SCIENCE NORTH SCIENCE NORD

Grade: 8	Course: Science
Strand: Earth and Space Systems – Water Systems	**Lesson Name: Water quality and watersheds**
Big Ideas: • Water is an important resource that needs to be managed sustainably.	**Specific Expectations:** 2.4 use scientific inquiry/research skills to investigate local water issues. 2.5 use technological problem-solving skills to design, build, and test a water system device that performs a practical function or meets a need. 2.6 use appropriate science and technology vocabulary, including water table, aquifer, polar ice-cap, and salinity, in oral and written communication. 3.2 demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning. 3.3 explain how human and natural factors cause changes in the water table (e.g., lawn watering, inefficient showers and toilets, drought, floods, overuse of wells, extraction by bottled water industry).
Learning Goals: • For students to gain an understanding what a watershed is. • Understanding pollution in the context of watersheds • Learn about water treatment generally and in a local context.	**Assessment:** Assessment For learning **Cross-Curricular:** Geography **Description:** In this lesson, students build a model of a watershed to experiment with and learn about the effects of pollution on a watershed.

Introduction:
If you didn't do the other Science North lesson on watersheds then a general introduction may be needed first:

Watersheds
- Let's start with a discussion about the topic of today: watersheds. What is a watershed?
- A geographic area from which all the water drains into the same stream or lake. A **drainage basin**.
- A local watershed can be part of a larger one (e.g. the local creek watershed is part of the larger river watershed). (See resources to learn about Ontario's watershed boundaries).
- Get examples of a watershed the students can think of (e.g. the local watershed, a famous river basin).
- Watch one or several of the included videos to learn more!

Pollution and Water Treatment

Today we will focus on pollution:
- **What kinds of pollution could get into the water?** Take examples – farm runoff, highway runoff, raw sewage, a spill (e.g. gasoline or a chemical), sediments from erosion, pesticides and herbicides that homeowners apply, ANYTHING that people put down the drain or storm sewer!
- **What could you do to prevent pollution?** (Water treatment plant – but they are not always perfect. It's always best to NOT release the pollution in the first place)

So, let's do some experiments to understand how pollution affects watersheds better.
You may have already built the watershed model in the previous lesson – if so skip to the experiments. Otherwise follow instructions:

Action:
This lesson will work well if students are in groups of 2 or 3.

Creating the Watershed model:

- Give each group a piece of Styrofoam, a sharpie, and a tool to make a channel in the foam.
- Instructions:
    - Draw a watershed on your foam. Include:
        - A stream from one end of the foam to the other
        - A wetland
    - To make your wetland we will use a sponge. It will absorb water much like a real wetland! So – what you will do is mark an area the size of the sponge you receive and then make a hole deep enough to fit the whole sponge.
    - Use your tools to cut out the channels and holes (lakes and wetlands) you drew. Make the sides (close to) vertical and at least 1 cm deep.
    - This will be a bit messy so one student's job should be to collect the Styrofoam bits and put them in a bag.

Testing model:
NOTE: If groups have a plastic bin to catch water runoff then they can get water in a pitcher from the sink and do the testing at their desk. Otherwise students will have to take turns at the sink.

- Place the model in the bin/sink and incline gently (you can try a steeper slope to see what happens)
- Slowly pour water in the top of the channel(s).
- If banks overflow, reduce amount of water and/or use a lower slope. If water still overflows, make your channels deeper!
- Once students are happy with how their model works they can do the following experiments, and fill in the worksheet.

In order to do our experiments on pollution **we will need some dirty water**! We suggest you make a large container of water mixed with potting soil. Mix it in well so that the water turns brown but there are also still some larger pieces of debris in it. This way you will see how polluting materials of different sizes are filtered out.

Experiments
Fill in the worksheet as you do the experiments. For all experiments note especially what happens in the "wetland" (sponge).

1. **Pour the dirty water into the top of the watershed model**. Observe: where does any "pollution" accumulate? Don't forget about the bin the water runs into, which could represent a larger body of water or ground water.
2. **Repeat the experiment but run the water through a sieve**. Note the differences from before. Also try with water that just has some food colour added to it. How much of the colour is caught?
3. **Repeat again but run the water through a coffee filter**. Again try with dirty water and coloured water.

Consolidation/ Extension(s):

Reserve some time to discuss the results. Students could also think about these issues independently or do research on them:

- What did students notice?
- Where did pollution accumulate when no filters were used?
    - A lot of it probably ended up in the bin, meaning it would have reached a lake/ocean or seeped into the ground water. These are places we draw drinking water from…
    - The large debris may be scattered along the stream. This is how garbage accumulated along rivers.
- Was the course filter good at eliminating pollution?
    - It probably only caught large debris. The food colour and finer dirt (brown water) goes right through. Much of the pollution we face is in the form of very small particles. For this reason we need very good filters to catch the pollution.
- Did things improve with the coffee filter?
    - Yes, quite a bit. This shows us the importance of water treatment. You could think of the filter as a water treatment plant or water treatment done to runoff from a factory or farm.
- What did you notice happen in the wetland?
    - Pollution accumulates in the wetland. It can act as a purifier, but it can also get polluted if we do not protect

it.
    - Wetlands can play an important role in reducing pollution downstream. One approach that we can use is to build **rain gardens**, which will actually purify runoff before it hits a larger stream, just like our wetland model did.

What can we do to protect our water?

- Make sure we have regulations that limit pollution and protect sensitive areas:
    - Every type of business/industry faces different regulations.
    - Home owners as well. For example in Ontario we are no longer allowed to use many herbicides for cosmetic use at home.
    - What kind of regulations (for example) do you think a car wash faces? How would that compare to a garden centre? (see resources for link to Ontario water regulations)
- Even when there ARE regulations, often pollution happens when there is a big storm and sewers are overwhelmed. Then raw sewage (for example) may be released into streams. This is especially a problem as climate change leads to more heavy storms!
- **Clean up ourselves**
    - For example every year there are special "**shoreline cleanup** days" in Canada. You can join and collect trash along your local body of water (see link below for one such initiative).
    - **Don't throw your trash into nature**. It may well end up in a river float somewhere where creates problems in the environment.

Results of pollution:

- What can happen once pollution gets into the water? (Runs downstream into lakes and oceans, seeps into **aquifers/groundwater**, harms wildlife, could get into drinking water etc.)
- Many animals are affected by garbage in our water. Especially seabirds are often found with stomachs full of plastic that they ate mistaking it for fish.
- Pollution can lead to unsafe water. You may have heard of local swimming bans in summer or even drinking water bans in some Canadian communities. This is because the water is too polluted.
    - Blue-green algae will form when too many nutrients (fertilizer) are in the water
    - E-coli can be found due to farm-runoff
    - In some communities, the water may contain heavy metals or other pollutants that occur naturally or come from such things as mining. Treating all drinking water is very important!

Materials/Resources:

Activity materials (for each group):

- Sharpies
- A piece of Styrofoam (or other material that can be easily shaped), at least 12'' on a side and 1.5'' or 2'' thick. (Get it from the insulation section of your local home improvement store)
- Sandpaper and/or knives to cut channels in the foam.
- A sponge
- A bag to collect Styrofoam bits and optionally a balloon to pick up Styrofoam bits
- Optional:
    - plastic bins to catch water running off the watershed model
    - containers to pour water from (e.g. milk jugs)
- Sieve or other fine mesh (such as window screening)
- Coffee filter
- Potting soil
- Optional: Food Colour

Watershed maps:

- Watershed locator: https://www.ontario.ca/environment-and-energy/great-lakes-watershed-locator
- OMNR watershed mapping: http://www.gisapplication.lrc.gov.on.ca/OFAT/Index.html?site=OFAT&viewer=OFAT&locale=en-US

Videos on watersheds:

- A great basic introduction: https://youtu.be/QOrVotzBNto
- Nice quick explanation and thinking about how water flows through the watershed “tree”: https://www.youtube.com/watch?v=b98kdNGYZt0
- A really comprehensive (AND fun) introduction, but US oriented: https://youtu.be/2pwW2rlGIa8

Ontario Water Regulations: https://www.ontario.ca/laws/statute/90o40
TD shoreline cleanup: https://shorelinecleanup.ca/

Worksheet – Pollution in Watersheds

Prepare some dirty water by thoroughly mixing some potting soil into water.

1. **Dirty Water without filtering.** Slowly pour the polluted water into the top of your watershed model.
    a. Where does any pollution accumulate? Where does it end up? Describe in words or with a sketch.

    b. What happens in your wetland? Is it different from the rest of the watershed?

2. Repeat the experiment but this time **pour the water through a sieve** before you let it flow into the watershed model.
    a. How much of the pollution is removed? Does the colour of the water change?

b. How much pollution collects in your wetland now, compared to the first experiment?

3. Repeat the experiment again, but this time **pour the water through a coffee filter** first.
   a. How does this filter compare to the sieve?

   b. Again, describe what happens in the wetland.

4. **Conclusions.** Based on your experiments does filtering the water make a big difference? What is the impact of pollution on wetlands? Etc.