Grade: 8	Course: Science
Strand: Earth and Space Systems – Water Systems	**Lesson Name: 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 of what a watershed is. • Appreciate the importance of wetlands and/or reservoirs in reducing flooding and droughts. • Understanding some of the impacts climate change has on watersheds and managing water flow.	**Assessment:** Assessment FOR learning **Cross-Curricular:** Geography **Description:** In this lesson, students build a watershed and use it to conduct experiments which simulate an actual watershed.

Introduction:

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, famous river basins etc.).
- Watch one or several of the included videos to learn more!

Features in a watershed

Let's think now of what types entities make up a watershed:

- Rivers
- Lakes
- Wetlands (e.g. a swamp or bog)
- Reservoirs (artificial lakes)

Today we will build our own small watershed and do some experiments to better understand how this all works.

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 something to scrape the Styrofoam with (knives, coarse sandpaper, or even a fork or spoon to use as a scraping tool work well).
- Instructions:
  - Draw a watershed on your foam. Include:
    - A **stream** from one end of the foam to the other
    - At least one **lake or reservoir** – BUT leave a little bit of foam so it's **NOT YET CONNECTED** to the stream (for now)
    - A **wetland** (also NOT connected to the stream for now)
  - Let's talk about the wetland a little. How could we make a model of a wetland? (It should be something that can hold water). A good solution is to **use a sponge for your wetland**. 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.
    - Fun option: pick the small bits up using static electricity: blow up a balloon rub it on a piece of clothing, then drag it through the foam bits and rub them off the balloon inside the 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, pour water more slowly and/or use a lower slope. If water still overflows, make your channels deeper!
- Once you are happy with how your model works do the following experiments, filling in the included worksheet.

Experiments:

1. **Pour water onto the model**. Describe what happens. Does the water accumulate anywhere? Does it overflow anywhere?
2. Pour the water over the model **faster.** Is there flooding? Is the amount of water leaving the watershed the same as the amount entering?
3. **Open up the reservoir** (by removing foam separating it from stream). Ensure that the water flows into the reservoir. Compare the flooding above the reservoir to the flooding that occurred below the reservoir. Compare your results to the scenario without the reservoir, considering how much water flowed out of the watershed.
4. **Open up the sponge wetland**. Repeat experiments again and compare results.
5. **Investigate Groundwater**. Place a straw or thin tube into the bin and make sure there is some water in it. This is your groundwater. Draw the water up through the straw and make it run down the watershed. Look at what happens if the runoff does not return to the groundwater etc.

Consolidation/ Extension(s):
Discussion:

- How did the reservoir and wetland affect the watershed? (They both retain water. They can reduce flow rate. Flooding downstream will be less. A reservoir can be used to supply water during a drought. Etc.)
- Wetlands act just like sponges. They can absorb a lot of water during a flood. This water is then only slowly released back into streams, reducing flooding downstream.
  - Wetlands provide capacity for streams to absorb extra water.
  - When we destroy wetlands we increase the risk of flooding downstream.
  - Wetlands also help to clean the water (more on that in lesson 2)
- With climate change we predict that there will be both more intense flooding and droughts happening. How can that affect watersheds? Would reservoirs and wetlands become more important? (yes)
- What do communities have to do to adapt to a changing climate?
  - How might YOUR community adapt?

Extension:

- Make a proposal for a local water management plan based on what you learned. What rules will developers have to follow (e.g. build reservoirs, preserve wetlands, etc.)? What areas can be developed, and what areas can't?

Materials/Resources:

PowerPoint slides contain some useful images for this lesson.

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, knives or other tools 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)

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

Worksheet – Wetlands

1. Pour water into the watershed at the top. Describe what happens with as much detail as you can.

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2. Repeat the experiment, but first note the amount of water you are going to release.

   Mark the waterline on your container or record amount: ______________ ml

   Capture the water running off the watershed. How much water do you capture?

   Mark the waterline on your container or record amount: ______________ ml

   How does this compare to the amount of water you released at the top?

3. Pour the water into the watershed again but this time pour it faster. Describe what happens and how it differs from your first experiment.

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4. With the reservoir opened so water can flow into it, pour water into the watershed again. How does the result differ from before? Record how much water you released on how much you captured this time at the bottom.

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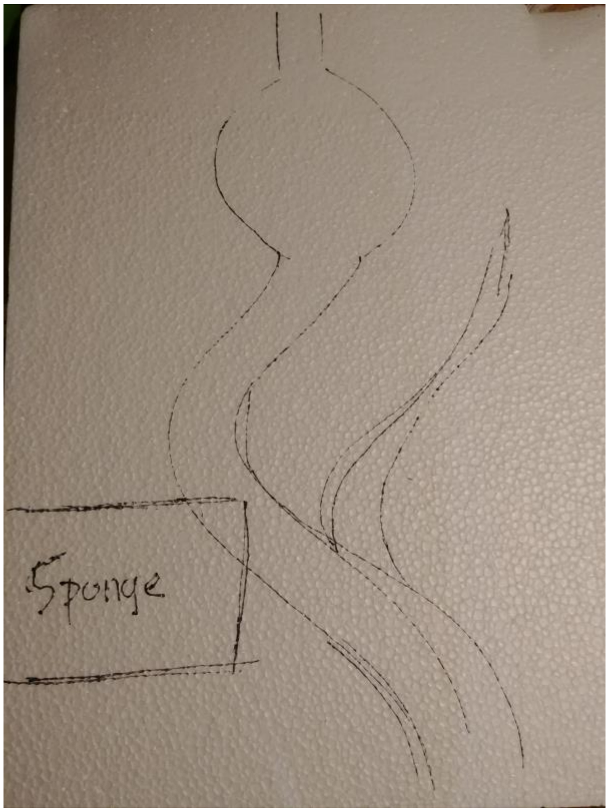
5. With the wetland (sponge) now accessible to the water as well repeat your experiments again. How does the wetland affect water flow and flooding below it in the watershed? How does it affect how much of the water initially released flows out of the watershed at the end?

Reference Images for Watershed model



Watershed drawn on

Watershed extruded, sponge wetland included.