

Acids and Bases Mystery Experiment

FRAMEWORK
I. Scientific and Engineering Practices
II. Cross-Cutting Concepts
III. Physical Sciences

SKILLS/OBJECTIVES
○ To teach students about pH, the pH scale, and the characteristics of acids and bases.
○

MATERIALS
○ Small Vials with Caps ○ Universal Indicator ○ pH scales for universal indicator ○ Vinegar ○ Baking Soda ○ Lemon Juice ○ Apple juice ○ Tums dissolved in water ○ Egg Whites ○ Distilled Water ○ Milk of Magnesia ○ Milk ○ Tap Water ○ Pipettes
○ For all activities and demos ○ With needed amounts assuming 15-20 kids

NOTES

BACKGROUND

Interactive Explanation of Topic:

- Present the poster board that displays a pH scale from 1-14 along with pictures and characteristics of common substances. Explain pH by stating that substances below 7 are acidic, and mention characteristics associated with acids (i.e. “sour”). Also discuss that substances with a pH of more than seven are basic or alkaline, and are described with qualities such as “soap-like” or “slippery”. Make sure to emphasize these characteristics and use pictures, since the numbers may seem abstract to the children. Explain that 7 (water) is neutral and that it doesn’t have either basic or acidic qualities.
- Now have the students try to place the pictures of common foods/substances (which have Velcro attachments) on the correct spot on the pH scale.
- Correct the placement of the pictures, explain why each substance has a certain pH values.

Activity # 1	pH of a substance
Materials	Small Vials with Caps Universal Indicator pH scales for universal indicator Vinegar Baking Soda Lemon Juice Apple juice Tums dissolved in water Egg Whites Distilled Water Milk of Magnesia Milk Pipet
Worksheet	N

- Ask students: How can we find out the pH of a substance?
- Explain that there are special chemicals called “pH indicators” that change different colors based on pH value when mixed with a sample. Tell them that the color chart on the board is similar to the colors the substances produce with the indicator.
- Tell the students that you mixed up all your chemicals and you need their help to identify them. Explain that they will use a universal indicator to

discover all the different “mystery chemicals” which are samples of the items described and depicted on the poster.

- Show how the universal indicator works by testing the pH of one of the “mystery chemicals” . **Add just TWO DROPS with the pipette to the sample, close the cap securely and shake gently. Show how to match the color to the “secret code”** (pH scale provided, remember if it is in between two colors they can use integers of 0.5). Then compare the pH value of the sample to a pH value on the diagram to discover what the chemical is.
- **Split the students into groups of three.**
- **Give each group three different “mystery chemicals” in a small vials, and a “secret code” (pH scale), and a worksheet. Have each member of the group be responsible for filling out a worksheet for one of the three chemicals. Ask them to write down predictions on the worksheet.**
- **Have the children test the substances. To do this, have an activity helper/leader sit with the students to ensure they use the universal indicator properly (Add just two drops to the sample with the pipette, cap the sample tightly and shake).**
- *For youngers have an instructor add the universal indicator, and then let the children shake the sample after the instructor has screwed the cap on.
- **Tell the children to use the “secret code” to figure out the pH of the solution.**
- **After they have figured out the pH, have them go up to the diagram to compare their value to the one on the diagram, to uncover what the “mystery chemical” is.**
- Have the students discuss/record whether their prediction matched their results
- Have all the students work together to line up the their tested samples (which are now a variety of colors!) from a pH of 1 to 14.
- Why do none of these samples have a pH of 1 or 14?
- Because these extreme pH values would be harmful to ingest, the human body can only be exposed to certain pH values without damage being done...ect...

Activity # 2	pH of water
Materials	Water Small Vials with Caps Universal Indicator pH scales for universal indicator Vinegar Baking Soda Lemon Juice Apple juice Tums dissolved in water Egg Whites

	Distilled Water Milk of Magnesia Milk
Worksheet	N

- What is the pH of the schools tap water? Is it acidic or basic?
- **Have students test the pH of tap water**
- What happens when you mix the chemicals? Are new pH values produced?
- **Mix chemicals into the tap water and test pH**

CONCLUSIONS

Why does different substances have different pHs?

Why does no drinks have a pH of 1 or 14?

Next time you are drinking a juice think about if its an acid or base.

Instructor Cheat-Sheet for “Mystery Chemicals”

Chemical Number	Substance	pH (May vary)	Color	Example of Color
1	Lemon Juice	2.3	Bright red	
2	Apple Juice	2.9 -3.3	Reddish orange	
3	Vinegar	2.4-3.4	Light red	
4	Baking Soda	8.0	Bluish green	
5	Tums	10	green	
6	Milk of Magnesia	10.5	Blue/green	
7	Egg white	8.0-9.0	green	
8	Milk	6.6	Orange/yellow	
9	Distilled Water	7.0	Orangish yellow	
10	Tap Water	? 6.5 -8.0		

*The numbers on the bottles match the numbers indicated above. There are not samples with the number “10” because it’s the school’s tap water.

*There are designated bottles of universal indicator, which are labeled. It should be used sparingly, since testing only requires TWO DROPS. Too many drops of universal indicator will change the predicted results.

Cheat Sheet for order of chemicals on poster(The substances go A- I from left to right)

Letter (On back of card)	Chemical/Substance
A	Lemon
B	Vinegar
C	Apple Juice
D	Milk
E	Water
F	Baking Soda
G	Egg Whites
H	Tums
I	Milk of Magnesia