Forest & Lake Ecosystems in Ontario

Materials:

- Pennies
- Vinegar
- Clorox wipes
- 5 bags of 3 different beans (mixed)
- Spoons, forks, knives
- Dixie paper cups
- Pipettes
- pH paper & legend
- Rainwater
- Plastic Cups

Introduction:

1. What do scientists do?
2. Where do you find scientists?
3. What is a biologist? What is an ecologist?
4. How does this type of science affect your life? What about other types?

Basic Needs of Life:

1. What are the basic needs of living things (what do living things need to survive?
    a. Show the students a picture of a fish (for example, redside dace) to help guide their answers… What do these fish need to survive?
        i. Food (redside dace eat insects)
        ii. Water (redside dace need water for breathing and living in)
        iii. Oxygen (redside dace breathe oxygen dissolved in water)
        iv. Shelter (redside dace hide under logs and lay eggs in other fish's nests)
        v. Habitat (redside dace live in cool, shady streams)
    b. Have students try to list as many things as possible, grouping the common ones if necessary.

A Healthy Ecosystem:

1. What does an ecosystem need to be balanced and healthy?
2. Introduce the idea of abiotic and biotic factors, basing it on the notion that biology is the study of life.

a. Abiotic (non-living) factors:
    i. Soil
    ii. Air
    iii. Water
    iv. Nutrients
b. Biotic (living) factors:
    i. Plants
    ii. Animals
    iii. Fungi
    iv. Micro-organisms

The Animal Kingdom:

1. What's the biggest group of animals? Prompt with fish or mammals if necessary.
2. Discuss why students might think that insects are so important within the Animal Kingdom. *Pollination of trees and plants for us to eat from, also part of the food chain.*

Adaptations:

1. What is it? *When a species somehow changes to better suit it's environment or to evade predators.*
2. How did these animals do it? *The caterpillar adapted a camouflage technique; along with its colours, the part that appears to be its head is actually the tail end… The eyes are fake so that predators will go for the wrong end and miss the real head containing most of its essential organs, giving it a better chance of survival (adapting to biotic factors). The seal has adapted to become more streamlined as well as having a thicker layer of blubber since they tend to be found in colder waters (adapting to abiotic factors).*
3. What are some prey adaptations? *Flight, poison, camoflauge… This can extend into a discussion on evolution and biodiversity, but I suggest you keep this shallow and quick.*

Community:

1. What's a community made up of? *Prey and predators.*
2. Discuss what would happen to the top and bottom of the foodchain if one animal went extinct. *If the fieldmice died out, the snake would have to adapt to this change and search out other sources of food to avoid starvation. The grasshopped/locust population would thrive, however, and this could have negative effects on crops or other insects that depend on plants for food.*

3. Discuss if students can think of any animals that could live in both a terrestrial or a marine food chain. *Bears, amphibians, humans.*

Appendages Activity:

1. Discuss why insects have different appendages. *Different prey, different purposes.*
2. Draw connections between the utensils listed and the three insects' limbs (in order).
3. Have the students sit in five groups, and each group will get a bag with three types of beans in it.
4. Each student will get a pain of utensils (spoons, forks, or knives) and a cup for their stomach.
5. Tell them that they will have 45 seconds for foraging, where they will use their utensils as chopstick to pick up their prey and put them in their stomachs (cups). Warn them that at 30 seconds you will tell them information about one of their prey; one will become poisonous and you will have to dump your stomach out (vomit) if you have eaten any of that prey (this way they will be at least somewhat listening when you make the announcement… this activity gets quite loud).
6. After the 45s, have students count their prey and put all the beans back in the bags as you circulate to collect the materials.

Appendages Activity:

1. How did the specialized appendages help with your foraging? *The spoons were likely easiest, and knives likely the hardest.*
2. What happened to the population of the prey that became poisonous? *It would have remained level in the game, but in real life it would have thrived.*
3. How will that adaptation affect the other, non-poisonous prey? *They would be targeted instead so they would decrease faster.*
4. What happens if one predator becomes resistant to poison, say the people with knife appendages? *The poisonous prey would become a target once again and would decrease.*

Acid Rain!

1. Acid Rain & PH
    a. Introduce students to the concept of Acid Rain, playing upon their prior knowledge if possible. Introduce the pH scale, and discuss what the different ends mean. Discuss the terms "acidic", "basic", and "neutral".

b. Show the pH scale and warn that bases can also be very dangerous. Show familiar examples along the scale to help them relate.
c. Ask them what pH they would like to see their rainwater be at? *7 – neutral.*

Acid Rain Sources

1. Where does acid rain form? *Up in the clouds where SO_2 and NO_x react to form sulphuric acid and nitric acid in the atmosphere.*
    a. How does the acid get back to the ground? *Rainwater, snow, fog, other forms of precipitation mix with the acids and fall to the earth as acid rain*. Some students might ask about whether the acid in the atmosphere can affect things they settle on when it's not raining. This is known as **dry deposition** and can be introduced as well.
    b. Acid Rain Sources
        i. Ask students if they remember the two main chemicals that contribute to acid rain (SO_2 and NO_x). Tell them that these often come from man-made objects, such as smoke stacks.
        ii. Quiz students on whether or not they can come up with some natural sources that might through acids up into the atmosphere. (Geysers and volcanoes)
        iii. Why don't we worry about these natural sources? *Nature has ways of recycling these acids by absorbing them and breaking them down. They are also only a small portion of the acidic rainfall we see today. In small amounts, these acids are able to actually help dissolve nutrients and minerals for plants. Unfortunately today we see an overload of acid due to human activities, and the balance has been thrown off in the ecosystems.*
        iv. Ask students why acid rain sometimes travels and affects other places? *Most smoke stacks are over several stories high now, ejecting the chemicals way up into the air and being carries by wind currents to other places hundreds of miles away. In fact, sending pollution high into the sky increases how long the pollution is in the air as well as the chances that the pollutants will form acid rain.*

Acid Rain & Metals:

1. Demo: http://www.epa.gov/acidrain/education/experiment9.html
    a. Explain the effect of acid rain on man-made objects.
        i. Causes metals to rust quicker.
        ii. Wears away and discolours stone work.

iii. Lifts and cracks paint.

2. Make the connection to the Parliament Buildings whose roofs are copper. They were originally the colour of our pennies but the acid rain effect and exposure to air afterwards has changed it to the green we see today.

Acid Rain & Forests:

1. Trees and plants are **primary producers** since they produce their own food and provide it for animals and other living things.
    a. Trees need **calcium** to grow, and so they suffer a **nutrient deficiency** when acid rain dissolves and washes away this and other minerals.
    b. Acid rain releases **aluminum** from the soil, which is very harmful to trees and plants. It can wind up in water systems as well, where it can also harm and kill water plants and fish.
    c. **Haze** is caused by the same pollution that causes acid rain, and it scatters light back towards the sky. This reduces the amount of light available for plants to use in photosynthesis.

Acid Rain & Ponds, Lakes and Streams:

1. Use this slide to revisit the pH scale. As students if the water is getting more acidic when the pH gets smaller? *Yes.*
2. Which animals can handle acidic water best? *Frogs, perch.*
3. Which animals are most sensitive to changes in pH? *Clams, snails.*

Testing Kingston Rainwater:

1. Have students get into small groups. Each group should have a pipette, beaker, and pH paper (with a colour legend)
2. Circulate and allow students to use the pipettes to obtain rain water from you, and then determine the pH.
3. Discuss the implications of the pH, referring back to the previous slide on the effects on ponds, lakes, and streams.
4. Discuss the terms **turbidity** and **temperature**, and how these factors play a role in the lake ecosystem.

What's Being Done:

1. Capping & Monitoring: *many countries have capped how much their companies can send out in emissions. It doesn't matter how they lessen, it just has to be below the max level of sulphur dioxide and nitrogen oxides released. EPA and other agencies also monitor the atmosphere and weather patterns.*

2. Alternative energy forms: hydroelectric, wind, nuclear, solar, fuel cells.
3. Conserve electricity: turn off lights, appliances, and computers when no one is using them.
4. Transportation: walk, bike, take public transit, carpool. Plan your trips wisely, and choose a good, fuel-efficient vehicle wherever possible.
5. Carbon footprint: watch the thermostat and AC levels.
6. Recycle: reducing the amount of waste we produce also reduces the amount of new products that have to be made to replace those unrecycled objects.

Extras:

1. *Guilty or Innocent* activity
2. Have students list off local lakes and rivers, and talk about potential threats to their ecosystems.

Sources:

1. “Testing the Waters” – Lake Norman State Park PDF
2. “Learning About Acid Rain: A Teacher’s Guide for Grades 6 through 8” - EPA