Lesson 5 - pH

**Problem statement**

Picture this: It’s a beautiful summer day and your family goes to the lake to swim. When you arrive there is a large sign that reads “Lake closed for swimming due to pollution.” While you are bummed out, you overhear a lifeguard stating that he hasn’t seen any salmon either. This gets you thinking about the connection between not being able to swim and the missing salmon.

The health of the environment is at a critical point. The government agency that oversees this, The Environmental Protection Agency (EPA), has lost a big portion of its budget. That means that they are unable to have enough employees to help make sure people are following the laws. Since people are not being held accountable, some people are breaking the laws and causing damage. One piece of the environment that is greatly impacted is the water. Bodies of water, like lakes and rivers, provide homes to many different types of plants and animals. When pollution enters these ecosystems the damage done is difficult to repair.

The Environmental Protection Agency is looking for new ideas to solve the water pollution problem. You will need to convince the EPA that your plan is the right one to solve this problem and save the fish!

**Learning Objectives:**

* I can determine the pH of a substance using numbers and words.
* I can explain the connection between air pollution and pH.
* I can explain the impact pH has on an organism and environment.

**Lesson standards (NGSS, CCSS, CTE):**

**4-ESS-2: Cross Cutting Concept:** Cause and effect relationships are routinely identified and used to explain change.

**4-LS-1 and 4-LS-2 Cross Cutting Concept:** A system can be described in terms of its components and their interactions.

**4-LS-1:** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

If relevant to lesson, include:

Soft skills: Critical Thinking and Problem Solving, Communication and Collaboration

Locally and/or personally relevant for students: Students can make connections to foods they eat and other items in their homes and how they interact with their environment and their own bodies.

Connections to career and educational pathways: Chemist, Water Treatment Engineer, Biologist, Meteorologist

**Materials:**

-pH Scale with illustrations (prediction/hypothesis)

* 1 per group

-Picture File Cards OR actual items for students to sort for their prediction (soap, lemon, vinegar, milk)

* 1 set per group

-pH Strips

* at least 3 per student

-Cups for Substances #1-4

* 4 cups per group

-#1 Lemon juice, #2 vinegar, #3 liquid soap, #4 water

* Each of these substances is needed for EACH group.
* Each substance needs to be numbered #1-4. Don’t tell students which substance is which.

-pH Test Table Printout

* 1 per student

-Water Quality Science Journals

**Lesson preparation:**

1. Print:
   1. pH Scale (one per group, preferably in color).
   2. Print Picture File Cards (one set per group, preferably in color) OR gather actual items for students to sort for their prediction (soap, lemon, vinegar, milk).
2. Sentence Stem written on the board: “I think fish will survive best in acidic/basic/neutral water because \_\_\_\_\_\_\_\_\_.”

**Time required**: 110 minutes

**Grouping of students for instruction:** Students should ideally be in groups of four.

**What is the instruction?**

|  |  |  |
| --- | --- | --- |
| Time | Teacher | Student |
| 5 min  5 min  10 min  5 min  5 min  30 min  5 min  5 min  10 min  10 min  5 min  5 min (however long to finish)  10 min | Gather students in a way that works for your classroom. Review the problem statement.  Review the KLEWS chart & lab safety.  Explain to students that they will be:  Salmon Killer Detectives  All the fishin the lake have died. However, the killer left behind evidence. Your mission is to find the fish killer.  Show students the pH scale images with examples of something acidic, basic, and neutral. Ask students to repeat these key vocabulary words.  Hypothesis/Prediction activity:  Give each group a printout of pH Scale (1 per 4 students).  Pass out picture file cards OR actual items (soap, lemon, vinegar, milk).  Demonstrate and explain how to use the pH strip with water and vinegar. First, soak the strip in the water, and wait 1 minute. Then, remove the strip and match the color to the scale bar of the pH scale. This determines the degree of pH. Show how to record on the table.  Have kids gather required materials (pH strips, substances #1-4, and pH test table printouts) in a way that works for your classroom.  Explain to students that each person in the group is responsible for testing the pH of one of the items. (For example, student A will test the pH of vinegar 3 times, student B will test the pH of water 3 times, etc.)  Explain that we need to do at least 3 pH tests of each substance to practice scientific accuracy.  At some point when most kids are done, teach them how to find the mean (average) of the three trials.  Instruct students to infer what they think each substance is (explain that one of them is water, which they saw a demonstration of).  Prompt students to compare their data with their predictions. Ask: Were your predictions correct? Did they match the pH scale? After discussing, rearrange your picture file cards/items if you need.  Refer back to pH scale and discuss/point out how human blood is pH 7. Based on what you know about living things, what do you think is the best pH level for fish to survive?  Sentence stem & turn and talk:  \*I think fish will survive best in acidic/basic/neutral water because \_\_\_\_\_\_\_\_\_.  Show the following video to demonstrate the impact pH can have on plant growth. <https://www.youtube.com/watch?v=zQowljL8e5E>  After watching the video, ask the following questions to connect pH level to pollution (CO2), Lake Washington (or other body of water), and human impact on fish and environment. Turn and talk:   1. How can humans cause acid rain? 2. Why is acid rain bad for plants and animals? 3. What could be a cause of the pH fluctuation (change) of Lake Washington? 4. In this situation, what was the salmon killer?   Ask: What can we do?  Team Challenge: Give students 2 minutes to write down as many ways as possible to balance pH in water (make the pH neutral so that plants and animals can survive).  -Share out  Pass out the exit slip.  As a group, add new findings to the KLEWS chart. | Listening to problem statement.  Turn & talk, review learning from Lessons 1-6.  Repeat key vocabulary words.  Students will place the items where they think they go on the pH scale. Share out.  Watch the demonstration and record the pH results on their table.  Students will collect or receive materials.  Each student does 3 trials of their substance, then they will log each trial on the provided table.  When all the kids are done, they will share their data with one another to fill in the rest of their data table.  When students are done sharing and recording all data for all trials and substances, they will find the mean pH of each substance.  Write down their inferences (partner, group, individual--depending on what the kids want). Students compare their results with their predictions and rearrange their prediction/hypothesis cards or items on the pH scale.  Kids will turn and talk with their partner using the sentence stem.  “I think fish will survive best in acidic/basic/neutral water because \_\_\_\_\_\_\_\_\_.”  Students watch the video.  Students turn and talk about each of the questions. Students share when called on between each question.  Students write a list of their ideas to balance pH in water. Students share their ideas. This is completed in teams.  Individually, students complete and turn in exit slip. |

**Accommodations:**

* Set up groups ahead of time to support different student learning needs.
* For students with vision needs, arrange for the to sit closer to the presentation or print out copies for personal use.
* Lesson may be broken up into parts if needed.
* Alternative to exit ticket may be used if the classroom has other strategies that work for assessing student growth and learning.
* Preview vocabulary to pre-teach or emphasize during lesson based on student needs.

**Extensions:**

1. Allow students to test and compare the pH of their spit
2. Test and compare the pH of vinegar and lemon juice to see which is more acidic.

**Assessment:**

1. Formative Assessments throughout-turn and talks
2. Team Challenge Collaborated List of ways to balance pH
3. Exit Slip

**References/Resources:**

Why is soil pH important to farmers?

<https://www.youtube.com/watch?v=zQowljL8e5E>