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Topic: Acid & Base Lab

Summary: Students will determine the pH of common household acids and bases and transfer their knowledge about acids and bases to homeostasis of the human body.

Goals & Objectives: Students will be able to analyze the pH results of common household foods and products. Students will be able to analyze different situations using acids and bases.

NGSS Standards: *HS-LS1-3.* Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Time Length: 90 minutes

Prerequisite Knowledge: Lab safety procedures, how to use a pipette, what is an acid and base

Materials:

- pH paper
- Red cabbage indicator juice: base = green, acid = red
- Goggles and lab aprons
- Pipettes, two per acid/base station.
- Well plates, one per group or six wells per lab group
- Lemon Juice (pH 2.2-2.4)
- Aspirin dissolved in water (pH 3.3)
- Milk (pH 6.7)
- Coke (pH 2.9-3.3)
- Borax water solution (pH 9.2)
- White Vinegar (pH 2.6)
- Tums (pH 6.9)
- Baking soda (pH 8.3)
- 409 cleaner (pH 9-10)
- *Control:* Tap Water (pH 7)
- Clorox with bleach (pH 11-12)
- Saliva (pH 6.5-7.5)
- Teacher demonstration of indicators: NaOH and the HCl

Lab Setup:
Pervious night: Prepare cabbage juice by cooking a cabbage in hot water. Discard the cabbage and use the juice as an indicator. Lab supply table: Prepare each material station on the counters around the room. Place each solution/mixture into a beaker. Place two pipettes into each solution/mixture. Number the beakers 1 - 12. Student lab stations: Place a well plate, safety goggles, one pipette, a small beaker with cabbage juice, and litmus paper for every lab group. Place the NaOH and the HCl in front of the class for you to demonstrate how to pipette and how to take a pH measurement with paper and the cabbage juice.

Procedures:
1. Group students as lab partners. Each group should be assigned to a lab station. If there are more groups than stations, put two groups per station or make groups of four. Review lab safety equipment.

2. One student needs to go to six of the twelve lab stations (either even or odd number stations), one at a time, and bring back to the table a pipette with the number solution inside. The beaker of that solution stays on the counter. It is important that students do not contaminate the solutions.

3. Once one lab partner returns to the desk with the pipette, he/she drops the solution into a well of the well plate. The other student then places a small portion of the litmus paper into the well. The color change is recorded. The student who stays at the desk should then put several drops of the cabbage juice into the solution and record the color change.

4. This repeats for six stations, odd or even. Students then share their information in their data tables with another group who is opposite of their odd/even.

Accommodations: Students who are not able to participate or are not willing to participate in the handling of acids and bases can record observations. Students with an IEP can take the handout home if they need extra time, work with two other partners if not able to take measurements, and/or answer on half of the question in the analysis section.

Editable DOCX File and Answer Key:
Available at www.ngsslifescience.com

Name: _____ Row: _____

Date:_____ Period:_____

Acid & Base Lab

Question:
Do common household items contain acids and bases?

Background:
pH is a measurement of the amount of H_3O^+ ions and OH^- ions in a solution. When there is more H_3O^+ or hydronium ions, you have an acid. When there is more OH^- or hydroxide ions, you have a base. Acids and bases are measured on a scale on 0-14, with 7 being neutral, acids being 0-7 and bases 7-14. Litmus paper is either red or blue. Red paper turns blue when the pH is alkaline, while blue paper turns red when the pH turns acidic.

Hypothesis:
If we test the pH of common household items, then we can determine if the material is an acid, base, or neutral.

Materials:

- Milk
- Lemon Juice
- Tums
- Vinegar
- Tap Water
- Baking Soda
- 409 cleaner
- Borax Solution
- Coke
- Saliva
- Aspirin dissolved in water
- Clorox Bleach
- pH paper (red and blue)
- Color chart for pH paper
- pH indicator (red cabbage)
- Well plate
- Pipettes (medicine droppers)
- Goggles, gloves, and lab aprons

Procedures:

1. Students will make predictions of the pH for 12 different common household items. Write your prediction into the data table below.

2. There are twelve lab stations: milk, lemon juice, Tums, vinegar, soda, tap water, baking soda, 409 cleaner, Borax solution, Clorox bleach and aspirin stations. Both the Tums and the aspirin materials are dissolved in water. Gently put your saliva into the well plate for the saliva.

3. Half of the lab group will go to even numbered stations, while the other half go to the odd stations. One student per group will be the collector, while the other student will stay at the desk and be the recorder. The collector must get a solution with a pipette. They will drop the solution into the well plate and then return the pipette to the correct numbered beaker. Test only one substance at a time. It is important to not contaminate the solutions.

4. The recorder then places a small portion of the litmus paper into the well. The color change is recorded. The recorder should then put several drops of the cabbage juice into the solution and record the color change. All students will fill out their own lab write-up.

5. This repeats for six stations, odd or even.

6. Students then share their information in the data tables with another group who is opposite of their odd/even. Record data in the data table.

7. One student takes the well plate to the sink and cleans them with a brush, soap, and water. The other student takes a paper towel and cleans their lab station. Student returns the well plate to their lab station once cleaned.

Variables:

Independent Variable: _____ Dependent variable: _____

Constants: _____

Control Group: _____

Experiment:

Material	Predicted pH	Color of litmus paper	Color of cabbage juice	Acid or Base
Tap water	_____	_____	_____	_____
Baking soda	_____	_____	_____	_____
Milk	_____	_____	_____	_____
Vinegar	_____	_____	_____	_____
Tums	_____	_____	_____	_____
Lemon juice	_____	_____	_____	_____
409 cleaner	_____	_____	_____	_____
Borax solution	_____	_____	_____	_____
Coke	_____	_____	_____	_____
Saliva	_____	_____	_____	_____
Aspirin dissolved in water	_____	_____	_____	_____
Clorox bleach	_____	_____	_____	_____

Conclusion: Write a Claim Evidence Reasoning paragraph answering the lab question.

Practical Applications:

1. Is Coke an acid, base or neutral? _____ Coke has many acids in it including carbonic acid. When carbonic acid (H_2CO_3) ionizes in water, predict the two products H_2CO_3 is broken down into?

Gas: _____ Liquid: _____

For the human body to operate, blood pH must be kept at a stable range. Buffer systems help to keep the pH levels within this range. A buffer can absorb either hydrogen ions (H^+) or hydroxide ions (OH^-). Kidneys produce hydrogen carbonate (HCO_3^-) that acts as a buffer.

2. What biological process in every cell of your body creates CO_2? _____

3. Predict what happens to the pH of your blood when the CO_2 is added? _____

4. How does your body get rid of the CO_2 that was added to your blood? _____

5. Is saliva an acid, base or neutral? _____ Saliva has a certain biochemical that aids in digestion (break down of polymers). What is this biochemical and what pH range does this particular biochemical thrive in?

Biochemical _____

Predicted pH Range _____

The human body needs to regulate its pH level to keep it in a certain range. Outside this range of pH, proteins are denatured and broken apart, enzymes (a type of protein) stop functioning, and the body cannot sustain itself.

6. How does Tums help with acid indigestion/heartburn?

_____

7. Why do you think the human stomach pH range is 2.0 – 3.0?

_____

8. What biology process is it called when your body tries to maintain a certain pH level, called set-point, in your blood?

_____

9. Predict what happens to enzymes when the pH range in your stomach falls outside of the optimal level?

_____