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We value your feedback and recommendations.

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UNIT 1: Diversity of Materials in the Environment

Overview

This set of five modules on the Diversity of Materials in the Environment provides many opportunities for students to increase their understanding of solutions, substances and mixtures, elements and compounds, acids and bases, and metals and nonmetals, through engaging them in scientific inquiry.

There is a wide range and variety of materials on Earth. These include natural materials, those that have been made from other materials (processed or manufactured), and those which make up living things. In Grade 7, the development of ideas about materials begins with awareness of solutions, which students often encounter everyday as liquid mixtures. Further awareness of materials in terms of the components they are made of—substances, elements, compounds are taken up in Modules 2, 3, and 5. Students will also study the properties of a special group of compounds—acids and bases in Module 4.

These concepts will be encountered by the students in the contexts and life situations that they are most familiar with. It is important to recognize that the teaching of the concepts covered in this set of modules focuses more on the 'macro' view (the tangible and visible). Science education research recommends that concepts be taught, initially, at the macro level only. Explanations at the 'submicroscopic' level (atomic or molecular level) could be shared in appropriate doses enough to be processed by the students. The use of chemical symbols and equations are reserved for higher grade levels much later. The experiences gained through different activities in each module will allow students to transform the information they obtain into a form that is usable to them in their own personal and community context.

The development of the modules veers away from teaching science that is textbook-centered to that which incorporates interactive and inquiry-based learning experiences. Inquiry is essential in learning science. When students are engaged in inquiry, they describe objects and phenomena, "identify questions that can be answered through scientific investigations; design and conduct a scientific investigation; use appropriate tools and techniques to gather, analyze, and interpret data; develop descriptions, explanations, predictions, and models using evidence; think critically and logically to make the relationships between evidence and explanations; recognize and analyze alternative explanations and predictions; communicate scientific procedures and explanations; and use mathematics in all aspects of scientific inquiry" (The National Science Education Standards, U.S. National Research Council, 2000. p.19).

Research has shown that the use of inquiry and investigative skills develop with age. In this set of modules, the students will apply the inquiry skills they learned in earlier grades. They will plan and carry out simple science investigations. Each student will be able to participate first-hand in looking for evidence to answer questions they have posed at the beginning. They will have opportunities to gather
and interpret data as well as draw conclusions based on evidence they have gathered. They will perform fair tests by identifying variables to be changed, measured and controlled, and do repeat trials.

The teacher needs to guide and intervene throughout the process of investigation to improve the students’ understanding of the concepts involved. Gradually, the students will gain more independence in looking for evidence to answer questions as they move from guided inquiry to full investigations.

It is hoped that through the use of inquiry, teachers will be able to facilitate learning of science and assess each student's developing understandings and abilities. Some activities, by themselves, can be considered as embedded assessment. There is also a pre/post test that should be administered before and after all the activities in each module have been completed. The teacher needs to analyze the results of these tests. The pretest results will indicate students' prior knowledge and alternative conceptions (if any). The posttest results will show the extent of students' comprehension of the concepts and their capacity to demonstrate needed skills. The posttest can also reveal students' misconceptions that need to be addressed in succeeding modules.
In this module on Solutions, the activities have been sequenced in such a way that the concepts are developed gradually from the first to the last activity. It starts with the students being acquainted with solutions found in their home. The second activity allows them to study some common characteristics of solutions—appearance, number of phases observed, ability to be dissolved in water, and ability to be filtered. In Activity 3, students begin to distinguish a saturated from an unsaturated solution through a guided investigation where they learn that there is a maximum amount of solute that can dissolve in a given amount of solvent at a certain temperature.

**Key questions for this module**

- What common properties do solutions have?
- Are solutions always liquid?
- Will all solids dissolve in water?
- How fast do solids dissolve in water?

The development of inquiry skills is also gradual. In Activity 1, the students will simply write observations and present their observations in table form. In the second activity, students will predict, find some patterns and draw conclusions based on the collected data in order to give some common characteristics of solutions. Students will have the opportunity to observe, measure, analyze data and consequently give generalizations when they distinguish between a saturated and an unsaturated solution in Activity 3.

Activities 4 to 6 deal with factors affecting how fast a solid solute dissolves in water. Students will perform a guided investigation where they will (1) formulate specific question(s) to a testable form; (2) formulate a hypothesis that identifies a cause and effect relationship between the dependent and independent variables; (3) select and justify a procedure to be used in answering the specific question(s); (4) identify the dependent and independent variables in the investigation; (5) carry out the procedure that includes a fair test, including controlling variables and doing repeated trials to increase accuracy and reliability; (6) make observations that are relevant to the specific question(s); (7) make measurements using appropriate
devices; (8) record and report all observations and data; (9) interpret patterns from the data gathered; (10) infer and explain relationships from the data; and (11) draw a conclusion from the results obtained, including a statement to support or reject the hypothesis.

**Activity 1**

*What solutions do you find in your home?*

**For the TEACHER**

1. Assign your students to go to a store or grocery and list the products being sold. Ask them to identify which among the products are solutions.

2. Let the students describe the products in terms of color and appearance, odor, feel, and taste (for food products).

3. They may also search their kitchen shelves and storage areas at home to identify the solutions they use at home. Let the students bring the product itself or the label of the used product.

4. Bring to class other solutions which students may not recognize as solutions. Some examples are bronze medal, brass, stainless steel utensils, sterling silver jewelry, coins, and other solutions.

**Activity 2**

*What are the properties of solutions?*

Table 1. Data table for Activity 2

<table>
<thead>
<tr>
<th>(1) Sample solid or liquid</th>
<th>(2) Will dissolve in ½ cup water (yes or no)</th>
<th>(3) Appearance</th>
<th>(4) Number of phases</th>
<th>(5) Can be separated by filtration (yes or no)</th>
<th>(6) Path of light (can or cannot be seen)</th>
<th>(7) Solution or not?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>completely uniform</td>
<td>one</td>
<td>NO</td>
<td>cannot be seen</td>
<td>solution</td>
<td>solution</td>
</tr>
<tr>
<td>Salt</td>
<td>completely uniform</td>
<td>two</td>
<td>NO</td>
<td>cannot be seen</td>
<td>solution</td>
<td>solution</td>
</tr>
<tr>
<td>Mongo seeds</td>
<td>not at all</td>
<td>two</td>
<td>YES</td>
<td>can be seen</td>
<td>not a solution</td>
<td>not a solution</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>----------------------------------</td>
<td>-------</td>
<td>--------------</td>
<td>-----------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td></td>
<td>Sample solid or liquid</td>
<td>Will dissolve in ½ cup water (yes or no)</td>
<td>Appearance</td>
<td>Number of phases</td>
<td>Can be separated by filtration (yes or no)</td>
<td>Path of light (can or cannot be seen)</td>
</tr>
<tr>
<td>Powdered juice</td>
<td>completely or partially</td>
<td>not uniform</td>
<td>two</td>
<td>NO or some powder left on filter paper</td>
<td>can be seen</td>
<td>colloid (not a solution)</td>
</tr>
<tr>
<td>Cooking oil</td>
<td>not at all</td>
<td>not uniform</td>
<td>Two layers</td>
<td>NO</td>
<td>can be seen</td>
<td>not a solution</td>
</tr>
<tr>
<td>Vinegar (clear type)</td>
<td>completely</td>
<td>uniform</td>
<td>one</td>
<td>NO</td>
<td>cannot be seen</td>
<td>solution</td>
</tr>
<tr>
<td>Colloidal type</td>
<td>completely</td>
<td>not uniform</td>
<td>one</td>
<td>NO</td>
<td>can be seen</td>
<td>not a solution</td>
</tr>
</tbody>
</table>

**Note 1:** In column 3, students may describe the mixture in other ways such as homogeneous or heterogeneous. They may also describe the color of the mixture.

**Note 2:** For salt as sample, students might observe two phases (the liquid part and some solids at the bottom of the container.) These particles may either be undissolved salt or particles of dirt from the sample used. In this case, the number of phases is two. However, if all of the salt dissolved, then the number of phases is one.

In Activity 2, students found out that a solution is formed when a solute dissolves in a solvent to form a single phase that appears uniform throughout. In a solution, the particles are too small that they cannot be seen by the unaided eye. The particles in solution are smaller than the pores of the filter paper or the cheesecloth and so these can pass through the filter.

Each part of a solution retains its characteristic properties. When a sugar solution is filtered, the filtrate tastes sweet. The sweetness of sugar is present in any part of the sugar solution.

Ordinarily, a path of light from a source cannot be seen unless the light passes through mist or through dust in the air. These particles scatter light. The path of light is visible only when the light is scattered by particles. So, when a beam of light from a flashlight is passed through a solution, the path of light is not observed because the particles are too small to scatter light. On the other hand, particles of colloids and suspensions scatter or reflect light. The scatter of visible light by particles is called **Tyndall effect.**
In Activity 2, the path of light cannot be seen in the samples which dissolved completely in water. These are solutions. So, one property of solutions is that they do not scatter light. Solutions do not exhibit Tyndall effect. However, the path of light can be observed in the samples that did not completely dissolve in water.

Based on the results of Activity 2, there are common properties that solutions have.

Some common properties of solutions:

1. Solutions are homogeneous. They are mixtures consisting of one phase only. The components are so well mixed that all parts of the solution appear the same. A solution has the same composition and properties throughout.

2. The solute cannot be separated from the solvent through filtration because these are so small that they pass through the filter paper or cheesecloth.

3. Solutions do not scatter light. They do not exhibit Tyndall effect.

It would be good to introduce the concept of solute and solvent after Activity 2. A solution consists of two components called the solvent and the solute. Generally, the component present in small amount is called the solute. The solute and the solvent dissolve in each other. Usually the solvent is the component present in greater amount. So in a sugar solution, sugar is the solute and water is the solvent.

Answers to Questions

Q1. The solution appears uniform throughout. It is homogeneous.
Q2. Five and ½ teaspoons of sugar were added when there was excess undissolved sugar observed remaining in the container.
Q3. Five teaspoons of sugar is the maximum amount that can dissolve in 20 mL of water.
Note: Activity 3 is done at room temperature only. The effect of temperature on solubility is not yet discussed in Grade 7. Activities 4 to 6 will deal only with the factors affecting how fast a solid solute dissolves in water.

While in general, solubility of solute increases as temperature is increased, it should be noted that the relationship between temperature and solubility is not simple. Faster dissolving does not necessarily mean more extensive dissolving. It is important to distinguish the effect of temperature on how fast the process of dissolving takes place from its effect on the final amount of solute that will completely dissolve.

The solubility of some solutes decreases as temperature increases. On the other hand, there are solutes that increase their solubility at higher temperatures. For some other solutes, their solubility is not affected by an increase in temperature. Since the effect of temperature on different solutes is more accurately explained using solubility curves, Grade 7 students are not expected to use these solubility curves, which will be taken up in Grade 9. The effect of temperature on the solubility of gases in liquids will also be taken up also in Grade 9.

**Teacher Demonstration: Concentration of Solutions**

**Materials**

- food color (blue, yellow, or green)
- medicine droppers
- water
- 4 clear, transparent bottles
- stirrer

**Procedure (Part 1)**

1. Label the clear, transparent bottles with numbers 1 to 4.
2. Place one drop of food color in bottle #1.
3. Add 50 mL water to the food color in bottle #1 and stir the solution.
4. Place 10 drops of food color in bottle #2.
5. Add 50 mL water to the food color in bottle #2 and stir the solution.
6. Show the class bottles #1 and #2 and ask them to differentiate the two bottles.

**Procedure (Part 2)**

1. Place one drop of food color in bottle #3.
2. Add 20 mL water in bottle #3 and stir the solution.
3. Place one drop of food color in bottle #4.
4. Add 100 mL water to the food color in bottle #4 and stir the solution.
5. Show the class bottles #3 and #4 and ask them to differentiate the two bottles.

After the demonstration, student should be aware that concentrated solutions can be prepared either by adding more solute and keeping the amount of solvent the same or keeping the amount of solute the same and reducing the amount of solvent.
Activities 4 to 6 focus on some factors affecting how fast a solid solute dissolves in water. These activities will allow students to perform simple investigations where they have to do the following:

1. formulate a specific question or problem to a testable form
2. formulate a **hypothesis** (the statement that gives a tentative answer or solution to the question; a possible explanation that will be proven or disproven)
3. select and justify a procedure to be used in answering the specific question
4. identify the dependent and independent variables in the investigation

The **dependent variable** is the factor or condition that is

- *measured or responding* in an experiment
- the change or *result* that occurs due to the independent variable
- the “what will happen” in an experiment

The **independent variable** is the factor or condition that is

- *changed* in an experiment directly caused by the experimenter
- *manipulated* in the experiment
- the “what you do” in the experiment

5. carry out the procedure that includes a fair test, which includes identifying the **control variables** (factors that are kept the same) and doing repeated trials to increase accuracy and reliability.

A **fair test** is making sure that in an experiment, one factor or condition (the independent variable) affects another (the dependent variable) by keeping all other conditions constant or the same.

6. make observations that are relevant to the specific question
7. make measurements using appropriate devices and units
8. record and report all observations and data
9. interpret patterns from the data gathered
10. infer and explain relationships from the data; and
11. draw a conclusion from the results obtained, including a statement to support or reject the hypothesis.

The teacher will demonstrate the effect of stirring, as one factor affecting how fast solids dissolve in liquids. For the other factors affecting how fast solids dissolve in water, the class can be divided into groups of 6-8 students, where different groups can address any one of the following:

a) the effect of particle size
b) the effect of temperature
c) the nature of the solute
The discussion for Grade 7 will be limited only on the factors that affecting how fast a solid solute dissolves in water based on the results of the students’ investigations in this module.

**Teacher Demonstration: The Effect of Stirring**

1. Put one (1) teaspoon of chocolate powder in each of two different transparent drinking cups, labeled cup A and cup B, respectively.

2. Add ½ cup of water in each of the cups. Let the students observe closely.

3. Stir the mixture in cup A 10 times using a stirrer or teaspoon. Do not stir the mixture in cup B.

4. Let the students observe what happens in each cup.

5. Ask the students: what differences do you observe between cup A and cup B?

6. Let the students give the reason(s) for the results they observed.

   Emphasize that stirring the solution will let the solvent particles come in contact faster with the corners and edges of solute particles. Therefore, the solute dissolves faster. Keep in mind that stirring does not affect the amount (how much) of solute that dissolves in solution. You will recall in Activity 3 that a solute remains undissolved no matter how much you stir if it is already a saturated solution.

**Activity 4

**Size matters!**

1. Let different groups of students design and conduct an investigation to find out whether the particle size of a solid affects how fast it dissolves in water.

2. Ask students to come up with a hypothesis in a testable form. Example: The crushed salt dissolves faster than the uncrushed (salt which has bigger size of particles).

3. Ask students to think about how they could investigate this question using table salt. Introduce them to the idea that crushing salt will make the particle size smaller.

4. Provide measuring cups and teaspoons, water, table salt (big crystals) and crushed salt. Let them use a big cup or glass bottle to roll over table salt in order to crush it.
5. Let the students list the materials they need. Check whether the list is complete. Make sure that the following materials are listed (though the groups may ask for different amounts):

   - 2 clear plastic cups
   - 2 stirrers
   - Measuring cups: ½ cup, 1 cup
   - 2 tablespoons of rock salt
   - water

6. Check the procedure of the students. The dependent and independent variables should be identified. The control variable should also be specified and considered in the procedure to be done.

7. Let the students perform at least two trials (replicates), but it is much better if three trials or replicates are done.

**Effect of Particle Size**

In the discussion, ask students if their observations from the investigation support this idea that smaller pieces can dissolve faster than larger ones. They can infer that when water and salt are mixed, the particles are constantly moving within the container.

The teacher should let the students imagine that in a solution, the particles of the solute (table salt) and the solvent (water) are constantly moving. Water particles collide everywhere along the surface of the particles of table salt.

When the water particles come close to the salt particles, the collision happens more often at the corners and edges of the solid salt. At the corners and edges of the solid, the particles are more easily removed than those which are within the solid.

The container with crushed salt has much smaller particles in the solution than the container with bigger crystals of salt. So water particles could more easily surround the smaller particles of crushed salt than the surface of the big salt crystal. Therefore, the crushed salt dissolves faster. Thus, the smaller particles of salt, the easier they mix with the water.

These explanations refer to the surface area of the solute particles. The surface area is the area of the solute particles exposed to the solvent (water in this case). Since the crushed table salt has a bigger the surface area, then it dissolves faster. Therefore, crushed table salt dissolves faster than the bigger granules of salt.

**Note:** The term “surface area” is not used in explaining the effect of particle size to Grade 7 students since it may still be difficult for them to visualize what it means. However, showing a big whole cube and another cube of the same dimension but cut
into smaller pieces of cubes may help students visualize that the cube cut into smaller pieces has a larger surface area.

Activity 5

How fast does coffee dissolve in hot water? In cold water?

This activity will let students conduct an investigation to see how fast coffee dissolves in cold and in hot water.

1. Ask students how they make hot coffee. Ask them if they could make “cold coffee” by adding cold water or milk to the hot coffee.

2. In groups, ask them to write a hypothesis in testable form to compare how fast coffee dissolves in cold and in hot water. An example of a hypothesis is: Coffee powder dissolves faster in hot water than in cold water.

3. Give time for the students to determine which variables should be controlled. They should come up with the following variables: amount of water in each cup; amount of coffee in each cup; method of stirring; time when the solid is added to water, and how long each solution is stirred. Students should know that what differs in each cup is the temperature of the water.

   Note: You may either have each group conduct its own investigation according to the group’s plans, or have a class discussion to decide on a procedure that everyone will use.

4. Let them list the materials they need as well as the amounts needed. Their list should include the following:

   - 2 cups hot water
   - 2 cups cold water
   - instant coffee powder
   - 2 clear plastic cups
   - 2 stirrers
   - Measuring cups: ½ cup, 1 cup
   - Measuring spoons: ½ tsp, 1 tsp

5. The following procedure is one method students can use. Different ratios of coffee and water can be used since different groups are assigned to investigate the effect of temperature.

   Procedure

   1. Place ½ cup of cold water in a cup.
   2. Place ½ cup of hot water in another cup.
   3. At the same time, add ½ teaspoon of coffee to each cup.
4. Stir each solid for 10 seconds and observe.
5. Stir for another 10 seconds and observe again.

*Expected results:* The coffee in hot water will make the color of water dark brown or black. The coffee powder will dissolve faster in hot water. In cold water, there will be some coffee particles remaining that did not dissolve. With more stirring, the coffee in the cold water may also completely dissolve in the water after some time.

*Note:* Coffee is used in this activity because making hot coffee is common to students and such will show how heating a liquid can affect how fast a solid dissolves.

Let the students draw diagrams or illustrations showing the stages of a solid dissolving. Ask students questions like the following:

- Does coffee dissolve faster in hot water?
- What is the best way to make “cold coffee”?

**The Effect of Temperature**

Most solids, like coffee powder, dissolve faster in hot water than in cold water. At higher temperature, the water particles move faster and come in contact more frequently with the solute particles (the coffee powder).

**Activity 6**

Which dissolves faster in hot and in cold water? Sugar or salt?

Questions to investigate: Does salt dissolve faster in hot water than in cold water? Does sugar dissolve faster in hot water than in cold water?

1. Ask students to investigate how temperature affects how fast sugar and salt dissolve in water.

   In their earlier investigations, students learned that the temperature of water affected how fast coffee dissolves in water. Ask students how they could test whether the temperature of water affects how fast salt dissolves in water. Similarly, ask them how they can test whether temperature of water affects how fast sugar dissolves in water.

2. Let the students formulate a hypothesis in testable form. For example, they can predict that both sugar and salt dissolve better in hot water than in cold water.

3. Ask the students to identify the dependent and the independent variables.
4. Give time for the students to determine which variables should be controlled. They should come up with the following variables: amount of water in each cup; amount of salt and sugar in each cup; method of stirring; time when the solid is added to water, and how long each solution is stirred. Students should recognize that what differs in each cup is the temperature of the water.

You may ask students these questions to guide them in controlling variables:

- Do you need to use the same amount of sugar in each sample?
- Do you need to use the same amount of water in dissolving both sugar and salt?
- Should the water be at the same or at different temperatures?

5. Let them list the materials they need as well as the amounts needed. Their list should include the following:

2 cups of water
2 cups cold water
2 tablespoon sugar
2 tablespoon salt
4 plastic cups
2 stirrers
Measuring cups: ½ cup, 1 cup
Measuring spoons: ½ tsp, 1 tsp

6. The following procedure is one method students can use. Different amounts of salt, sugar and water can be used depending on the planned procedure of the students.

**Hint:** It is better to use a small volume of water, for example, 20 mL of water to make the time for investigation shorter.

**Sugar in hot and cold water**

a. Place 20 mL of hot water in a cup.
b. Place 20 mL of cold water in another cup.
c. At the same time, add 2 teaspoons of sugar to each cup.
d. Stir the sugar in each cup for 10 seconds and observe. What happened to the sugar?
e. Record your observations.
f. Stir for another 10 seconds and observe again.
g. Set aside both containers.
h. After 5 minutes, observe closely the bottom of the container.

**Salt in cold and hot water**
Repeat Steps 1 to 7 with salt.

7. Discuss the results of the investigation. Ask the following questions:
   - Does temperature affect how fast sugar dissolves in water? Give the evidence based on your observations.
   - Does temperature affect how fast salt that dissolves in water? Give the evidence based on your observations.
   - Which dissolves easier in hot water: sugar or salt?

Expected results:

For sugar: Sugar dissolves faster in hot water than in cold water. Two teaspoons of sugar can completely dissolve at room temperature in three minutes. But, two teaspoons of sugar can completely dissolve at 75°C in one minute and 13 seconds.

For salt: There is about the same amount of salt remaining at the bottom of both the hot and cold containers. Only a little more salt can dissolve in very hot water than in cold.

Students can conclude that temperature affects how fast sugar dissolves in water more than it affects how fast salt dissolves in water. This conclusion is based on the difference in the time needed to dissolve sugar in cold and in hot water. However, there is only a slight difference in the time needed to completely dissolve the salt in hot water than in cold water.

8. Let students use their observations to make statements about the effect of temperature on how fast salt dissolves in water as well as how fast sugar dissolves in water.

9. When all groups have completed their investigation, compare the results.
PRE/POST TEST

1. Which of the following is an example of a solution? (Choose more than one.)
   a. Vinegar
   b. Mud in water
   c. Food coloring in water
   d. Sugar dissolved in water
   e. Ice cream

   Give the reason why you think these are solutions.

2. Which statement describes the solute?
   a. It is the solid formed in solution.
   b. It is the liquid part of the solution.
   c. It is the component of a solution in smaller amount.
   d. It is the component of a solution in bigger amount.

3. Which is more concentrated, a solution containing 5 grams of salt in 10 grams of water or a solution containing 18 grams of salt in 90 grams of water? Show your calculations.

4. The label of the 200-mL rubbing alcohol that Mrs. Herrera bought shows that it contains 40% ethyl alcohol. What is the volume of ethyl alcohol does the rubbing alcohol contain? Show your calculations.

5. Joel and Ben wanted to find out how much salt is needed to make a saturated solution in 100 mL of water. Use the following data to answer the questions below the table.

<table>
<thead>
<tr>
<th>Step Number</th>
<th>Amount of salt added</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6 grams</td>
<td>After stirring, salt completely dissolved.</td>
</tr>
<tr>
<td>2</td>
<td>6 grams</td>
<td>After stirring, salt completely dissolved.</td>
</tr>
<tr>
<td>3</td>
<td>6 grams</td>
<td>After stirring, salt completely dissolved.</td>
</tr>
<tr>
<td>4</td>
<td>6 grams</td>
<td>After stirring, salt completely dissolved.</td>
</tr>
<tr>
<td>5</td>
<td>6 grams</td>
<td>After stirring, salt completely dissolved.</td>
</tr>
<tr>
<td>6</td>
<td>6 grams</td>
<td>After stirring, salt completely dissolved.</td>
</tr>
<tr>
<td>7</td>
<td>6 grams</td>
<td>After stirring, some salt is seen at the bottom of the container.</td>
</tr>
</tbody>
</table>

   a. Which is the solute of the solution? Which is the solvent?
   b. In which step is the solution described as saturated solution? Explain your answer.
   c. What the concentration of the solution in step 4?

6. Give one reason why people stir coffee or juice in water after they have added sugar.
7. Why do you think that it is easier to dissolve powdered brown sugar than a big whole piece or chunk of brown sugar (the size of a small ice cream cup) in water?

For items 8-10: A group of students was asked to investigate how fast sugar dissolves in cold and in hot water?

8. If this is going to be a fair test, what variables should they control?
   a. Amount of water and sugar in each cup, method of stirring, time when the solid is added to water, how long each solution is stirred.
   b. Amount of water and sugar in each cup, method of stirring, how long each solution is stirred.
   c. Amount of sugar in each cup; method of stirring, time when the solid is added to water, how long each solution is stirred.
   d. Amount of water in each cup, method of stirring, time when the solid is added to water; how long each solution is stirred.

9. What is the dependent variable (what is being measured)?
   I. The temperature of water.
   II. The amount of sugar.
   III. The length of time that sugar completely dissolves in hot water.
   IV. The length of time that sugar completely dissolves in cold water.
   a. I only  
   b. II only  
   c. II and III  
   d. III and IV

10. What is the independent variable in the investigation?
    a. I only  
    b. II and III  
    c. II, III and IV  
    d. I, II and III
1. (a), (c), (d); Vinegar, food coloring in water, and sugar dissolved in water are all solutions since each appears to be in one phase only (homogeneous) and transparent.

2. (c). The component in smaller amount is the solute. The component present in greater amount is the solvent. The solid formed in a solution is called a precipitate.

3. 5 grams salt in 10 grams water is more concentrated.
   Calculations:
   5 grams salt/10 grams water x 100% = 50% salt
   18 grams salt/90 grams water x 100% = 20% salt

4. % volume = volume solute/volume solution x 100%
   40% = volume solute/200 mL x 100%
   volume solute = 40% x 200 mL = 80 mL ethyl alcohol

5. a. Salt is the solute; water is the solvent.
   b. The solution is saturated at step 6. The solution is saturated when all (maximum amount) of the solute was dissolved. At step 7, some salt already came out of solution and did not dissolve anymore.
   c. 24 grams/100 mL

6. Stirring will increase the movement or allows faster spreading of solute particles in the solvent. This in turn hastens the contact between the surface of the solute and the solvent particles.

7. Powdered brown sugar has more corners and edges since the particles of the powder are smaller. So there will be more particles of brown sugar that can attach or come in contact with the water, making it dissolve faster in water.

8. (a)

9. (d)

10. (a)
References


In this module, students will broaden their knowledge about the different samples of matter. They will find out that mixture is just one of the two major classes of matter. The other of which is the substance. Based on differences in behavior under certain conditions, they should be able to distinguish one from the other.

**Key questions for this module**

How are mixtures different from substances? How are they similar?

A series of activities will gear the students in answering the questions above. With the hope that students will find connection between the topics they have learned in the lower grade levels to the ones they are about to learn, the first activity will bring them to their past lesson on separating mixtures. Moreover, the products obtained from this activity will be the ones used for the proceeding activity which will focus on differentiating substances from mixtures. In this manner, the students will be more convinced that mixtures may be composed of substances. A culminating activity will check if they have learned the distinguishable behaviors between these classes of matter vis-à-vis their ability to design an investigation.

**Skills enhanced in this module**

<table>
<thead>
<tr>
<th>Science Inquiry Skills</th>
<th>Manipulative Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>• making qualitative and quantitative observations</td>
<td>• observing proper behavior in the laboratory to prevent accidents and errors</td>
</tr>
<tr>
<td>• drawing inferences from observations</td>
<td>• using the correct technique in smelling, feeling, and tasting samples</td>
</tr>
<tr>
<td>• organizing and tabulating data</td>
<td>• using the correct technique in making temperature readings</td>
</tr>
<tr>
<td>• comparing and contrasting behaviors of substances and mixtures</td>
<td>• setting up equipment for boiling and melting samples</td>
</tr>
<tr>
<td>• classifying samples as mixtures and substances</td>
<td>• constructing an improvised equipment</td>
</tr>
<tr>
<td>• plotting and interpreting line graphs</td>
<td></td>
</tr>
<tr>
<td>• stating a generalization based on observations or data which are consistent in a number of trials</td>
<td></td>
</tr>
</tbody>
</table>
In grade 6, students have encountered several ways in separating mixtures. Most of them are techniques to separate heterogeneous mixtures such as scooping, filtration, and decantation. In this activity, they will experience a way of separating the components of a homogeneous mixture. It is important that they are aware of the kind of sample they are working with — mixture. They may review some characteristics of mixtures such as those in the table on the right. They may check the sample that they are going to use in this activity if it does have the characteristics listed in the table. The students should know that the seawater sample is made up of components; however, they cannot be distinguished because the sample is homogeneous. This activity will help them “see” the components of their seawater sample which are salt and water. They will distill the water out from the mixture and may refer to this product as distilled water. The remaining sample will evaporate out the rest of the water leaving salt crystals.

**Important!**

- Emphasize the ones written in the “Take Care!” boxes.
- Make sure to use protective eyewear at all times during the activity. Some samples may splatter when inflamed.
- Have a fire extinguisher (blanket, sand or big jar) ready at all times.

### Characteristics of Mixtures

- may be solid, liquid or gas
- may be homogeneous or heterogeneous
- made up of two or more components
- components may be separated/recovered by physical means such as filtration, and distillation
- amount of components may vary
Alternative materials

- *Salt solution instead of seawater.* To prepare a salt solution, add about 3.0g table salt and 10 mL water. Mix well and filter undissolved particles.
- *Broken tiles or porous pot chips instead of boiling chips.* The chips can be reused two times. After the activity, collect all the chips. Wash, dry and then keep them in a covered container.
- *Ballpen casing and rubber hose instead of the delivery tube used for the distillation setup.*
- *Aluminum foil instead of evaporating dish.* The foil may be shaped like a bowl and fitted around the mouth of a beaker. See Figure 2 in Student Module 2.

- *Wire gauze without the asbestos.* Simply scrape off the asbestos center of those old wire gauze, provided they are not yet worn out. Collect the asbestos and dispose of properly.

Distillation techniques

- Do not remove the flame from the test tube while distillation is in progress. This may cause the cold liquid to be sucked back into the hot test tube. Remove the receiving test tube first before extinguishing the flame.
- Do not let the solution in the sample flask dry up. Remove the flame as soon as the liquid in the sample flask is only about 1 cm high from the bottom.
- Keep the receiver in the water bath while doing the distillation. It is better to add ice to the water bath.

- You may discuss the distillation techniques above and ask the students the possible reason for such techniques. Allow the students to think or give them prompt questions that may lead them to think of the reasons.

- Let the students be the ones to assemble the distillation setup, however make sure that they have done it correctly. You may include this as an assessment.

Answers to Activity Questions

**Part A**

Q1. There are some small, solid crystals left.

**Part B**

Q2. The intensity of the yellow color flame is the same with the residue and the table salt. It is highly possible that the residue from Part A is table salt, which is sodium chloride.
In Activity 1, students have learned that mixtures, despite the homogeneity, are made up of components. These components were referred as substances. However, the word *substance* is being introduced in the module for the first time. The students may not have any idea on what a substance is. Hence, this activity will build in the students the concept of *substance* from their previous knowledge on mixtures. They will find out that the behavior of mixtures are much different than those of substances. Being so, substance is another class of matter.

This activity is divided into two parts: part A will differentiate substances and mixtures through the way the temperature changes during boiling; while in part B, these two are differentiated through how they appear/behave while they are melting. Both parts will make use of samples that appear to be identical. Part A will use the distilled water obtained in Activity 1 and seawater; while Part B will use benzoic acid and a mixture of benzoic acid and salt. They will first differentiate the samples based on appearance. They will find it difficult to identify one from the other by simply looking at them since they are homogeneous. As such, *looks may be deceiving*. Only after the activity, they will realize a way these samples may be differentiated. From here, the students will give their operational definition of substances.

It is highly encouraged to use the distilled water obtained in Activity 1 as the sample for Part A. In this manner, the students will be more convinced that mixtures may be composed of substances. Salts that were recovered from Activity 1 are still mixtures of different salts and minerals. In effect, it may be said that mixtures may also be composed of mixtures.

### Reminders

- In part A, make sure the students will boil the *distilled water* sample first. In this manner, the chances of contaminating the *distilled water* may be lessened. Also, make sure the seawater sample has the same odor as distilled water. Allow the seawater to dissipate its characteristic odor by leaving the container partly covered overnight.

- In part B, make sure the samples are placed in their assigned X marks of the improvised melting dish.

- The expected results and generalization are as follows. Allow the students to come about these generalizations by themselves as you facilitate in processing their results.
cont’d.

- During boiling, the temperature of a substance changes at first then it becomes the same, while the temperature of a mixture is different at different times.
- During melting, a substance melts completely/smoothly within a short time; while the mixtures have portions that seem to be not melting.

Do the following after Activity 2 to emphasize that melting and boiling behavior of a substance are the same even the amount changes.

- Boil different volumes (1 mL, 3mL, 5mL) of distilled water. Ask the students to describe the boiling behavior of distilled water in different volumes. (The behavior is the same for the different volumes of distilled water, i.e., the temperature changes at first then it becomes the same.)
- Melt different amounts (1 scoop, 2 scoops, 3 scoops, 4 scoops) of benzoic acid. Ask the students to describe the melting behavior of benzoic acid in different amounts. (The behavior is the same for the different amounts of benzoic acid, i.e., the samples melt completely/smoothly within a short time.)
- Let them think of other properties that will not change with the amount of a substance (e.g., density).

**Reminders**

- Emphasize that the samples that will be used in Part A are the products from Activity 1. Part B will not be using the ones collected from Activity 1. However, after the activity, students will infer the melting behavior of one of its products.
- The melting dish made by other classes or batches may be used. You may skip the construction of an improvised melting dish if it is already available. Other possible materials for melting dish are the metal lids of mayonnaise/marmalade jars and Piknik shoestring potato snack.
- In case some materials for Part B are not available, a video may serve as an alternative. To get a copy of this video, please access curriculum.nismed.upd.edu.ph.
- Allow students to tinker with the samples so they may be able to give a rich description for each of them. Hand lens, if available, may be used.
- Let the students assemble the setup for boiling. This will give an opportunity for the students to enhance their lab/manipulative skills. This can also be included as an assessment.
- Review techniques in the proper use of a laboratory thermometer. Make sure temperature is read at the eye level. There is no need to shake the thermometer to bring the reading to zero.

**Teaching Tips**

- Emphasize that the samples that will be used in Part A are the products from Activity 1. Part B will not be using the ones collected from Activity 1. However, after the activity, students will infer the melting behavior of one of its products.
- The melting dish made by other classes or batches may be used. You may skip the construction of an improvised melting dish if it is already available. Other possible materials for melting dish are the metal lids of mayonnaise/marmalade jars and Piknik shoestring potato snack.
- In case some materials for Part B are not available, a video may serve as an alternative. To get a copy of this video, please access curriculum.nismed.upd.edu.ph.
- Allow students to tinker with the samples so they may be able to give a rich description for each of them. Hand lens, if available, may be used.
- Let the students assemble the setup for boiling. This will give an opportunity for the students to enhance their lab/manipulative skills. This can also be included as an assessment.
Teaching Tips

- Check how your students construct their graphs. This part is an opportunity to reinforce what they have learned about investigations in Module 1. This can be a way to check if they understand the concepts of independent and dependent variables; and if they can plot using the appropriate graph to show their results.
  - Let them identify the kind of graph (line) that best suits their data.
  - Let them identify the independent (time) and the dependent (temperature reading in °C) variables.
  - Let them plot the graph and see to it that it is correctly done.
    - The data for the x-axis must be the independent variable, while the y-axis is for the dependent variable.
    - The scale is appropriate. They should have regular intervals in their x-axis. Since reading is done every 30 sec, you can suggest that they plot every reading they have obtained. Hence, the x-axis will have 30 sec per unit.
    - The axes should be labelled with both quantity and units.
    - There is a descriptive title for their graph.

- Compare the data obtained by the different groups. Discuss similarities and differences among these data. Make a generalization based on the data obtained. Emphasize that this generalization was based on data that is consistent in a number of trials.

- After doing Part B of Activity 2, ask the students to describe how sodium chloride melts. Tell them that it is a substance. After some students have shared their answers, show them a video on how sodium chloride melts.

- Allow students to tinker with the samples so they may be able to give a rich description for each of them. Hand lens, if available, may be used.

- Reiterate the point that “looks can be deceiving” and may not be enough basis to classify a sample as substance or mixture.

  - Allow them to revisit what they wrote in Tables 1 and 2 in the cell labelled Appearance/Odor. Do the liquid samples look the same? (Yes.) How about the solid samples? (Yes.) Based on the appearance, can you say that the samples are the same? (Yes.)
  - Try this one too! If it is possible to freeze the samples from Activity 1, the students can compare the physical states the samples can assume. Ask them the following questions: Do they look the same? (Yes.) Right after getting the samples from the freezer, what were their physical states? (Solid.)
Teaching Tips

- After establishing that appearance, odor, physical state cannot distinguish a substance from a mixture, ask them the following questions: When you boiled these two samples, can you say that they are the same? (No, they are not anymore the same.) How about the solid samples you used in part B? (They are also not anymore the same.) Can you say that they are the same after you have observed how they behave while being melted? (No, they are not anymore the same.)
- How can boiling and melting determine if a sample is a substance or a mixture? (During boiling, the temperature of a substance changes at first then it becomes the same, while the temperature of a mixture is different at different times. During melting, a substance melts completely/smoothly and within a short time, while the mixtures have portions that seem to be not melting.)

Answers to Activity Questions

Part A
Q1. The temperature changes at first and then it becomes the same.
Q2. A substance has the same boiling temperature.
Q3. The temperature is always changing.
Q4. A mixture has changing boiling temperature.

Part B
Q1. Benzoic acid melts completely/smoothly within a short time.
Q2. A substance melts completely/smoothly within a short time.
Q3. Some parts of the mixture have started to melt and some parts don’t seem to melt.
Q4. A mixture does not melt completely/smoothly like a substance. There are some portions that seem to be not melting.
This activity may assess two things: 1) their understanding of the distinguishable behaviors between substances and mixtures; and 2) their ability to conduct an unstructured investigation. Each student is given one unknown sample, either a solid or liquid. Refer to the table below for some samples that may be used as unknowns. They will design a procedure that will identify their unknown sample as substance or mixture. They will decide which methodology is best fitted to test their sample. This procedure may be critiqued by their fellow students but you will still be the one to give the final check and "go signal" to do the activity.

Some unknown samples that may be used in the activity

<table>
<thead>
<tr>
<th></th>
<th>Liquid</th>
<th>Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>distilled water</td>
<td>benzoic acid</td>
</tr>
<tr>
<td>Mixture</td>
<td>vinegar</td>
<td>benzoic acid-salt*</td>
</tr>
<tr>
<td></td>
<td>mineral water</td>
<td>benzoic acid-monosodium glutamate*</td>
</tr>
<tr>
<td></td>
<td>seawater</td>
<td>benzoic acid-white sugar*</td>
</tr>
</tbody>
</table>

*The ratio between the two components is 1:1.

Answers to Activity Questions

Q1. Answers will depend on the student's unknown.
    For solid unknown, determine its melting behavior to identify whether it is a substance or a mixture. A substance melts completely/smoothly, while a mixture takes longer time to completely melt.
    For liquid unknown, determine its boiling behavior to identify whether it is a substance or a mixture. A substance has a constant boiling temperature, while a mixture boils at a temperature range.

    Note that the method has to be repeated at least three times before the student can conclude if their unknown sample is a substance or a mixture.
PRE/POST TEST

1. You were tasked to check if the liquid sample you have is a substance or a mixture. Which among these tests is the **BEST** way to do so?

   I. Color comparison  
   II. Taste comparison  
   III. Boiling test  
   IV. Melting test  

A. I, II, III and IV  
B. I, II and III only  
C. I, II and IV only  
D. I and III only

2. A liquid has the following properties: one-phase, colorless, boils at varying temperature. Which of the following **BEST** describes the liquid?

A. Solution  
B. Substance  
C. Suspension  
D. Coarse mixture

3. Jill has an unopened box of a 2-meter foil labeled 100% made of aluminum. Aluminum is a substance. Jill takes just a thumb-size piece of the aluminum foil. Which of the following statements is **TRUE** about the piece of aluminum foil that Jill took compared with the rest that was left in the box?

A. Its mass and melting behavior are different.  
B. Its mass and melting behavior are the same.  
C. The mass is different but the melting behavior is the same.  
D. The mass is the same but the melting behavior is different.


Answer Key


References


In this module, students will begin broadening and deepening their knowledge about substances. They will find out that substances, like mixtures, are of various kinds. Being so, like mixtures which may be classified in many ways such as solution, suspension, and colloid; substances may also be further classified into smaller groups, such as elements and compounds.

Key questions for this module

How are elements different from compounds?
How are they similar?

A series of activities will gear the students in answering the questions above. With the hope that students will find connection between the topics they have learned in the lower grade levels to the ones they are about to learn, the first activity will resurface some ideas from Module 2. It will begin with compound, for the reason that it is more comparable with mixtures in terms of the number of components they are made of. Moreover, the products obtained from this activity will serve as the examples used to introduce the next concept, which is element. In this manner, the students will see better the connection between compounds and elements, that is, compounds are made up of elements. The periodic table will also be introduced to familiarize the students with the elements and the periodic table per se. Two activities culminate this module which will let the students realize that these elements and compounds are found just about anywhere, even with the food they eat.

Activity 1 Water, “wat-er” you made of?

In Module 2, students have learned that substances and mixtures share some similarities such as homogeneity. All substances are homogeneous while only some mixtures are. Also, they learned that being homogeneous does not automatically say that a sample is made up of only one component. This holds true for one group of substances — the compounds. Compounds are homogeneous
which are also made up of components. In this activity, the students will separate components of widely used compound — water. They will learn that water is made up of the elements *hydrogen* and *oxygen*. The properties of each of these substances are different from one another.

Components of water are separated through the passage of an electric current, hence the process is termed as *electrolysis*. The students will use an improvised electrolysis apparatus. You will find below how to construct one from commonly available materials.

**Reminders**

- Acquaint the students with the apparatus before doing the activity. Emphasize some parts (as shown in Figure 1) because they will be mentioned in the activity procedure.
- Prepare ahead 5% NaOH. You may either use NaOH pellets or Liquid Sosa.
  - **NaOH pellets.** Place 100 mL distilled water in a beaker. Dissolve carefully 5 g of NaOH pellets (corrosive). Store NaOH solution in PET bottle. Label with its name, concentration and date of preparation. NaOH absorbs CO$_2$ from air. Its concentration could change after some time.
  - **Liquid Sosa.** Mix thoroughly 1mL liquid sosa and 20mL water.

![Figure 1. An improvised electrolysis](image-url)
Teaching Tips

- Run down the procedure before doing the activity. Together, visualize what is supposed to be done. Have one complete setup the students can look at while emphasizing some procedures. Ask some questions as you go through each step, for example:

  - Procedure 1: What are the components of a 5% sodium hydroxide solution? (Sodium hydroxide and water.) How much in percentage is each of these components present in the said solution? (95% water and 5% sodium hydroxide.) What is the component that is of highest amount in the solution? (water.)
  - Procedure 2: What is the basic solution referred to? (5% sodium hydroxide solution) Why is it referred as a basic solution? (Sodium hydroxide is a base.)
  - Procedure 4: Here is the dry cell, where will you connect the red wire? (Positive terminal.) How about the black wire? (Negative terminal.)

- Assess your students’ capability in doing the activity. If you find that the students are not yet ready to be the ones to do this, you are free to make this as a demonstration activity instead.

- Emphasize the difference in behavior of the the two products. In the presence of a flame or spark, hydrogen gives off a “pop” sound while oxygen induces a brighter spark. You may also try doing the same thing with water. Collect some water vapor in a test tube and insert a glowing stick/flame. Nothing is supposed to happen. This will let the students observe that these three exhibit different behaviors, hence are different substances.

Answers to Activity Questions

Q1. A “pop” sound was heard.
Q2. A brighter spark was observed.
Construction of an Improvised Electrolysis Apparatus

Materials Needed

- glue
- ruler
- alcohol lamp
- stripping knife
- dry cells (1.5V)
- 2 paper clips (bulldog type)
- 3 disposable syringes (10 mL)
- 2 stainless steel screws #6 (2 x 12)
- 2 connecting wires (red and black)
- GI wire (about 6 cm, ordinary wire)
- plastic bottle (1 L, 8 cm in diameter or more), preferably thick and hard
- hard plastic straw or dextrose plastic tube (6 cm long)

Procedure (Source: Practical Work in High School Chemistry)

1. Get two disposable 10 mL syringes and remove the plungers. Attach the two syringes at the base. Using an alcohol lamp, heat the edge of the base to be attached. Refer to the figure on the right.

2. Insert each tip of the syringe inside a plastic straw about 6 m long. Bend the straw to close it and place a bulldog type paper clip on the bend to keep it in place. Refer to the figure on the right. These will serve as the "electrolysis syringes".
Construction of an Improvised Electrolysis Apparatus

3. Divide the plastic bottle into three portions. Mark “cutting lines” around the bottle. Refer to the figure on the right.

Distance between cutting-line marks:
- **Bottom portion (3):** about 5 cm from the bottom part of the bottle.
- **Middle portion (2):** about 6 cm from the marked line of the bottom portion (3)

Heat the stripping knife in an alcohol lamp. Use the hot stripping knife to cut around these line marks.

4. Use the middle portion of the bottle to make a stand for the sample container. Make two small squares measuring about 2 cm x 2 cm at opposite sides of the base. These will serve as passageway for the connecting wires.

5. Use the bottom portion of the bottle as the sample container. Measure the distance between the centers of the “electrolysis syringes”. Mark this length with a line on the bottom of the cup. Then using a hot GI wire (2 mm in diameter) bore a small hole at each end of the line. The stainless screws will pass through these holes.

6. Insert the stainless screw through each hole by rotating it carefully until 1/4 of the nail is out at the bottom of the bottle. Refer to the figure on the right. To prevent leaks, apply glue around the stainless screws at the bottom part of the sample container.

*Note: The glue should only be applied on the outside surface of the sample container.*
7. Support the sample container on the stand prepared in #3. Refer to the figure on the right.

8. Invert the “electrolysis syringes” over the stainless screws. Complete the setup as shown in the figure on the right. Insert the dry cells between the connecting wires when you are ready to do the electrolysis.

Note: This procedure is also available in http://curriculum.nismed.upd.edu.ph/2012/04/how-to-make-an-improvised-electrolysis-apparatus/

**Activity 2**

The periodic table: It’s element-ary!

In Activity 1, they were able to generate two elements — *hydrogen* and *oxygen*. In this activity, they will find out that these two elements are just a fraction of the numerous elements currently existing. Also, that these are the substances that are homogeneous which are made up of only one component. Being so, they are said to be the “simplest form of matter”.

All of the elements are systematically organized in the *periodic table*. It was described to be “amazingly” done as varied information about all of the elements are laid out in a single table. Patterns and trends are evident in the arrangement. It serves as a handy reference and as such was labelled as a chemist’s tool. This tool can then be a good starting material to learn about the different elements. However, note that this is the first time for the students to formally use this tool. Being so, this activity, as it walks them through the periodic table, focuses only with the basic
information — name and symbol. Do not overwhelm them with the vast information the periodic table can provide. Worse, if they are required to memorize its contents. Gradually, let them realize these different information through varied activities that require its use. In that manner, they may find the periodic table not that complicated — it’s even quite simple that it’s “element-ary”.

Reminders

- At this grade level, the students are not expected to have a fully-developed concept of "element." The atomic definition comes after learning about the particulate nature of matter in grade 8. Discussion at this grade level is limited to the idea that elements are the ones that make up compounds and all of these elements are listed in the Periodic Table.

- Periodic table is a tool in Chemistry that we can refer to every now and then. The more we use it, the more we get to be familiar with what it contains. Thus, there is no need to memorize such table.

- A periodic table is provided at the end page of Modules 3 and 5. The information placed there is limited to the scope of the module for this quarter. It is highly encouraged to begin with the names and symbols of the elements as they try to know what the elements are. Group number will be introduced at the latter part of the activity. Atomic numbers, at this point, will serve as a guide on how elements are sequenced in the table; it will not be defined as the number of protons of an element’s atom. The latter will be discussed in grade 8 when they have already learned about the particulate nature of matter.

Teaching Tips

- Show students pictures of some elements. You may refer to some of the books and websites listed at the end page of this guide. They may give other descriptions of the elements such as physical state at standard conditions and color. If possible, use real samples.

- As an assignment, a student may choose one element and find more information about it. A poster or something similar may be done as if the student is trying to promote that element.
Food in itself is a sample of matter and thereby made up of either elements, compounds or mixtures. By law, these matter must be written in food labels. In this activity, the students will find these matter on food labels. They will focus on the elements and compounds that make up the food they eat. They will be more aware of the existence of elements and compounds around them. They will find out that these elements are some of the nutrients that a food provides. These nutrients are called minerals. They can find them listed in the Nutrition Facts. Moreover, these

### Table 1. Name and symbol of some elements and the group number it belongs to.

<table>
<thead>
<tr>
<th>Q#</th>
<th>Name</th>
<th>Symbol</th>
<th>Group Number (Q9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>beryllium</td>
<td>Be</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>phosphorus</td>
<td>P</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>germanium</td>
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</tr>
<tr>
<td></td>
<td>darmstatdtium</td>
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</tr>
<tr>
<td>2</td>
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<td></td>
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<tr>
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</tr>
<tr>
<td></td>
<td>calcium</td>
<td>Ca</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>manganese</td>
<td>Mn</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>iron</td>
<td>Fe</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>silver</td>
<td>Ag</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>mercury</td>
<td>Hg</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>lead</td>
<td>Pb</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>silicon</td>
<td>Si</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>magnesium</td>
<td>Mg</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>gold</td>
<td>Au</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>aluminum</td>
<td>Al</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>copper</td>
<td>Cu</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>tin</td>
<td>Sn</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>carbon</td>
<td>C</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>potassium</td>
<td>K</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>titanium</td>
<td>Ti</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>barium</td>
<td>Ba</td>
<td>2</td>
</tr>
</tbody>
</table>
minerals are not added as the elements themselves. Most of the time, compounds of that element are the ones added to manufacture the food. Being so, it is the compound which is the one listed as the Ingredient.

Aside from the knowledge the students may gain in this activity, it is also hoped that the students acquire the habit of reading food labels. The food they eat has a major implication to their health and well-being. It is imperative then to be aware of what is taken in by the body. These are all listed in a food label. Therefore, reading food labels “matter”.

### Teaching Tips

- Ask the students to bring more food labels. The ones used in the activity are hoped to be only supplemental.
- As an assignment, the students can find product labels other than food such as medicine, household cleaning products, cosmetics and toiletries. They can identify elements and compounds listed on those labels.
- In the activity, the students will find out that the list of ingredients does not seem to contain those nutrients in the Nutrition Facts. The iron reported in chocolate candy is provided by the unsweetened chocolate/cocoa listed in the ingredient. This is an opportunity to emphasize that aside from knowing the name of the compound, it is an added advantage if they are familiar with the natural mineral content of the food. Some of them are listed in Table 2 of Module 3. It may also go the other way around. An ingredient is listed but does not have a counterpart in the Nutrition Fact. There may be two reasons for this. One is that the mineral is not that essential for health maintenance. The other is that the food product does not significantly provide that nutrient.

### Answers to Activity Questions

Note: Answers below are based on those labels provided in the activity. However, it is highly encouraged that the students use additional labels for reference.

<table>
<thead>
<tr>
<th>Food Product</th>
<th>Compound</th>
<th>Constituent Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal Drink</td>
<td>iron pyrophosphate</td>
<td>iron, phosphorus, oxygen</td>
</tr>
<tr>
<td></td>
<td>zinc sulfate</td>
<td>zinc, sulfur, oxygen</td>
</tr>
<tr>
<td>Chocolate candy</td>
<td>sodium bicarbonate</td>
<td>sodium, hydrogen, carbon, oxygen</td>
</tr>
<tr>
<td></td>
<td>calcium chloride</td>
<td>calcium, chlorine</td>
</tr>
<tr>
<td>Soy sauce</td>
<td>monosodium glutamate</td>
<td>sodium, carbon, hydrogen, nitrogen, oxygen</td>
</tr>
</tbody>
</table>
Most of the minerals added to the food are in the form of compounds, for it is more easily absorbed by the body if it is in such form. Being so, rarely that the element itself is added. However, there are food products which are fortified with element iron.

Iron in the blood is the one responsible in carrying oxygen from the lungs to the rest of the body. For the body to function well, oxygen is critically needed. Health officials had to find ways to ascertain that there is enough iron in the food. Besides, there was a time when a lot of people were stricken with anemia — sickness caused by a deficiency of iron. To address this, most of the food products especially milk and cereal were required to be fortified with iron. Some food are added with compounds of iron such as ferrous sulfate, ferric pyrophosphate, and ferrous fumarate. However, addition of some of these compounds affect the taste of the food. In effect, consumers may not buy or patronize the food product. Food technologists devised other ways to add iron to food products. One of which is to manufacture a food grade iron. This is the elemental iron which was subjected into a reduction process that makes it permissible to be added to food. Being the element iron itself, properties of this substance are retained such as its ability to be attracted by a magnet.

In this activity, students will be able to recover the iron present in a food product. Emphasize though that the iron in the food is safe to eat compared to the iron that makes up the concrete nail and other products that are not meant to be ingested. Also, the ones that will be recovered from the activity should not be ingested.

Most of the equipment needed for this activity may be available in your TLE laboratory. A video (http://curriculum.nismed.upd.edu.ph/2012/04/the-iron-y-of-food/) is provided in case the materials for this activity are not easily accessible/available.

**Answers to Activity Questions**

Q1. There are small, black pieces or bits that are attached to the magnet.

Q2. With its attraction to the magnet, it is highly possible that the black bits recovered from the food are pieces of iron.
PRE/POST TEST

1. Which of the following statements is TRUE?
   A. Ferrous sulfate cannot be broken down into simpler substances.
   B. Compounds are made up of one kind of element.
   C. Water is composed of more than two elements.
   D. Compounds are more complex than elements.

2. Which of the following statements is TRUE?
   A. Ferrous sulfate cannot be broken down into simpler substances.
   B. Compounds are made up of one kind of element.
   C. Water is composed of more than two elements.
   D. Compounds are more complex than elements.

For questions 3 to 5. Refer to the information below. You may also refer to the periodic table. Write the symbols only.

<table>
<thead>
<tr>
<th>Substance Symbol</th>
<th>Substance melts at</th>
<th>Substance boils at</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>850 °C</td>
<td>1490 °C</td>
</tr>
<tr>
<td>Cu</td>
<td>1083 °C</td>
<td>2600 °C</td>
</tr>
<tr>
<td>Fe</td>
<td>1540 °C</td>
<td>2900 °C</td>
</tr>
<tr>
<td>He</td>
<td>-270 °C</td>
<td>-269 °C</td>
</tr>
<tr>
<td>Mg</td>
<td>650 °C</td>
<td>1110 °C</td>
</tr>
<tr>
<td>NCl₃</td>
<td>-37 °C</td>
<td>71 °C</td>
</tr>
<tr>
<td>NO</td>
<td>-163 °C</td>
<td>-152 °C</td>
</tr>
<tr>
<td>Na₂CO₃</td>
<td>858 °C</td>
<td>890 °C</td>
</tr>
<tr>
<td>SiO₂</td>
<td>1610 °C</td>
<td>2230 °C</td>
</tr>
</tbody>
</table>

3. Which compound melts above 1000°C and boils above 2000°C?
4. Which element is gaseous at room temperature?
5. Which substance is liquid at 30°C?
Answer Key

1. D  2. B  3. SiO₂  4. He  5. NCl₃

References


In this module, students will get acquainted with the properties of a group of compounds—acids and bases. They will prepare plant indicators to help them determine the acidity or basicity of common household items. Upon completion of this module, students will be able to answer the following key questions that will allow them recognize the characteristic properties of acids and bases.

**Key questions for this module**

- How acidic or basic are common household materials?
- Does water from different sources have the same acidity?
- What is the effect of acid on metals?

Similar to Module 1, the activities have been developed in such a way that concepts are developed gradually from the first to the last activity. It starts with the students distinguishing between acidic and basic mixtures through the use of a plant indicator, which they will prepare. Using the plant indicator, they will determine the acidity or basicity of common household items as well as that of water from different sources. In Activity 2, students are guided to determine the pH of the solutions in Activity 1. In Activity 3, students will investigate the effect of an acid on a metal like iron. They will find out what happens after the metal has been in contact with the acidic mixture for some time.

**Activity 1**

*How can you tell if a mixture is acidic or a basic?*

This is a colorful activity that the students will enjoy. Instead of using litmus paper, which can only indicate if a sample is acidic or basic, the use of plant indicators has an advantage since these can specify a range of pH values.
This activity is divided into three parts. Part A allows the students to prepare the plant indicator and use it in Part B to determine the acidity or basicity of common household items. Similar to Part B, Part C gives the students the opportunity to test different water samples from various sources for acidity or basicity.

If you want the class to always have indicator paper available for use, then it is good to ask selected students to work on the following with the guidance of the teacher outside of their class time in Science.

**Preparing an eggplant/camote acid-base indicator paper**

*Note:* You may do this if you need to use an indicator to test samples in other science activities.

1. Pour the indicator solution prepared in Part A into a shallow plastic or ceramic container. (Do not use a metal container.)

2. Cover the entire filter or bond paper with the indicator solution by dipping the paper into the solution.

3. Air dry for about five minutes. (There is no need to air dry the paper completely at this point.)

4. Repeat procedure numbers 1 and 2 three times or until the color of the paper becomes dark.

5. Continue drying the indicator paper. When the paper is completely dry, cut the paper into small square pieces. This is your indicator paper. Keep it in a covered bottle.

6. Label the bottle properly (with name of material and date of preparation).

**Background Information on Indicators**

The red, purple, and blue colors of most flowers and some vegetables contain compounds called anthocyanins. A typical anthocyanin is red in acid, purple in neutral, and blue in basic solution. The eggplant extract shows yellow in a strong base since it contains anthoxanthins (colorless in acid, yellow in base) in addition to anthocyanins. Note that anthocyanins and anthoxanthins are usually present in many plants. The green color is a mixture of blue and yellow. Colors of anthocyanins in neutral to basic condition are very unstable. The purple, blue, and green colors will fade and eventually turn to yellow upon exposure to air.
Part A

- Only one of the suggested plants will be prepared by all groups in the class.
- If the other plants are available, you may assign some groups to use the other suggested plants that can be used as indicators.
- Emphasize the caution written in the “Take Care!” box.

Part C

- Instruct the students to use a wide-mouthed plastic container, about ½ liter capacity to collect water. The container for collecting water should be dipped or immersed about 6 inches or about 15 cm from the surface of the source of water.

### Table 1. Acidic or basic nature of household materials

<table>
<thead>
<tr>
<th>Sample</th>
<th>Color of indicator</th>
<th>Nature of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>calamansi</td>
<td>strongly acidic</td>
<td></td>
</tr>
<tr>
<td>tap water (water from the faucet)</td>
<td>weakly acidic</td>
<td></td>
</tr>
<tr>
<td>distilled water</td>
<td>neutral</td>
<td></td>
</tr>
<tr>
<td>vinegar</td>
<td>strongly acidic</td>
<td></td>
</tr>
<tr>
<td>sugar in water</td>
<td>weakly acidic or neutral (depending on the type of water used)</td>
<td></td>
</tr>
<tr>
<td>baking soda</td>
<td>basic</td>
<td></td>
</tr>
<tr>
<td>baking powder</td>
<td>basic</td>
<td></td>
</tr>
<tr>
<td>soft drink (colorless)</td>
<td>strongly acidic</td>
<td></td>
</tr>
<tr>
<td>coconut water (from buko)</td>
<td>weakly acidic</td>
<td></td>
</tr>
<tr>
<td>toothpaste</td>
<td>basic</td>
<td></td>
</tr>
<tr>
<td>shampoo</td>
<td>basic</td>
<td></td>
</tr>
<tr>
<td>soap</td>
<td>basic</td>
<td></td>
</tr>
</tbody>
</table>
This activity introduces students to another method that can be used to distinguish acids from bases. It is through the use of the pH scale, which extends from 0 to 14. Students simply need to use color range given for eggplant indicator in the student module.

**Reminder**

- It is recommended that preparation for Activity 3 be started the day before Activity 2 is done. This will ensure that students have three days to observe the changes in each setup of Activity 3.

**Activity 2**

**Color range, pH range**

This activity introduces students to another method that can be used to distinguish acids from bases. It is through the use of the pH scale, which extends from 0 to 14. Students simply need to use color range given for eggplant indicator in the student module.

**Teaching Tips**

- If a universal indicator paper is available, it would be good to use it also and compare the pH observed with that of the plant indicator.

- The excess plant indicator can be stored in a bottle and kept in a cool dark place or inside a refrigerator.

- The pH indicated in the answers for Table 3 may not be exactly the same as the pH observed using the plant indicator prepared by the students. This is acceptable as long as the nature of the sample (acidic or basic) is the same as expected. This means that a sample of calamansi may not have exactly pH 2, but it should still be in the strongly acidic range.
**Answers to Activity 2**

**Table 3. pH of samples from Activity 1**

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH based on eggplant/camote indicator</th>
<th>Acidic or Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>calamansi</td>
<td>pH 2</td>
<td>strongly acidic</td>
</tr>
<tr>
<td>tap water (water from the faucet)</td>
<td>pH 5 to 6</td>
<td>weakly acidic</td>
</tr>
<tr>
<td>Distilled water</td>
<td>around pH 7</td>
<td>neutral</td>
</tr>
<tr>
<td>vinegar</td>
<td>pH 2 to 3</td>
<td>strongly acidic</td>
</tr>
<tr>
<td>sugar in water</td>
<td>pH 6-7</td>
<td>weakly acidic to neutral</td>
</tr>
<tr>
<td>baking soda</td>
<td>pH 8 to 9</td>
<td>basic</td>
</tr>
<tr>
<td>baking powder</td>
<td>around pH 8</td>
<td>basic</td>
</tr>
<tr>
<td>soft drink (colorless)</td>
<td>pH 2 to 3</td>
<td>strongly acidic</td>
</tr>
<tr>
<td>coconut water (from buko)</td>
<td>pH 5</td>
<td>weakly acidic</td>
</tr>
<tr>
<td>toothpaste</td>
<td>pH 8 to 9</td>
<td>basic</td>
</tr>
<tr>
<td>shampoo</td>
<td>pH 8 to 9</td>
<td>basic</td>
</tr>
<tr>
<td>soap</td>
<td>pH 8 to 9</td>
<td>basic</td>
</tr>
</tbody>
</table>

Answers to Part C will depend on the sources of water, so pH will depend on the specific water sample tested by the student.

**Activity 3**

**What happens to metals when exposed to acids?**

**Answers to Activity Questions**

Q1. There are three different bottles for each sample of iron nail to make sure that replicate data are gathered for the setups.

Q2. At the end of 3 days, the iron nail has rust all over its sides, head, and tip.

Q3. When iron rusts, it produces a characteristic flaky red-brown solid, commonly called iron rust.
PRE/POST TEST

1. Arrange the following household items: toothpaste, milk, tap water, vinegar from the most acidic to most basic?
   a. tap water, milk, toothpaste, vinegar
   b. milk, tap water, vinegar, toothpaste
   c. toothpaste, milk, tap water, vinegar
   d. vinegar, tap water, milk, toothpaste

2. Arrange the household items in question number (1) from the item with the highest pH to the one with the lowest pH.

3. Give a reason why farmers need to know how acidic or basic the soil is before they plant their crop.

4. Give at least two (2) safe ways you should practice when you handle an acid, like muriatic acid.

5. Why does “rust” form on some metallic materials?

Further Explanation on Rusting of Iron

Rust is hydrated iron or iron (III) hydroxide, Fe(OH)_3, sometimes written as Fe_2O_3·3H_2O. This layer does not securely stick to the surface of the iron. It flakes off, weakening the metal and leaving it exposed to further rusting and structural decay.

Iron forms rust upon prolonged exposure to oxygen and moisture in the air and in the presence of acid. Recall that the acid used in Activity 3 is vinegar, which is about 4.5 to 5% acetic acid.

Note that you do not need to let the students memorize the chemical formula of iron rust. It is sufficient for Grade 7 students to know that rust is hydrated iron or iron hydroxide.
Answer Key

1. (d) vinegar, tap water, milk, toothpaste
2. toothpaste, milk, tap water, vinegar
3. Any one of the answers below is considered correct.
   (a) Some plants grow well in acidic soil while others prefer basic soil. Farmers need to know the pH of their soil since plants will only grow in a specific pH range.
   (b) The pH also affects how much nutrients from the soil become available to plants.
4. Any two of the following answers is considered correct.
   (a) Do not take internally (Do not taste nor drink).
   (b) Avoid contact with eyes, nose and mouth.
   (c) Use only in well ventilated areas.
   (d) Always keep the container tightly sealed.
   (e) Do not store in a warm place.
   (f) Keep out of reach of children.
5. A metal like iron forms rust when exposed for a long time to oxygen and moisture in the air and in the presence of an acid.

References


Heyworth, R. M. (2000). *Explore your world with science discovery 1*. First Lok Yang Road, Singapore. Pearson Education South Asia Pte Ltd.


Students are already familiar with metals. They have encountered a lot of this during their early grade levels. In fact, they use metals as one of the segregation scheme when they were starting the habit of 5Rs — reduce, reuse, recycle, recover and repair. Appearance was their primary basis when they identify metals. In this module, students will broaden their knowledge on the properties of metals. They will learn additional characteristics of metals. They will find out that these are also elements. Moreover, they will find out that not all elements exhibit such properties. Most of them have highly contrasting properties with that of metals. As such, they were referred as nonmetals.

Key questions for this module

How are metals different from nonmetals?
How are they similar?

A series of activities will gear the students in answering the questions above. With the hope that students will find connection between the topics they have learned in the lower grade levels to the ones they are about to learn, a simple activity on identifying the metals around them will be done. It is expected that they will be basing it on the appearance of the material. Other simple activities are interspersed within the student module to learn more properties exhibited by different metals. They will verify if such properties are truly exhibited by metals. For instance, they will bring close a magnet to different samples of metals. They will find out that not all of these properties are exhibited by metals. The main activity highlights the property that is common to all metals — electrical conductivity. It will be followed by another activity that will likewise differentiate a metal and a nonmetal.
Prior to this activity, the students must have learned that metals share a number of common properties. However, not all of the metals exhibit these properties. For instance, only some metals are magnetic. The common ones are iron, nickel and cobalt.

In this activity, students will learn that there is a property that all metals possess — electrical conductivity. This is the ability of a material to allow electricity to pass through it. They will use an improvised electrical conductivity tester to check for such property. You will find below how to construct one from commonly available materials.

**Activity 1**

**Which can conduct electricity, metals or nonmetals?**

Prior to this activity, the students must have learned that metals share a number of common properties. However, not all of the metals exhibit these properties. For instance, only some metals are magnetic. The common ones are iron, nickel and cobalt.

In this activity, students will learn that there is a property that all metals possess — electrical conductivity. This is the ability of a material to allow electricity to pass through it. They will use an improvised electrical conductivity tester to check for such property. You will find below how to construct one from commonly available materials.

**Reminder**

- The sound (and light) indicates that a material is electrically conductive. The stem of the tester is electrically conductive. Please see figure on the right. Make sure that the tips of the conductivity tester are not touching each other especially when testing the sample material.

**Teaching Tips**

- Acquaint the students with the electrical conductivity tester before starting the activity. Allow them to try having the tips of the tester touch each other. Ask them about what they observe. This will help emphasize the reminder stated above.
After processing the activity, you may go back to the reminder set for this activity. Ask the students again why they were asked not to let the tips of the electrical conductivity tester touch each other. What could be the material of the stem of the conductivity tester? (Metal.)

The students can find other objects around them to test using the improvised electrical conductivity tester; and identify these objects if these are made up of metals or nonmetals.

Students have to understand the concept of conductivity, that is, a material is conductive if it allows something to pass through it. In the case of electrical conductivity, it is electricity that is allowed to pass. A material may also allow heat to pass through it. In this case, the material is said to be thermally conductive. However, the concept of being thermal has not been formally introduced to the students. Being so, describe the elements that are thermally conductive as heat conductors. The term thermal conductivity is the one used for many references, so for familiarity purposes, the term is mentioned. Moreover, when they have to find the values from different references, these are referred as thermal conductivity values. During the 3rd quarter (physics), the student will learn more about conductivity.

Show students pictures of some metals and nonmetals. You may refer to some of the books and websites listed at the end page of this guide. They may give other descriptions of the elements such as physical state at standard conditions and color. If possible, use real samples.

**Teaching Tips**

**Answers to Activity Questions**

Q1. Aluminum, copper and iron look like metals; while iodine and sulfur look like nonmetals.

Q2. Aluminum, copper and iron are electrical conductors; while iodine and sulfur are nonconductors of electricity.
Construction of an Improvised Electrical Conductivity Tester

Materials Needed

- alcohol lamp
- stripping knife
- pliers (long nose)
- musical greeting card
- insulated copper wire, 2 pcs (2.0 mm in diameter, 24 cm long);
- 2 pcs wood/chopstick (1 cm x 1 cm)
- thick iron nail, 7 cm long, 3 mm thick

Procedure

1. Using pliers and a stripping knife, remove about 6 cm of the insulation of the copper wire on one end. At the other end of the wire, remove about 15 cm of the insulation.

![stripped end](image1)

Fig. 1

2. Measure four 1.5 cm length on the 6 cm stripped portion of the copper wire. Mark these lengths as L1, L2, L3, and L4.

![Fig. 2](image2)

Fig. 2

3. Using a pair of pliers, completely turn L1 180° angle until its end touches the L2 side of the wire. Turn L3 opposite to L1. Lastly, bend L4 in the opposite direction so that four zigzag bends are formed. See Figure 3. Do this for both wires.

![Fig. 3](image3)
4. Open the musical greeting card and carefully remove the integrated circuit by cutting out the paper on which the IC is attached.

![Fig. 4](image)

5. Lift the long metal sheet of the switch part of the IC. Fold it to expose the negative (-) terminal of the switch. Retain the dry cell.

See Figure 5.

![Fig. 5](image)

6. Clip the metal electrodes on the IC, one on the positive (+) terminal and the other on the negative (-) terminal. Place a block of wood or plastic or any insulator between the two electrodes and fix it by taping. See Figure 6.

![Fig. 6](image)
This activity reinforces the idea learned from Module 3, that is, compounds may be formed when elements combine. Hence, metals and nonmetals, being elements, may form compounds. Combining with oxygen, a metal or a nonmetal may form an oxide. However, the acidity differs depending on the nature of this oxide. This, again, is a defining characteristic of a metal and a nonmetal. A metal oxide is generally basic; while a nonmetal oxide is acidic.

Moreover, the activity will allow the students to apply their learning in Module 4. They will test the acidity of their samples. It is very important that they know how to interpret the color changes of the acid/base indicator. The litmus paper is suggested to be used in this activity. However, you may use other acid/base indicators that are more available in your school. You may refer to Module 4 for some of these indicators.

**Answers to Activity Questions**

Q1. Magnesium is a metal.
Q2. The red litmus paper changed its color to blue.
Q3. The oxide of magnesium is basic.
Q4. Sulfur is a nonmetal.
Q5. The blue litmus paper changed its color to red.
Q6. The oxide of sulfur is acidic.
PRE/POST TEST

1. Which of the following elements is most likely ductile at room temperature?
   A. Sulfur  
   B. Mercury  
   C. Nitrogen  
   D. Aluminum

2. An element was subjected into flame and the acidity of the oxide formed was tested. Solution of this oxide turned red litmus paper to blue. Which is most likely that element?
   A. Chlorine  
   B. Nickel  
   C. Phosphorus  
   D. Silicon

For questions 3 to 5. Refer to the information below. Write the symbols only.

<table>
<thead>
<tr>
<th>Element Symbol</th>
<th>MP (°C)</th>
<th>BP (°C)</th>
<th>Electrical conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>660</td>
<td>2450</td>
<td>Good</td>
</tr>
<tr>
<td>Br</td>
<td>-7</td>
<td>58</td>
<td>Poor</td>
</tr>
<tr>
<td>Ca</td>
<td>850</td>
<td>1490</td>
<td>Good</td>
</tr>
<tr>
<td>Cl</td>
<td>-101</td>
<td>-35</td>
<td>Poor</td>
</tr>
<tr>
<td>Cu</td>
<td>1083</td>
<td>2600</td>
<td>Good</td>
</tr>
<tr>
<td>He</td>
<td>-270</td>
<td>-269</td>
<td>Poor</td>
</tr>
<tr>
<td>Fe</td>
<td>1540</td>
<td>2900</td>
<td>Good</td>
</tr>
<tr>
<td>Pb</td>
<td>327</td>
<td>1750</td>
<td>Good</td>
</tr>
<tr>
<td>Mg</td>
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<td>1110</td>
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<tr>
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<td>-39</td>
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</tr>
<tr>
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<td>Poor</td>
</tr>
<tr>
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<td>Poor</td>
</tr>
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<tr>
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</table>

3. Which metal is liquid at room temperature?
4. Which nonmetal is liquid at room temperature?
5. List the nonmetals in order of increasing boiling point.
Answer Key

1. D
2. B
3. Hg
4. Br
5. He, N, O, Cl, Br, P, S

References


