



Veggie Trials (The Untold Story)

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Suggestions for Teachers

Mr. Stokies, the chemistry teacher who lives across the street from the high school, has taken home his lab reagents to work on over the weekend. His wife is really thrilled about turning the kitchen into a laboratory. He gets everything set up and finds that he has left his acid/base indicators at school and has forgotten to label the concentrations of his acid/base solutions. He can't return to school because the alarm is on. He does not know the code because the principal knows how absent-minded Mr. Stokies can be!! He is fussing and fretting because he promised his students that the lab would be ready to go on Monday morning. He turns to his wife and screams with frustration. Mabel, his sweet wife, has put up with this all weekend and after looking on the Internet gives him a few pointers. From the "Chemicals in Food" website, she has found that different veggies can be used as indicators and announces that red cabbage, rhubarb, and beets are great "natural" acid/base indicators. New ideas flash into the chemistry teacher's brain and he starts to work on the dilemma.

Introduction:

The lab will be introduced with a series of test tubes showing the different colors red cabbage juice has for different pH values. Prior to this inquiry-based experiment, students have performed respiratory experiments using bromthymol blue, litmus paper, and pH paper as indicators. This experiment can be used for high school chemistry and physiology classes.

Purpose:

To understand the concepts of acid-base reactions, neutralization and molarity.

Objectives:

Students will be able to demonstrate knowledge of the following:

- Acids and bases
- Titration
- Neutralization Reactions
- Precipitate
- Double Replacement Reactions
- Indicators
- Molarity

Students will be able to demonstrate the following process skills:

- Formulating an hypothesis
- Understanding molar concentration
- Graphing skills and interpretation
- Communicating with others
- Balancing chemical equations
- Collecting data
- Analyzing data
- Observation

Materials:

Students will work in groups of 2 to 3. Each group will need the following:

- Red cabbage juice
- 1 mL micropipettes (plastic)
- Universal Indicator
- Litmus paper (red/blue)
- Micro-well plates
- Safety goggles
- Forceps
- Hydronium paper (pH paper)
- Different concentration solutions of:
 - Vinegar
 - Ammonia
 - Sodium bicarbonate
 - Hydrochloric acid
 - Lemon juice
 - Bleach
 - Sodium hydroxide

Please note: Different concentrations should be diluted!

Description of Activity:

Part I:

Solutions of the different concentrations of the acids and bases will be made before hand. The containers will be labeled with the name of the reagent but **NOT** the molarity (concentration). Students will be provided with dropper bottles labeled with the name of the veggie indicator. This reagent will be used in the first part of the experiment. Students will test solutions of acids and bases to investigate the color given by the “veggie” indicator.

1. Students will design an experiment to find the relative concentrations of the acids and bases.
2. Students will form an hypothesis to find the relative concentrations of the acids and bases.
3. Students will be encouraged to combine different acid and base solutions to observe what happens with the indicator.
4. Students will be encouraged to count the number of drops of indicator needed to compare the concentrations of the different solutions.
5. Students will give reasons to account for color changes in the reactions. (Neutralization reactions in #3).
6. Students will use numbers, graphs or charts to describe their results.
7. Students will be able to write chemical formulas for the acids and bases.

8. Students will be able to write chemical equations for neutralization reactions of acid and bases.
9. Students will use the Internet sources for information gathering.

Part II:

The other indicators will be used in the second part of the experiment. Students will use litmus paper, pH hydronium paper, and universal indicator to confirm their findings with the red cabbage juice. They will design an experiment that shows how the veggie indicator is a useful tool in acid/base reactions. *Mr. Stokies had some helpful hints for his students that might be worth considering. In Part I, you were finding the relative concentrations of acids and bases by counting the number of drops of cabbage juice and observing neutralization reactions.* The three indicators in this part have labels and information that can be helpful in making comparisons with the cabbage juice. Remember these indicators are reliable and are used in labs every day for acid/base analysis. You can ask your instructor about the preparation of the cabbage juice (hint: concentration). Use the findings in Part I (drops of juice and relative acid/base concentrations) with the known indicators in this part of the investigation. Think about the limitations of using litmus paper as a standard of comparison with the cabbage juice.

1. Students will make comparisons between the veggie and other indicators.
2. Compare the usefulness of all four indicators in relationship to acid/base concentrations and neutralization reactions.
3. Students will collect data and present it in charts, tables or diagrams. *Think drops of liquid indicators and relative concentrations of the acids and bases.*
4. Students will make a presentation to the class of their findings in Part I and II.

Safety Precautions:

Normal safety precautions should be used for this laboratory, including cautions to students to not eat or drink during the lab, wash hands before and after the lesson, and use appropriate protective eyewear.

Draft Suggestions for Assessment:

1. The presentation is given in a logical and clear manner.
2. The findings support the hypothesis.
3. Data from the tests are valid and reliable.
4. Verbal and visual explanations are clear.
5. Each member of the group contributed to the presentation.
6. Students in the class will give their opinions of the presentation.

References:

www.chem4kids.com (acids and bases)
www.scifun.chem.wisc.edu/Homeexpts/AcidBase
www.bird.miamisci.org/pH/hexplore1
www.science.ubc.ca/~cham/tutorials/pH/launch