Healthy Water, Healthy Communities

Grade 7 – Watershed Forests

Overview:

In order to have a healthy community, one of the main things we need is access to clean, safe tap water. In the CBRM we are lucky enough to be able to turn on our taps and run clean, safe water ready for us to use. However, in some parts of the world not everyone has this precious resource readily available to them.

In this lesson, students will learn what a watershed is, how forests naturally filter the water, and build an understanding of how nature manages water on a watershed level.

Watershed protection and monitoring maintenance is a large part of making sure we have clean, safe tap water. This monitoring begins even before the water reaches our source water lakes. Throughout this lesson, students will develop the skills needed to identify tree species in their watershed. They will develop an understanding of the large role trees and plants play in filtering the water. They will also learn about forest succession and will be able to determine a healthy forest to protect and maintain a watershed.

Key Concepts:

- Learning about watersheds and how water is connected to everything
- Learning about the importance of watershed management and how the health of the watershed forest impacts our source water
- Learning how to identify tree species
- Determining how specific tree species can affect the quality of water

Curriculum Objectives:

<u>Physical Science: Mixtures and Solutions – Mixtures, Solutions, and the Environment</u>

- **112-7, 113-1:** Identify and explain examples of mixtures and solutions that have an impact on development in science, technology, and environment

<u>Life Science: Interactions Within Ecosystems – Components of an Ecosystem</u>

- **208-2, 208-3, 210-1:** Identify questions, investigate, and record collected data on the ecosystem's components using materials effectively
- **304-1, 109-1, 109-12:** Distinguish and explain how biological classification reflects the diversity of life on Earth, using specific terms and characteristics

<u>Life Science: Interactions Within Ecosystems – Ecological Succession</u>

- **306-4, 208-5:** Identify signs of succession in a local ecosystem and predict its future based on characteristics and succession

Supplies:

- DBH tape or any measuring tape (used to find diameter of tree)
- Activity sheet & clipboard
  If you plan to preface with the All the Water in the World demonstration:
- Water
- Eyedropper
- Food colouring
- 3 different sized beakers (small, medium, large)

Timeline:

This lesson plan will take approximately two 60 minute sessions to complete, comprised of one class day and one field day.

Introduction	Start with a brief but broad discussion with the class about water and climate change. What are the many ways in which climate change impacts access to safe water? How is the water cycle impacted by climate change? All the Water in the World Demonstration – Demonstrate just how little fresh water there is to drink in the world through a presentation using water, food dye, an eyedropper, and three different sized beakers (small, medium, large). Fill the larger beaker with water and a few drops of blue food dye so that its easy for the students to see. Explain to the students that the water in the large beaker represents all the water in the world (including ground water and icebergs in addition to oceans, streams, lakes, rivers, etc.) **Ask students:** how much of this water do you think is salty from oceans? Half? More than half? Less than half? How much of this water do you think is fresh water from lakes and streams? Proceed to pour approximately one cup of water from the large beaker into the medium sized beaker and explain to students that this represents the amount of freshwater in the world. Humans need fresh water (not salt water) to live. Even though our world is covered in plenty of water, we aren't able to drink most of it. Freshwater also represents water trapped in icebergs and groundwater. **Ask students:** of the freshwater, how much do you think is readily available for us to drink and use? Proceed to take a few drops out of the medium sized beaker and put them into the small beaker. Hold it up for all to see. Explain that a lot of Earth's freshwater is trapped and not easily available for human use. This is why its so important to conserve and protect the water that we do have.

	There are many people who don't have this access to clean water in the world. There are communities even in Cape Breton who can't access safe water. If we had to walk hours a day for water and then boil and filter it ourselves, we would not have the time to go to school or our parents would not be able to provide for us in the way that we are used to. Because we have this privilege, we have the responsibility to conserve and protect water, and to learn how to continue to protect water for the future.
Watershed Management	What is a watershed? What kinds of things would you find in a watershed? What watershed is our school in and where do we get our drinking water from? Discuss the negative effects of pollution on a watershed and how an unhealthy water source can lead to unhealthy people, plants, and animals. What can we do to prevent pollution/destruction in the watershed? How do forests influence water quality in a watershed? Briefly discuss the structure of a tree, and the key concepts related to water: • Interception – when precipitation does not reach the forest floor. Instead it is collected by leaves, branches, or plants on the forest floor. Interception of falling rain helps to buffer against erosion. • Direction – once the tree has intercepted precipitation it directs flow down its branches and trunk, towards its roots. • Infiltration – when water penetrates into the surface of soil. Infiltration is controlled by soil texture, soil structure, vegetation, and soil moisture. • Absorption – trees and other vegetation take up water. Just as human bodies are made of about 60% water, plants are composed of water as well. • Evapotranspiration – is when water evaporates from leaves and moves from a liquid back into a gas, rejoining the water cycle as water vapour.
Canopy Composition	Take the students outside and into the forest, woodlot, or simply landscaped trees around their school. Help them identify a few different trees by teaching them the characteristics of each tree (leaves, buds, bark, twigs opposite or alternate, needles flat or round, etc.). Explain what a coniferous and deciduous tree is. You may phone ACAP to help to identify the trees in your schoolyard in preparation if you would like added support.
DBH Activity	Split into groups of 4-5. Each group will get a clipboard, activity sheet, and a DBH measuring tape. Choose a spot in your woodlot, you will measure the diameter at breast height (DBH) of 10 different trees in that area.

	When you choose a tree, identify what kind of tree it is, record it on your sheet, then measure the diameter of the tree, in centimeters, at the height of your chest and record that data. Continue these steps for all 10 trees.
Canopy Closure	When taking the measurements of your 10 trees you will also calculate the canopy closure of that area. While at your tree look straight up to the tree tops. As a group, try to estimate how much of the canopy is covered in and circle the closure percentage on your data sheet.
Analyzing Findings/Final Discussion	Once the students have retrieved all of their data go back inside to analyze the findings and have a final discussion. What kind of trees did they find? What was the largest of their ten trees? What was the smallest? What was their canopy closure like? Why is it important to measure canopy closure?  Figure 1. Early succession tree assemblage in Cape Breton (examples: balsam fir, trembling aspen, white spruce, black cherry, paper birch). Early succession trees make use of the open sunlight of a disturbed site. The site could have been disturbed by human activity like logging, farming, or building a schoolyard. It could also be disturbed by natural processes like erosion or forest fires. In Cape Breton we get some interesting early succession trees that are short lived but grow quickly such as: 1. The trembling aspen grows and spreads quickly. Its bark is tinged with green so it can photosynthesize early in the spring before it's leaves are out allowing it to grow quickly. 2. The white spruce keeps its needles all year so it can make use of the sunlight when the deciduous trees have no leaves.

Figure 2. Late early succession.

These early succession trees are short lived. After a few decades of collecting nutrients from the soil and sunlight, they fall to the ground and all the nutrients locked inside these giant organisms is slowly released back into the earth through decomposition.

As the fallen trees slowly decompose they:

1. Increase soil depth
2. Provide habitat for fungi and insects up the food web
3. Sequester carbon
4. Absorb and hold stormwater
5. Slowly fertilize the soil as nutrients are released

The paper birch adds to the soil throughout its life as it frequently drops branches. Braches are not as big as 15-metre logs of course, but over the years decomposing branches add to the soil quality.

This young canopy can now create some shade that will allow some older succession trees to establish such as red oak or eastern hemlock saplings.

Figure 3. Late succession

	As the mature forest establishes and grows, moving from an early successional forest to a late successional forest, the tree canopy closes in densely and the soil layers become rich in organic matter which holds and filters water. Individual trees increase in size and are much longer lived than early successional species. Some examples of late successional forest species in Cape Breton include: • Yellow Birch • Sugar Maple • American Beech • Red Oak • Eastern Hemlock • White Pine • Red Spruce *Red Maple is also a common component of mature forests A mature tree is generally more efficient at intercepting precipitation, slowing down runoff, holding soil together, and filtering out contaminants in the air and precipitation. Forest composition can also influence water quality. It is something that watershed managers must take into account when planning watershed forest management. The percentages of coniferous and deciduous trees present in source water areas can make a difference in the quality of water that flows out of that forest and into surface water rivers, lakes, or trickles into ground water reservoirs. Coniferous trees, with their many needles that stay on the tree all year long, are very good at scrubbing pollution and particles out of the air and rain/snow. Following a large rain event, many of these pollutants and particles are flushed out of the coniferous trees and flow through the nearby ecosystem, and can ultimately end up in a source water supply. For this reason, it is more desirable to have source water forests that are dominated by deciduous trees because they are not as efficient at 'scrubbing' as coniferous trees are. Also, the accumulation of organic matter in the form of annual leaf litter helps to build soil and increase absorptive/filtering capacity of the forest. Looking at the data you collected including tree species, DBH, and forest canopy, what does this tell you about where your sample tree community is in the range of forest succession? How?