Soil Acidity	Grade 4 Life Systems

Lesson Plan

Safety Notes

This activity uses liquids that could be harmful. Ask an adult to assist you with this lesson.

Description

In this activity, students will learn about soil acidity and why different soil is important. They will learn about the Sudbury story, to help explain how humans can have positive and negative effects on **habitats** and the soil that all living things use. To understand all this, we will look briefly at what habitats are

Materials

- *Soil*
- *Vinegar*
- *Baking Soda*
- *Red Cabbage*
- *Saucepan*
- *Distilled Water*
- *2 Cups/Bowls*
- *Optional:*
- *7 jars/cups/containers for solutions*
- *Lemon Juice*
- *Milk*
- *Bleach*

Science Background

A habitat is a place where a **community** of organisms live. It includes all living and nonliving aspects of that environment. The soil is a non-living thing that plays a major role in habitats and communities for all living things. Soil is home to various kinds of plants, animals and tiny little bacteria. For plants, soil contains water and many essential nutrients needed for growth. For animals, soil can provide many necessities in their habitat. It can be a shelter for protection or a place that they get or store their food. A lot of good bacteria also live in soil. These helpful bacteria provide a large amount of nitrogen for plants, which creates a specific acidity in the soil that is crucial for the growth of the plants that live there.

Different Plants grow better depending on the acidity or alkalinity of the soil. This is determined by what is called the **pH Scale,** which shows a numbered scale from 0-14. Items that lie from 0-7 on the scale are high in acidity, whereas those 7-14 are alkaline, or basic. Items that sit at 7 are called neutral, not acidic, but not basic. Regular water is neutral and sits at 7 on the pH scale. Things like vinegar are

very acidic, which sits at 2.4. Baking soda is a basic or alkaline material, which sits at about 8.6 on the scale. Some types of plants that like slightly acidic soil are blueberries, broccoli, garlic, spinach, and onions. Some types of plants that like alkaline soil are asparagus, cabbage, cucumbers, cantaloupe, and grape vines.

All of these are needed to make a stable community and a healthy habitat. Humans are dependent on habitats for many things, including food, water, oxygen, building materials for shelters, clothing, and medicine. However, humans still destroy some habitats and communities that we depend on so much. This means we need to find a balance between taking the benefits from the environment and preserving that same environment.

An example of humans taking advantage of their environment and pushing its breaking point is the Sudbury story. In the early 1900's, Sudbury mines provided 80 percent of all the world's nickel production. Even to this day, the Sudbury basin is a major international producer of nickel. Over time, the mining operations affected Sudbury's landscape. Trees and plants were unable to grow in the contaminated soil. The problem was the sulfur mining by-products that deposited into the soil made it very acidic, so much so that very little could grow. This not only affected plants but it disrupted the entire habitat for all living things, and is why before 1970, the Sudbury landscape looked like a barren moonscape. The pH of the soil at this time was around 2.2, which is about the same as vinegar. This is an example of how human activities can have a negative impact on habitats.

The city of Sudbury began restoring its greenery in 1969. When the re-greening started, the soil was so acidic that the germinating seeds would die when they came in contact with the soil. To fix this high acidity, Sudbury needed to add a base or alkaline material to the soils, to balance out the acidity. This base would fight the acidity and bring the soil back closer to a neutral level by using lime. In 1974, after 2 years of doing this, there was a 7.4 acre patch of grass! (That's about the size of 5.5 football fields). Nature began to heal itself, and trees like birch and poplars, wildflowers, and shrubs, started to grow. Since then, mining companies in Sudbury have reduced the water pollution by controlling their waste water quality, and reducing air pollution by installing a giant smokestack to reduce the sulfur dioxide emissions. They have currently reduced emissions down to 10%. These changes are keeping a clean and happy habitat for all of Sudbury. This is a wonderful example of how humans can have a positive impact on habitats

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But why is soil so important, other than helping plants grow? We understand that soil has nutrients in it that help plants to grow. It also helps to hold plant roots in place, and protect the plant from erosion. So imagine soil that cannot sustain plant life. How will we grow food? How will we feed the animals we eat for food? Everything in a habitat becomes affected by the simplest changes.

Activity Procedure

Acidic or Basic Soils

1. Start by collecting soil from your yard. Think about where the soil lies and what environmental and human conditions may be affecting it. For example, is the dirt from the garden going to be the same as dirt under a pine tree? Make sure you label your samples with where you found them!
2. Take your two empty jars and put 2 teaspoons of the dirt in each.
3. Begin with the vinegar, measure ½ cup of white vinegar, and add it to the soil. Take a minute to observe the reaction. If your soil begins to fizz, that means your soil is alkaline, with a pH between 7 and 8.
4. If your soil doesn't fizz, then move onto the second container of fresh soil. Add distilled water to your dry soil just until it gets muddy. (Note: Distilled water will yield the best results in this experiment because it is neutral on the pH scale). Add ½ cup of baking soda. If your soil begins to fizz, you have acidic soil, most likely sitting at 5 or 6 on the pH Scale.
5. If you do not get a reaction from either baking soda or vinegar, then you are lucky to have neutral soil, at around 7!

Testing the PH

1. In this test, we'll test the pH of your soil using red cabbage juice. Red cabbage can help us determine pH because it contains a colouring compound called anthocyanin, which turns yellowish green when in a basic (alkaline) environment, and turns reddish pink when in an acidic environment. Other food items you could use to substitute a whole red cabbage are blueberries, blackberries, or black currants. These foods are also high in anthocyanin, however, we found that red cabbage works the best.
2. Measure 2 cups of distilled water into a sauce pan. Cut up 4-6 cabbage leaves into small pieces, and simmer in the water for 10 minutes. Remove from heat and let sit for up to 30 minutes. For extra juice, put your cabbage in a blender. Strain out the cabbage chunks with cheesecloth or other cloths, a stainer or coffee filters, anything you have to strain will work as long as there are no chunks. Your solution should be a purple/blue colour.
3. To test your soil, add 2 teaspoons of soil to a half cup of cabbage juice in a jar. Stir and wait 20-30 minutes for the colour to fully come in. Place the rest of your cabbage juice aside.

4. While your soil is sitting, you can choose to prepare a pH scale in order to match the colour of your soil to a number on the scale or you can use the scale I have made in the video.
5. **Optional:** create your own pH scale. Prepare 6 glasses with 1 cup of distilled water. From left to right, put 2 tablespoons of the following substances in the jars: lemon juice, vinegar, milk, just distilled water, baking soda, and bleach.
6. Using the rest of the cabbage juice, pour a bit in each of the six jars. Observe what colour each changes to! Each solution represents a number on the scale: lemon juice - 2, vinegar - 3, milk - 6, water - 7, baking soda - 8, bleach - 12. **Note: the bleach will drain the colour out very fast. Write down your observation for this one quickly. Determine what colour matches your soil sample after 30 minutes, and where it is on the scale.
7. You can expand your pH scale by using different household substances and repeating the experiment.

This is distilled water and cabbage juice. It sits at about a 7 on the pH scale, and is neutral.

This is Thunder Bay tap water and cabbage juice. It is visibly more blue, and sits at about an 8 on the pH scale. This means that the water is slightly alkaline. This makes sense, because the city added sodium hydroxide to their water to balance out the lead in it. Sodium hydroxide sits at about 13 on the pH scale.

Debrief

You can use this information to determine what will grow best in that soil. Different plants can grow differently depending on the soil pH. Plants that grow well in acidic soil include Azaleas, evergreens, beech trees, daffodils and blueberries. Plants that grow well in alkaline soil include poplar and oak trees, lilacs, lilies, and geraniums.

If you are wanting to plant these and your soil is the opposite of what the plant favours, there are ways to change your soil. If you have soil that is high in acidity, you can lower that and make it more alkaline by adding limestone to the top 6 inches of soil, scattering it and watering it well. However, if your soil is too alkaline, you can make it more acidic by adding organic

materials like pine needles, peat moss and compost. Remember to introduce change to your soil a little at a time. Too much of a change at once may destroy nutrients and make it harder for plants to grow in it.

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Handout

1. Label soil sample and describe where you found it.

2. Write down observations for each test (acidic and alkaline);

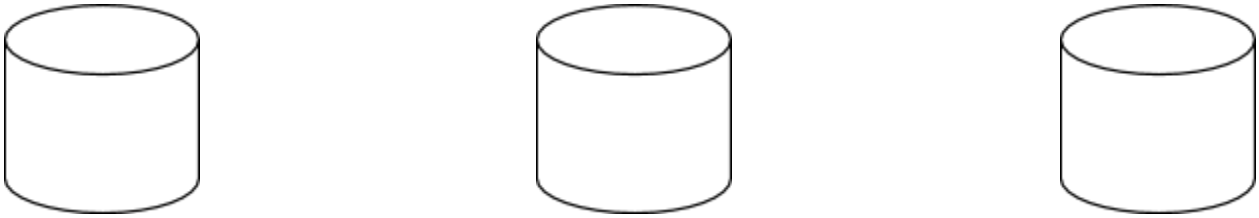
Acidic test (baking soda):	**Alkaline test (vinegar):**

3. Based on your observations what type of pH is your collected soil? Circle one;

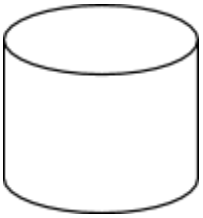
Acidic (< 7pH) **Neutral (= 7pH)** **Alkaline (> 7pH)**

4. Colour each of the jars to its correct pH colour:

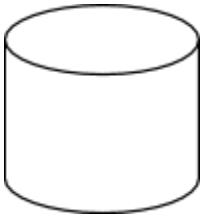
Lemon Juice Vinegar Milk



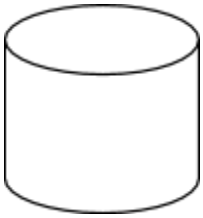
Water



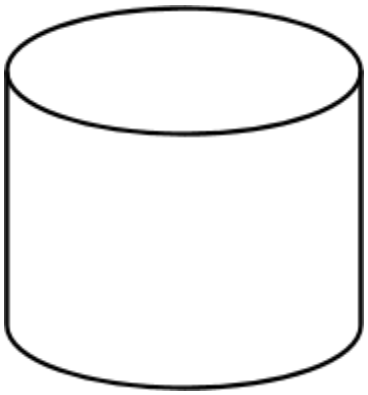
Baking Soda



Bleach



5. Determine what colour matches with your soil. Colour in your jar as well as write down what the pH is.



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Handout Ans

1. Label soil sample and describe where you found it.

Soil collected in my backyard garden in Sudbury, Ontario. Soil has flowers (Lillies growing in it). Soil is dark and has pieces of dead plant material and has white speckles.

2. Write down observations for each test (acidic and alkaline);

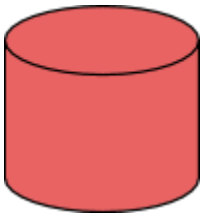
Acidic test (baking soda):	**Alkaline test (vinegar):**
No reaction. No bubbles formed. *Note: If bubbles form soil is acidic*	*No reaction. No bubbles formed.* *Note: If bubbles form soil is basic/alkaline*

3. Based on your observations what type of pH is your collected soil? Circle one;

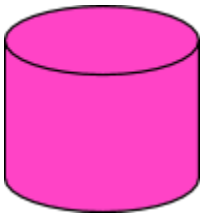
Acidic (< 7pH) Neutral (= 7pH) **Alkaline (> 7pH)**

4. Colour each of the jars to its correct pH colour:

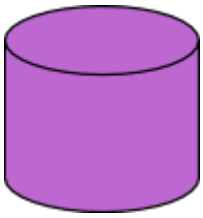
Lemon Juice



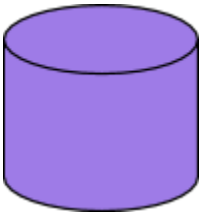
Vinegar



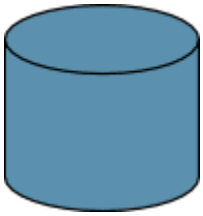
Milk



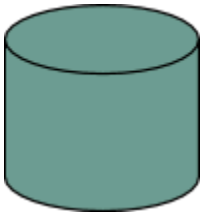
Water



Baking Soda



Bleach



5. Determine what colour matches with your soil. Colour in your jar as well as write down what the pH is.

Based on the results of my test the soil in my garden has a pH of around 6. This means that it is slightly acidic although close to a neutral pH.