MODULE 2: SUBSTANCES AND MIXTURES

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>
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<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>
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<tr>
<td>• organizing and tabulating data</td>
<td>• using the correct technique in making temperature readings</td>
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<tr>
<td>• comparing and contrasting behaviors of substances and mixtures</td>
<td>• setting up equipment for boiling and melting samples</td>
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<tr>
<td>• classifying samples as mixtures and substances</td>
<td>• constructing an improvised equipment</td>
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<tr>
<td>• plotting and interpreting line graphs</td>
<td>• stating a generalization based on observations or data which are consistent in a number of trials</td>
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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 glassware that were not previously used for harmful chemicals. The students will be asked to taste a portion of the distillate.
### Teaching Tips

- **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.
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.
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.

- 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).
• 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.

• 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.
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.
Teacher’s Guide
Module 2: Substances & Mixtures

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.

Teaching Tips

• 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.)
  ▪ 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><strong>Liquid</strong></th>
<th><strong>Solid</strong></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-</td>
</tr>
<tr>
<td></td>
<td>seawater</td>
<td>monosodium glutamate*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>benzoic acid-white sugar*</td>
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*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.
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**

1. D
2. A
3. C
Reference


