



ANTACID AND UNCLE HEARTBURN

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Annotation

In this guided inquiry exercise, students will use their knowledge of acids and bases to devise a procedure to determine which of three antacids is most effective.

Primary Learning Outcome:

Students will be able to design and follow a laboratory procedure.

Students will be able to identify common substances as acids or bases.

Students will be able to relate acid-base neutralization to changes in pH.

Students will be able to relate concepts of acids and bases to commonly encountered applications

Students will be able to communicate scientifically the procedures and results of the exercise.

Assessed GPS:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate techniques in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.
- d. Graphically compare and analyze data points and/or summary statistics.
- e. Develop reasonable conclusions based on data collected.
- f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh6. Students will communicate scientific investigations and information clearly.

- a. Write clear, coherent laboratory reports related to scientific investigations.
- b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.
- c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
- d. Participate in group discussions of scientific investigation and current scientific issues.

SPS6. Students will investigate the properties of solutions.

- d. Compare and contrast the components and properties of acids and bases.



e. Determine whether common household substances are acidic, basic, or neutral.

SC7. Students will characterize the properties that describe solutions and the nature of acids and bases.

b. Compare, contrast, and evaluate the nature of acids and bases:

- pH
- Acid-Base neutralization

Duration:

Preparation: 30 minutes

Introduction: 10 minutes

Lab Exercise: 70 minutes

Discussion: 15 minutes

Total Class Time: 90 minutes

Materials and Equipment:

For Teacher Preparation:

1. White vinegar
2. Mylanta Regular Strength Original Liquid Antacid
3. Maalox Regular Strength Original Liquid Antacid
4. Generic Regular Strength Original Liquid Antacid
5. 5-oz. Plastic cups

Per Lab Group:

1. 5 mL Vinegar
2. 5 mL Mylanta Regular Strength Original Liquid Antacid
3. 5 mL Maalox Regular Strength Original Liquid Antacid
4. 5 mL Generic Regular Strength Original Liquid Antacid
5. 4 Plastic pipettes
6. pH indicator strips
7. 1 Sheet of wax paper
8. 3 Toothpicks

Safety:

The acids and bases used in this lab are common household weak acids and weak bases. Liquids should not be ingested; otherwise, no special precautions are needed.

Technology Connection:

Not applicable.



Procedures:

Teacher Preparation:

Label cups as Maalox, Mylanta, generic, and vinegar. Pour approximately 5 mL of each solution into the appropriate cups. Prepare one set of cups per lab group. Assemble the remainder of the supplies.

Estimated Time:

30 minutes

Introduction:

Introduce students to the three antacids to be used in the lab: Mylanta, Maalox, and the generic brand. Ask them to define antacid and describe its function in practical and chemical terms. Review with students that acids are essential in the stomach for the proper digestion of foods; however, when excess acid results, antacids may be taken to neutralize stomach acid. The active ingredients in the antacids used in this lab are insoluble metallic hydroxides of aluminum and magnesium.

Explain to students that their assignment will be to determine whether there is a difference in the effectiveness of the three antacids. Review the materials provided. Based on their knowledge of acid/base titrations, students should use the available materials to develop a procedure that will allow them to determine the relative effectiveness of the three antacids. Stress to students that they should develop a clear plan for their procedure before beginning, because the available materials are limited. Guide students through the development of the procedures as needed.

Estimated Time:

10 minutes

Lab Exercise:

Students should obtain the provided materials. Students should use any available equipment to develop and perform a procedure to determine whether there is a difference in the effectiveness of the three antacids. All procedures should be recorded in students' lab notebooks. Student procedures may vary, but it is anticipated that the basic steps will involve placing several drops of vinegar on the wax paper at three locations. Each of the antacids can then be added, drop-wise, to the vinegar. After addition of each drop, the solutions can be stirred with a toothpick and the pH of the mixture checked with an indicator strip. In this simple titration setup, the antacid that is able to neutralize the vinegar with the fewest drops is the most effective.

Estimated Time:

60 minutes.

Discussion:

Have each group present to the class their procedures and results. As a class, discuss the methods chosen, the reasoning each was selected, and the results obtained. During the discussion, review the definitions of acids, bases, pH, and neutralization.

Estimated Time:

20 minutes.

Post-lab Questions:

Students should answer the following questions based on the data they collect during the exercise:

- Identify all acids and bases used in this experiment.
 - What is the definition of an acid?
 - What is the definition of a base?
- Using the pH values observed during this experiment, provide an explanation of neutralization.
 - What are the reactants of a neutralization reaction?
 - What product is formed in all neutralization reactions?
- Identify sources of uncertainty in this experiment.
 - What procedures and/or materials might you change to improve the experiment?

Discussion Questions:

- Magnesium hydroxide, $\text{Mg}(\text{OH})_2$ is the active ingredient of some antacids. Hydrochloric acid, HCl , is the acid found within the stomach. How does $\text{Mg}(\text{OH})_2$ work to relieve the pain caused by excess stomach acid?
 - Write the equation for the neutralization reaction of this acid/base pair.
- Provide a possible explanation as to why one antacid may be more effective than another.

Assessment:

Assessment should be based on process skills demonstrated during the laboratory exercise, reproducibility of procedures (i.e. could you recreate their procedures based only on their lab notes), accuracy of their results, and quality of post-lab write-up and interpretations.