Topic: Acid Base Lab

Summary: Students will determine the pH of common household acids and bases.

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.

Standards: CA Chemistry *5a. Students know* the observable properties of acids, bases, and salt solutions. *5d. Students know* how to use the pH scale to characterize acid and base solutions.

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)
- Water (pH 7)
- Clorox with bleach (pH 11-12)
- Saliva (pH 6.5-7.5)
- Control - .1 M HCl
- Control - .01 M NaOH

Lab Setup:
Pervious night: Prepare cabbage juice by cooking a cabbage in hot water. Discard the cabbage and use the juice as an indicator. Around class: 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 desks: 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.

Evaluation:
The data table is worth 6 points for being filled in correctly. The 8 analysis questions are worth 3 points each for a total of 24 points. This assignment is worth a total of 30 points.

Name: _____ Row: _____

Date:_____ Period:_____

Acid Base Lab

Problem Statement:
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. This lab will let you predict and discover the relative pH of items easily found around a house.

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)
- Beakers, one for each station
- Eye 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 test tube rack and tubes 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 test tubes to their lab station once cleaned.

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	_____	_____	_____	_____

Analysis: Use complete sentences and explain your reasoning.

1. Independent Variable _____ Dependent variable _____

Control Group: _____

2. What was the pH of Coke? _____ Coke has many acids in it including phosphoric acid and carbonic acid. When carbonic acid (H_2CO_3) ionizes in water, what are the two products?

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.

3. What organelle in the cell creates CO_2?

4. CO_2 dissolved in the blood acts as an acid. Your heart pumps the waste.

3. What was the pH of saliva? _____ Saliva has a certain biochemical that aids in digestion. What is this biochemical and what pH range does this particular biochemical thrive in?

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 stop functioning, and the body cannot sustain itself. Maintaining this balance is a part of homeostasis.

5. What was the pH of Tums? _____ How does Tums help with acid indigestion/heartburn? Why do you think the human stomach pH range is 2.0 – 3.0?

6. Water can help neutralize the pH of strong acids or bases. If you were to take an aspirin, what other food ingredient could you take to help neutralize the pH?

7. Hydrangea plants have flowers that turn blue when in acidic soil and pink when in basic soil. Fertilizers have a compound called ammonium (NH_3^-). After adding fertilizer to soil, a bacterium converts ammonium to nitrate. During this process $3H^+$ are released into the soil. What do fertilizers do to the pH of soil?

8. If your hydrangea flowers were pink in color, what could you add to make the flowers blue?