number of fun *Additional Challenges* are provided in boxes for your entertainment.

1.3 If you have any question

Contact your counselor or your scoutmaster! If you have questions about the program, contact Vincent Meunier by [email](#) (always make sure to copy another adult on all your communications!).

REQUIREMENT #1: RESEARCH AND READING

REQ ~ Choose A or B or C and complete all the requirements.

- A. Watch not less than three hours total of science-related shows or documentaries that discuss 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.

Tip: 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 or guardian’s supervision.

- B. Read (not less than 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.

Tip: 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 (not less than 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.

Additional Challenge

1. True or False? Water is the only substance found on earth naturally in three forms.
2. At what temperature does water freeze?
3. At what temperature does water vaporize?
4. How long can a person live without food? How long can a person live without water?

5. How much of the earth's surface is water?
6. In the US, how many households use private wells for their water supply?
7. How much water is used in the average five-minute shower?

Those questions were compiled by the EPA (see box under requirement #4 to learn more about the EPA). More questions are available at [EPA](#). (solutions are provided there)

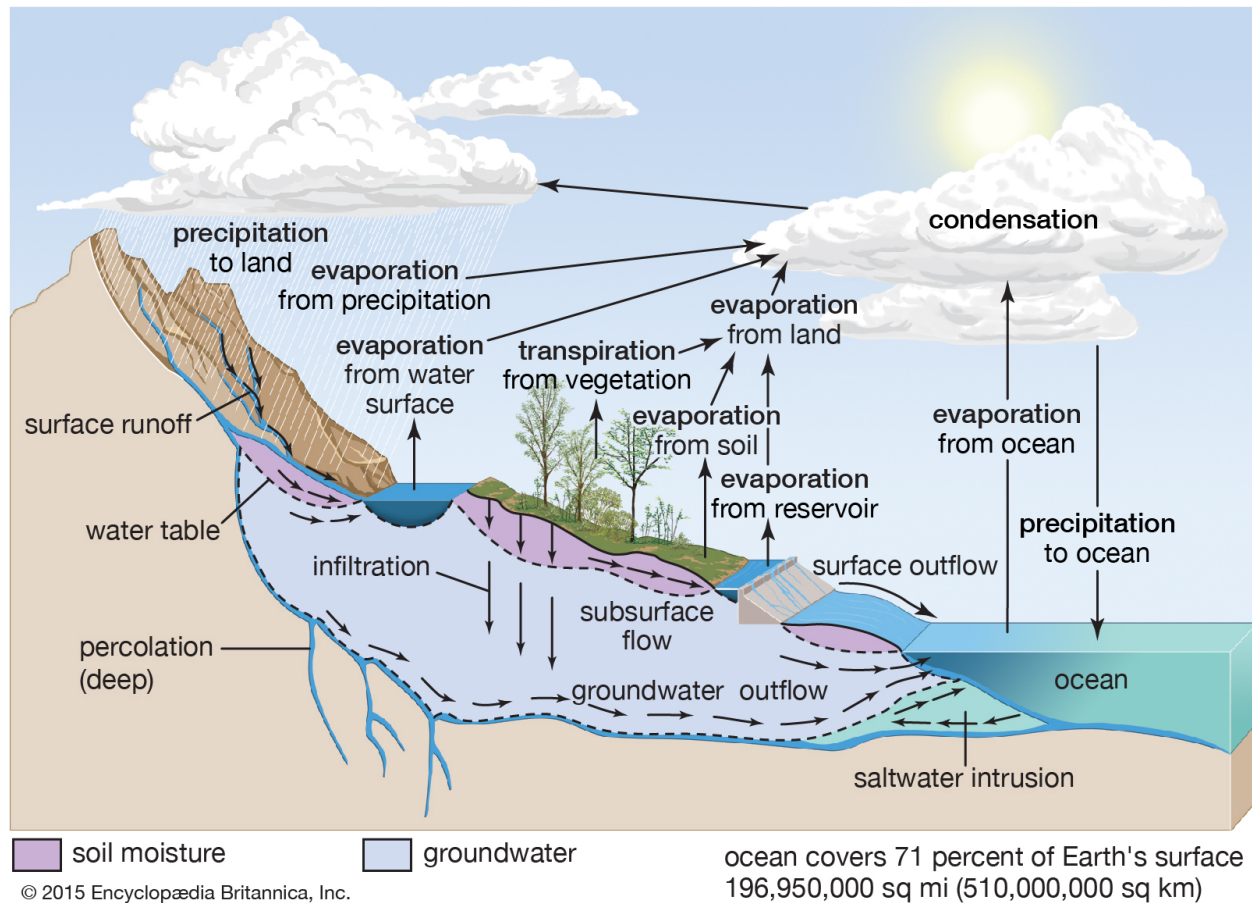


Fig. 1: In the hydrologic cycle, water is transferred between the land surface, the ocean, and the atmosphere. Image obtained from Encyclopedia Britannica (click on image for full reference).

Attention: Once you have completed this requirement, make sure you document it in your worksheet!

REQUIREMENT #2: MERIT BADGE

REQ Complete ONE merit badge from the following list. Choose one that you have not already used toward another Nova award. After completion, discuss with your counselor how the merit badge you earned uses agriculture.

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



Attention: Once you have completed this requirement, make sure you document it in your worksheet!

REQUIREMENT #3: STUDY WATER



Choose two requirements from A or B or C or D and complete ALL the requirements for the two you selected.

- A. Examine models of the structures of liquid water and ice. (You can use either a physical model or a computer model.) Note the similarities and differences between them. Discuss with your counselor how the structures of water and ice affect their properties and their ability to dissolve compounds and carry impurities.

Hint: Helpful Links (Be sure you have your parent's or guardian's permission before using the internet.)

- The Interactive Library — [Explain It With Molecules](#).
- University of Alcala - [Intermolecular hydrogen bonds in liquid water and in ice](#).

-
- B. Prepare two demonstrations or activities involving surface tension or hydrophobicity, and present them to a Cub Scout den or other youth group. Explain the science involved, and discuss your presentation with your counselor.

Hint: Information and Tools to Examine Properties of Water

- [A gentle introduction to water and its structure](#).
- The Interactive Library—[Explain It With Molecules](#).
- University of Alcala—[Intermolecular hydrogen bonds in liquid water and in ice](#)

Hint: Some Sources of Materials:

- Hydrophobic materials—Naturesorb (dried sphagnum peat moss);
- Scotchgard (for coating sand grains)
- Tulle fabric—From fabric store (use instead of screen)
- Dialysis tubing—Carolina Biological Supply

Hint: Some Experiments

- [Surface tension](#).
- Massachusetts Institute of Technology— [Surface Tension](#).

- WonderHowTo—How to do a science trick demonstrating surface tension with pepper, soap, and water.
- SteveSpangler.com—Magic Sand – Sand That Is Always Dry. (hydrophobic material)
- SteveSpangler.com—Mysterious Water Suspension. (water cohesion forces)
- Michigan Tech MindTrekks – Surface Tension Trap.

C. Use the internet (with your parent's or guardian's permission) to determine the annual water use for your state in gallons and acre-feet.

- (1) What are the main sources (provide percentages)?
- (2) Who are the main users (provide percentages)?
- (3) What are the trends in total and per capita water use over time? (4) Discuss what you learned with your counselor.

Hint: Helpful Link: * USGS Water Use in the United States <https://water.usgs.gov/watuse/>

D. Household water use. Create a list all of the ways that water is used around your home in a 24-hour period, including the bathroom, kitchen, and any appliances. Don't forget outdoor water uses such as pools, hot tubs, sprinkler systems, landscape and gardens, pets and/or livestock, and cleaning efforts such as washing cars, boats, pets, etc.

- (1) Estimate how much water is used for each function over a specific time period. Add your estimates to come up with an estimate of total water usage by your family for one month or one year.
- (2) Compare your estimate with the actual total found on your home water bill, and account for any large differences. (Hint: ask your parent or guardian to help you locate that information on the monthly water bill or well meter.)

Note: If you live in a multi-family housing unit and do not have an individual water bill, you may be able to obtain the information from your unit's management. If not, measure your water usage for at least two tasks (for example, by leaving the drain closed when you take a shower, then measuring the amount of water that collected in the tub during your shower), and use that data to revise your estimates.

- (3) How does your local usage compare to the average use per capita in your state? The United States Geological Survey ([usgs.org](https://www.usgs.org)) is a good source for data on average water usage.
- (4) Identify several ways to reduce your water consumption, and practice them for one month. Estimate how much clean water you have saved.
- (5) Discuss your work and what you learned with your counselor.

Attention: Once you have completed this requirement, make sure you document it in your worksheet!
--



Fig. 1: Surface tension allows those insects to walk on water! Image obtained from science-sparks.com (click on image for reference). Check that website for fun and easy experiments to learn more about surface tension.

REQUIREMENT #4: VISIT

REQ ~> Visit a place where water is being processed either by humans or by nature (wastewater treatment plant, naturalist center, conservation department, etc.), take a tour, and speak with a professional about the processing of the water. Discuss with your counselor the STEM being used.

Tip: You can complete this requirement using a *virtual* visit!

Water facts

- There is the same amount of water on Earth as there was when the Earth was formed. The water from your faucet could contain molecules that dinosaurs drank.
- Water is composed of two elements, Hydrogen and Oxygen. $2 \text{ Hydrogen} + 1 \text{ Oxygen} = H_2O$.
- Nearly 97% of the world's water is salty or otherwise undrinkable. Another 2% is locked in ice caps and glaciers. That leaves just 1% for all of humanity's needs — all its agricultural, residential, manufacturing, community, and personal needs.
- Water regulates the Earth's temperature. It also regulates the temperature of the human body, carries nutrients and oxygen to cells, cushions joints, protects organs and tissues, and removes wastes.
- 75% of the human brain is water and 75% of a living tree is water.
- A person can live about a month without food, but only about a week without water.
- Water is part of a deeply interconnected system. What we pour on the ground ends up in our water, and what we spew into the sky ends up in our water.
- The average total home water use for each person in the U.S. is about 50 gallons a day.
- The average cost for water supplied to a home in the U.S. is about \$2.00 for 1,000 gallons, which equals about 5 gallons for a penny.
- Water expands by 9% when it freezes. Frozen water (ice) is lighter than water, which is why ice floats in water.

These facts were compiled by the US Environmental Protection Agency (see box below to learn more about the EPA)

Note: *What Is the Environmental Protection Agency (EPA)?*

The Environmental Protection Agency (EPA) was established in December 1970 by the executive order of President Richard Nixon. It is an agency of the United States federal government whose mission is to protect human and environmental health. Headquartered in Washington, D.C., the EPA is responsible for creating standards and laws promoting the health of individuals and the environment. The EPA was created in response to widespread public environmental concerns that gained momentum in the 1950s and 1960s. From the EPA's creation, it has sought to

protect and conserve the natural environment and improve the health of humans by researching the effects of and mandating limits on the use of pollutants.



Fig. 1: Waste water treatment plant. Can you identify the various stages of water treatment? Click on image for full credit.

Attention: Once you have completed this requirement, make sure you document it in your worksheet!

REQUIREMENT #5: WATER @ LIFE

REQ ~> Discuss with your counselor what you have learned about how water affects your everyday life.

Challenge: What is lateral thinking?

Lateral thinking is, according to wikipedia, a *manner of solving problems using an indirect and creative approach via reasoning that is not immediately obvious. It is this moment of surprise, generating laughter and new insight, which facilitates the ability to see a different thought pattern which initially was not obvious.*

Examples of lateral thinking puzzles

- (1) There is a man who lives on the top floor of a very tall building. Everyday he gets the elevator down to the ground floor to leave the building to go to work. Upon returning from work though, he can only travel half way up in the lift and has to walk the rest of the way unless it's raining! Why?
- (2) A prisoner survived in a cell with no water. His only source of fresh water was from a well located on the other side of the thick steel door of his cell. How?
- (3) A man and his son are in a car accident. The father dies on the scene, but the child is rushed to the hospital. When he arrives the surgeon says, "I can't operate on this boy, he is my son!" How can this be?
- (4) A man is wearing black. Black shoes, socks, trousers, lumper, gloves and balaclava. He is walking down a black street with all the street lamps off. A black car is coming towards him with its light off but somehow manages to stop in time. How did the driver see the man?

Note: Some of these questions are inspired by this [site](#) and this [site](#). There are many other examples of lateral thinking online, look them up, as always, using what you learned during your Cyber Chip training!

Attention: Once you have completed this requirement, make sure you document it in your worksheet!



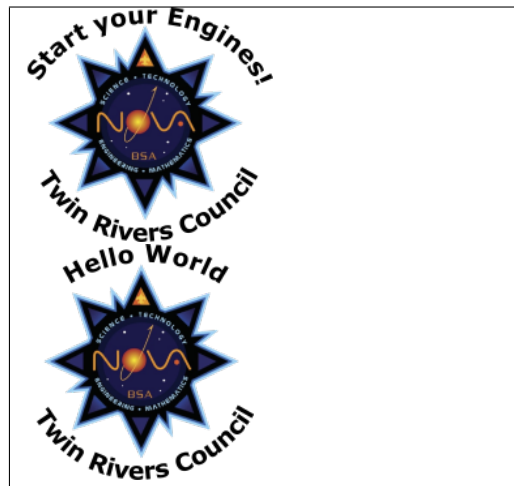
Fig. 1: Water is life! Image taken from onewater.my. Visit the website to learn more about water!

OTHER NOVA MODULES IN THIS SERIES

Science



Technology



Engineering



Math



ABOUT THE AUTHOR

These pages were written by Vincent Meunier, the Chair of the STEM committee of [Twin Rivers Council](#) in New York State.

Vincent Meunier is a Professor of physics at Rensselaer Polytechnic Institute. If you have any question, feel free to contact him by [email](#).

Note: Most of the material used here was obtained from a number of external scouting sources, including [scouting.org](#)



Fig. 1: A water droplet and its associated ripples.