Lesson Plan

Cross Curricular | N/A

Big Ideas

- Different household items can be neutralized using determinate amounts of substances of opposite pH levels (i.e. acids have the ability to neutralize bases)

Learning Goals

- Learn how to creates hypotheses and follow an experiment outline
- Understand how to interpret chemical changes
- Use proper scientific method to neutralize a given acid using a base.
- Properly use a pH indicator (phenolphthalein)
- Produce a written chemical formula for one of the neutralization experiments

Materials

For each group of students:

- 2 clear, plastic cups
- White vinegar
- Lemon juice
- Baking soda (mostly dissolved in water)
- Phenolphthalein
- 2 spoons
- Gloves
- Safety goggles
- 1 Syringe with measurements in mLs
- Investigative worksheet entitled “Neutralization of Acids Using Bases”
- Optional introduction materials:
  - -Sealable plastic sandwich (Ziploc) bag
  - -White vinegar
  - -Baking soda
  - -Large container

Specific Expectations

C2.5 plan and conduct an inquiry to identify the evidence of chemical change (e.g., the formation of a gas or precipitate, a change in colour or odour, a change in temperature

C2.6 plan and conduct an inquiry to classify some common substances as acidic, basic, or neutral (e.g., use acid–base indicators or pH test strips to classify common household substances)

C3.3 describe the types of evidence that indicate chemical change (e.g., changes in colour, the production of a gas, the formation of a precipitate, the production or absorption of heat, the production of light)

C3.7 describe how the pH scale is used to classify solutions as acidic, basic, or neutral (e.g., a solution with a pH of 1 is highly acidic; a solution with a pH of 7 is neutral)

C3.6 describe the process of acid–base neutralization (i.e., an acid reacts with a base to form a salt and often water)

C3.4 write word equations and balanced chemical equations for simple chemical reactions (e.g., $2H2 + O2 \rightarrow 2H2O$)

Safety Notes

- Wear goggles
- Do not ingest solutions
- Do not mix any solutions that are not outlined or directed. Combining certain solutions can result in toxic fumes.

Description

Students will learn about neutralizing acidic compounds using basic compounds. Students will be given two different household acids, phenolphthalein indicator, and one base. Students will add the indicator to the acid, which will show no immediate chemical change, as phenolphthalein appears colourless in acids. Slowly, students will introduce the base to the acid-indicator mixture, until the latter turns completely pink, indicating the presence of a base. Students will then record how much base they have added to one acid, and compare it to how much was added to the other acid. Finally, students will exhibit their knowledge of chemical formula composition by completing the formula on their worksheet entitled "Neutralizing Acids & Bases."

Accommodations/Modifications

Educator may pre-determine groups as some students may work best together.
Worksheets may be given in PDF formats for students requiring text-to-speech technology (please keep tablets or laptops clear of test solutions).

Introduction

Acids and bases are important, and potentially dangerous, parts of our environment. It is important to know how to neutralize one if someone is at risk.

Neutralization of an acid/base: Adding an acid to a base, or vice versa, will create a neutralizing effect on its pH value (neutral pH level of 7.0).

Chemically, the products that often result from mixing an acid and a base area compound, **water and a salt**. However, there are several exceptions and additions. Some acid-base mixtures also create gases or vapours when combined. Some of these gases prove to be harmless, but some are extremely toxic. For example, two common household items, vinegar (acid, pH approx. 3.0) and bleach (base, pH approx. 12.0). When combined, vinegar and bleach create a chlorine gas, which is very toxic to the human respiratory system. Hence, one should always do their research before throwing just any base on an acid spill.

Phenolphthalein is an indicator that works well for neutralization purposes. Though it does not have the colour range of other indicators, like litmus paper, it still produces a colour change. Rather than presenting a pH level, it indicates the presence of an acid or base. In an acidic (or neutral) compound, the phenolphthalein will remain colourless. However, in a basic or alkaline compound, the phenolphthalein will turn the mixture a bright pink colour. This is useful when neutralizing, as a colour change will indicate the moment when a neutral or very weak base appears.

The key, however, is to introduce the substances slowly. If you put too much of a basic compound on an acidic compound, the result could be a strong base that could be just as dangerous. Phenolphthalein indicates the presence of an alkaline substance, but not its strength. Therefore, neutralizations must always be done carefully.

- The educator will first ask students: "Are acids dangerous?" and "Are bases dangerous?"
- Educator may ask further discussion questions, such as "What should you do if you encounter a dangerous acid or base spill?"

- Educator should ask the class what they believe "Neutralization" is. How is it achieved?
- Educator will explain how phenolphthalein may be different than any other indicators the students may have previously used.
- Educator should discuss with class what products are present during a neutralization reaction.
- Educator may give a "hint" as to the answer for the final question on the worksheet by performing the "CO_2 Sandwich" experiment and testing the students' attention.
- **CO_2 Sandwich experiment (optional):**
  - Fill approx. 1/3 of the plastic sandwich bag with white vinegar. (This experiment may be easier with a larger sealable bag, but requires more substances)
  - Ask students: "what will happen when baking soda is added? What happens if the bag is sealed?"
  - Dump a small cup of baking soda into the bag and **seal it as quickly as possible.**
  - Put the bag into a clear container (preferable so all students can see the result) or sink.
  - The bag should burst open. Ask students why this happened, and to use vocabulary appropriate to their grade level. (Students should say that the chemical reaction produced a gas that pressurized the bag and caused it to burst).
  - Express that acid and base reactions generally produce water and a salt. However, it this case, it produced water and a common gas. (If you want to test their attention or give them a hint for their worksheet, tell them that this small experiment was called the CO_2 sandwich, which should give them a major clue as to the gas that was produced).
  - Explain that some gas from acid-base reactions can be toxic, but this particular gas, is smaller doses, is harmless.
- **Educator should stress to students the importance of safety in this experiment. Just because these are household items, does not mean they are not hazardous to a person's health.**
- Educator may sort the class into groups of 2 or 3 students.
- Educator will hand out materials and worksheets to each group.

Action

- In their groups, students will complete the "Hypothesis" section of the worksheet provided, entitled "Neutralizing Acids & Bases"
- Students will then add 50mLs of vinegar to a small, clear, plastic cup. Similarly, they will add 50mLs of warm water to another small, clear cup, and 100 mLs of warm water to a third clear cup.
- Students will add one spoonful of sugar to the cup with 50 mLs of warm water. Stir to dissolve as much as possible.
- Students will add two spoonfuls of baking soda to the cup with 100 mLs of warm water. Stir to dissolve as much as possible.
- Students will add a few drops of phenolphthalein to the vinegar, and a few drops into the sugar water. Do NOT add any to the baking soda water.
- With the syringe, students will **slowly** add the baking soda mixture to the sugar water mixture, drop by drop, intermittently swirling the cup with the sugar water.
- Once the entire mixture turns pink, students are to stop immediately, and record how many mLs of baking soda + water they would have added to the mixture just before that point.
- Students will now perform the same task, adding drops of baking soda + water mixture into the vinegar and phenolphthalein solution.
- Students will record their finding on the worksheet provided, entitled "Neutralizing Acids & Bases".

Consolidation/Extension

- Students will complete the "Conclusion" portion of their worksheet entitled "Neutralizing Acids & Bases."
- Educator will bring the class back together to discuss findings and results.

Results:

- **To neutralize sugar water:** only a few drops of the baking soda-water solution is required (approximately 1 mL).
- **To neutralize vinegar:** 30-40 mLs of the baking soda-water solution is required.