Lesson: pH & Drinking Water

Objective:

Students will understand the concept of pH, how it is measured, and its significance in determining the safety and quality of drinking water.

Preparation:

In the following activity, you and your students will test tap water, bottled water, distilled water, and four additional substances of your choice.

Determine what these latter four substances will be, aiming to represent both acidic and basic properties. For acidic items, consider lemon juice, soda, or vinegar. For basic items, consider a baking soda and water solution, dish detergent or bleach.

Place a little of each substance into a container and label it. Make enough containers of each substance to match the number of groups you will have in each class. For instance, if you have four groups, you need four containers of lemon juice, four containers of baking soda solution, and so on.

Introduction:

1. **Engage the Students:**
    - Start with a brief discussion on what students notice about the tap water in their home. Inquire if they drink their tap water, and ask what they've noticed about it (e.g. color, odor).
    - Introduce the concept of water-quality parameters – the different aspects of water that we measure to find out how clean and safe water is. (e.g. lead, arsenic, bacteria, and pH – the focus of this lesson).
    - Tell the story or share a reading about the **Flint, Michigan water crisis**, where a change in a public water source with lower pH resulted in lead being leached from pipes and causing lead poisoning in the city's population.
2. **Explain pH:**
    - Show the pH scale, which ranges from 0 to 14. Explain that 7 is neutral, below 7 is acidic (give examples), and above 7 is basic/ alkaline (give examples).
    - Explain that the pH of drinking water should fall between 6.5 – 8.5 (EPA standard).

Activity:

1. **Demonstration and Hands-On Practice:**
    - **Group Activity (20 minutes):** Divide the class into small groups. Give each group pH test strips and different samples of the substances you prepared.
        - Sample 1: Distilled Water
        - Sample 2: Tap water
        - Sample 3: Bottled water
        - Sample 4, 5, 6, 7: Samples with a known pH level (e.g., lemon juice, vinegar, soap, etc.)
    - Have students measure and record the pH of each sample using test strips (**see the accompanying pH activity for Intergenerational Learning for instructions on using test strips**). Ensure they use safety goggles and handle all materials carefully.
2. **Data Analysis:**
    - Have each group compare their results with the pH scale chart.
    - Ask them to discuss their findings in their group setting:
        - Which samples were acidic, neutral, or basic?
        - Why do they think these differences in pH between the substances might occur?
3. **Bioassays with pH:**

Have students use any of **our bioassay approaches** to look at the effects of pH on biological organisms. For example, how would a change in pH affect Daphnia's heartbeat? Planaria movement? Seed germination rate?

Discussion and Conclusion:

1. **Discuss Results:**
    - Have each group share their results with the class. Create a chart on the board with the pH values for each substance tested.

- Discuss why the pH of different water sources in the environment might vary.

    a) **Natural Dissolved Substances:** Water can pick up minerals and substances as it moves through the environment. For example, rainwater is typically slightly acidic because it absorbs carbon dioxide from the air, forming carbonic acid. Groundwater can be more alkaline if it picks up minerals such as calcium carbonate from rocks.

    b) **Pollution and Contaminants:** Human activities can affect water pH. Industrial waste, agricultural runoff, and other pollutants can introduce acids or bases into water sources. For example, acid rain from pollution can lower the pH of lakes and rivers, making them more acidic.

    c) **Geological Factors:** The composition of the soil and rocks in an area influences the pH of groundwater. Areas with limestone can have more alkaline water due to the dissolution of calcium carbonate.

    d) **Biological Activity:** In natural bodies of water, the presence of plants, algae, and bacteria can impact pH. For example, algae blooms can make water more alkaline, while decomposition of organic matter can make it more acidic.

- Discuss pH and the **"**Drinking Water Treatment Processes:" Because the pH of different water sources in the environment varies, public water supplies are often treated to adjust the pH to a safe and stable level. The pH can vary depending on the treatment methods used.

- Discuss the importance of drinking water having a pH of 6.5 – 8.5: Very acidic water can corrode pipes and thus contaminate the water with metals in the pipe (such as lead), while very basic water can taste unpleasant and have more mineral content (such as calcium and magnesium).

Source: **Acid and Base Experiment - The Homeschool Scientist**