Lesson Plan

Cross Curricular	N/A

Big Ideas

- pH levels of different household solutions can be determined using different indicators.

Learning Goals

- Learn how to creates hypotheses and follow an experiment outline
- Understand how to interpret chemical changes
- Use proper scientific method to create homemade pH indicator.
- Identify the pH levels of several household substances using two different indicators.
- Identify a “mystery” substance using both indicators.

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)

Description

Students will learn about acidic, basic, and neutral solutions through indicators and pH levels. Students will create their own homemade pH indicators using isopropyl alcohol, warm water, and red cabbage leaves. Students will then compare their homemade indicators to the litmus paper provided by testing each household substance and determining their pH levels based on the colour changes. Finally, students will identify a “mystery” solution using their indicators.

Materials

For each group of students:

- 1 spot plate, **or** 10 clear plastic cups (each with 50 mLs of substances)
- 1 small-medium container
- Distilled water
- White vinegar
- Lemon juice
- Baking soda (mostly dissolved in water)
- Sugar (mostly dissolved in water)
- Drano (drain cleaner; may or may not be dissolved in water)
- Dish soap (dissolved in water)
- Milk of Magnesia
- Bleach
- Gloves
- Safety goggles
- 1 Syringe or pipette
- Small bowl
- 99% isopropyl alcohol (150 mLs) **or** 70% rubbing alcohol (200 mLs)
- Warm water (50 mLs)
- 2 large leaves of red cabbage
- 1 spoon
- Investigative worksheet entitled "Identification of Acids & Bases Using Identifiers"
- At least 9 strips of litmus paper
- Tape (masking or scotch)
- Marker
- Coloured print-out or projection of homemade indicator results (Figure 1)

** For best results, all household solutions being tested should be moderately clear or white in colour.

Safety Notes

- Wear gloves and goggles when performing experiment
- Wash skin thoroughly if it comes in contact with strong acids or bases
- (3 < pH level > 12)
- Do not ingest solutions
- Do not mix any solutions that are not outlined or directed. Combining certain solutions can result in toxic fumes.

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. When used properly, they can be very beneficial in everyday tasks.

Their chemical formulas can be identified as follows:

ACID: compound with a chemical formula that begins with "H"
BASE: compound with a chemical formula that ends with "OH"**.**

Often, acids and bases can also be identified using simple tests. For example, acids would react noticeably with a base, but not necessarily with another acid or neutral substance. The same is true for bases. Furthermore, both acids and bases would be able to conduct varying degrees of electricity when dissolved in water, depending on its strength.

Many acids and bases may also be identified by their tastes, as sour and bitter, respectively. However, identifying an acid or base based on its taste is highly discouraged, as it could be extremely hazardous to the human body.

Though these forms of identification may be effective, the arguably best way to identify an acid or base, is through **identifiers**. The most effective identifiers include litmus, phenolphalein, and bromothymol blue. An indicator uses colour change to identify the solution as an acid or base, based on its **pH level.**

A solution's pH level indicates its acidity level, and stands for "potential of Hydrogen." A pH value ranges from 1-14, with 1 being the strongest acids, 7 being neutral solutions, and 14 being the strongest bases.

- The educator will first ask students: "What are acids?" and "What are bases?"
- Educator may ask further discussion questions, such as "Are acids and bases dangerous?" and "Where might I find them?"
- Educator will divide students into groups of 2 or 3, and give them Post-Its. They are to brainstorm things they believe to be acids or bases, and then post them to the blackboard or chart paper, located at the front of the class, that has been split into the two categories:

ACIDS	BASES

- Educator will group "like" answers, and discuss with class why they believe their

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substance to be an acid, or base, without giving away any answers.

- Educator will then discuss pH levels, and the range of acids and bases, and the neutral level.
- Educator will then ask "How do I know if something is an acid or base when I come across it?"
- Educator should now talk about identifying features of an acid and base, and ask questions like "Acids tend to taste sour, whereas bases tend to have a bitter taste. If I were to come across an unknown substance, should I taste it to determine what it is?" (The answer should be *no*, which is a great time to bring up safety precautions to take around acids and bases).
- Educator will then discuss the role of indicators, and how important they are in daily life (for example, unknown spills in the kitchen, or testing chlorine levels in a pool). Indicators identify pH levels within a substance, through a *chemical change*, specifically a change in colour. There are several different kinds of indicators, and can be found in many places. A natural example of this is the hydrangea plant, which turns a different colour depending on the pH level of the soil in which it is planted!
- Educator will now explain that the students will be creating their own homemade indicators, and comparing them to the indicators given to them by the educator (litmus paper), to determine which is more accurate or easy to use.
- The educator will also explain that these methods will be tested on several acids and bases that can often be found at home.
- **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. Students should use extreme caution, especially when handling drain cleaner, bleach, and isopropyl alcohol.**
- Students may remain in the same groups used for the Introduction activity, or educator may make up new groups as they see fit.
- Educator will hand out materials and worksheets to each group.

Action

- In their groups, students will combine 150 mLs of the 99% isopropyl alcohol and 50 mLs warm water in the small bowl, and stir with the spoon. (Note: though not as effective, the isopropyl alcohol + water combination may be substituted for 200 mLs of 70% rubbing alcohol only, as it is less harmful to skin and eyes).
- Students will then tear up two large red cabbage leaves into pieces approximately the size of a nickel, and carefully add to the alcohol mixture.
- Let soak for approximately 20 minutes, periodically crushing the leaves by pressing the back of the spoon against the bottom of the bowl.
- Educator should project or pass around colour printed copies of the pH colour changes for the homemade pH indicator (Figure 1). If the students are not receiving a bottle of

litmus paper with a colour legend included, this should also be accessible for student review.

- Add a small amount of each household solution to a cavity within the spot plate (Note: if spot plates are unavailable, you may also add about 50 mLs of each substances into 9 separate clear, plastic cups). Ensure to label each cavity (or cup) using masking tape and marker. If there is not enough space on the spot plate to write a full name, write a letter and create a legend on a separate piece of paper for review.

  Substances, in order:

  - lemon juice
  - white vinegar
  - sugar (dissolved in water)
  - Distilled water
  - Baking soda (dissolved in water)
  - Milk of Magnesia
  - Soapy water
  - Bleach
  - Drano (drain cleaner)
- Use a litmus paper on each solution. Record your findings on the worksheet entitled "Identification of Acids & Bases Using Identifiers".
- Pour **liquid contents only** of red cabbage/alcohol mixture carefully into a separate container.
- Use pipette or syringe to add a few drops of homemade indicator (red cabbage + alcohol mixture) to each substance. Record your findings on the worksheet entitled "Identification of Acids & Bases Using Identifiers".
- Educator will now pass around a "mystery" substance (any of the 9 already tested) to each group. They may all be the same substance, or each group may be given their own.
- Using the two indicators (litmus paper and homemade), students will identify the substance and record it on the worksheet, along with why they came to this conclusion.

Consolidation/Extension

- Educator will now pass around a "mystery" substance (any of the 9 already tested) to each group. They may all be the same substance, or each group may be given their own.
- Using the two indicators (litmus paper and homemade), students will identify the substance and record it on the worksheet, along with why they came to this conclusion.
- Educator will bring the class back together to discuss findings and results.
- If there were any substances recorded on the papers from the introduction that were tested, review them and if they were correct.
- Results:

Acids: Lemon juice (pH approx. 2.0-2.5), White Vinegar (pH approx. 2.0-3.0), sugar water (pH approx. 5.0-6.0).
Neutral: Distilled water (pH approx. 7.0)
Bases: Drain Cleaner (pH approx. 14.0), Bleach (pH approx. 12.0), Soapy water (pH approx. 11.0), Milk of Magnesia (pH approx. 10.0), baking soda water (pH approx. 8.5-9.0)

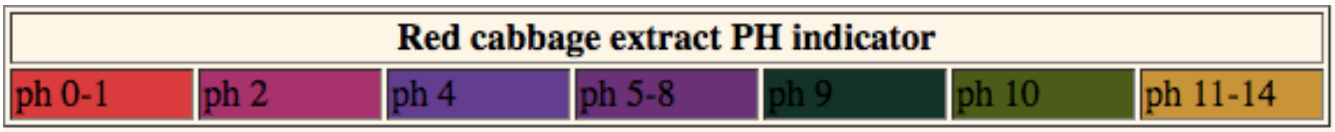

Figure 1: pH indicator colour results for homemade red cabbage + alcohol mixture. To be distributed or projected **in colour** to students during experiment.