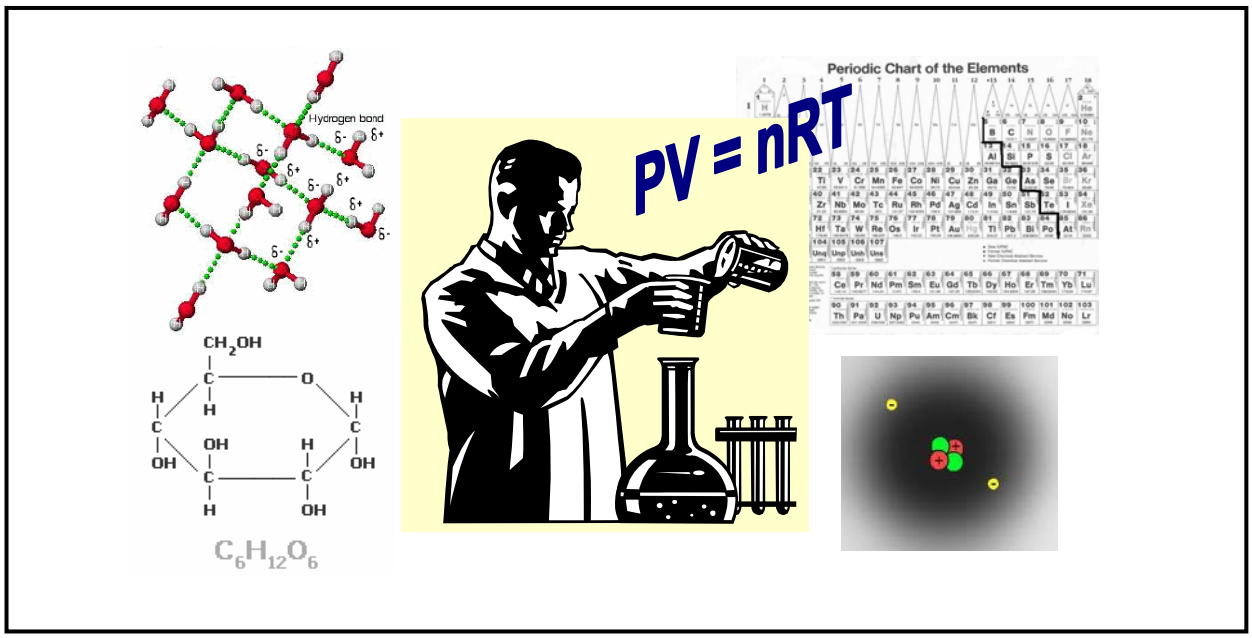
Project EASE

(Effective Alternative Secondary Education)

CHEMISTRY



MODULE 4

Mixed Matter

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Module 4
Mixed Matter

What this module is about

What are your favorite dishes? Are you fond of eating sinigang, bulalo, adobo, chopsuey and lumpia? What about your favorite dessert? Do you like gelatin, leche flan or buco salad? The dishes and desserts mentioned are mouth-watering examples of mixture. Do you know what a mixture is?

This module aims to guide you in describing a mixture and in classifying different types of mixture. It is also designed to help you in identifying the different methods of separating mixtures. So, read and learn more about the following lessons:

- **Lesson 1** – **What is a Mixture?**
- **Lesson 2** – **What are the Types of Mixture?**
- **Lesson 3** – **What are the Ways of Separating Components of Mixtures?**

What you are expected to learn

After going through this module, you should be able to:

1. define mixture operationally;
2. cite examples of mixture;
3. name and differentiate the types of mixture;
4. classify mixture as solution, colloid or suspension based on its characteristics;
5. discuss the different ways of separating the components of mixtures; and
6. infer that useful materials can be recovered when separating mixtures.

How to learn from this module

I am sure that you are already eager to get started. However, there are some things that you need to remember to learn most from this module.

1. Take the pre-test before proceeding to the lessons. Your score in the test will give you an idea how much time you need to devote to each lesson.
2. Read the instructions and bear in mind precautionary measures.
3. Before doing the activities, make sure that the materials are already prepared.
4. Answer the Self-Test and compare your answers to the key to correction.
5. Don't forget to answer the post-test since it would somehow gauge how much you have learned from the module.

Enjoy reading!

What to do before (Pretest)

A. Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following best describes a mixture?
   a. It exhibits Tyndall effect.
   b. It is a homogeneous system.
   c. Its components are present in fixed proportion.
   d. It is a physical combination of two or more substances.

2. Which is an example of mixture?
   a. dew
   b. sugar
   c. iodine crystals
   d. rubbing alcohol

3. Of the types of mixture, which exhibits Tyndall effect?
   a. colloid
   b. solution
   c. suspension
   d. all of the above

4. Air is to solution as _____ is to colloid.
   a. oil
   b. halo-halo
   c. marshmallow
   d. aqua oxinada

5. Which does **NOT** belong to the group?
   a. smoke
   b. soft drink
   c. mayonnaise
   d. toothpaste

B. Matching Type. Match the mixture in Column A with the separation method in Column B.

Column A	Column B
1. Salt solution	a. Evaporation
2. Iron filings and sulfur	b. Filtration
3. Ink	c. Decantation
4. Muddy water	d. Use of magnet
5. Sweetened camote and banana	e. Distillation
	f. Chromatography
	g. Hand picking/Scooping
	h. None of these

Key to answers on page 16.

Lesson 1. What is a Mixture?

A Collage of the Different Samples of Mixture

Mayonnaise, ink, glue, muddy water, air, smoke and chopsuey have one thing in common. They are all examples of mixture! To give you an idea on how things around us can be classified as mixture, why don't you perform Activity 1.1?

What you will do

Activity 1.1

Materials Needed:

sugar	glasses
water	fork
oil	teaspoon
egg yolk	mothballs

Procedure:

1. Put one teaspoon of sugar in a glass with water and then stir. Describe what happens.
   _____
   _____

2. Get another glass and fill it with water. Then, place some mothballs in it. Record your observations.
   _____
   _____

3. Mix 1 tablespoon of oil and 2 tablespoons of water. Observe. Now, add one tablespoon of egg yolk. Using a fork, continuously beat the mixture. Describe what happens.
   _____
   _____

Have you done activity 1.1? If yes, then we may now discuss your observations…

In Procedure A, what happens to sugar when mixed with water? Yes, you are right! The sugar dissolves in water. Therefore, what is in the glass is not just water but a physical combination of sugar and water.

In Procedure B, the mothballs (naphthalene) did not dissolve in water. But just the same, the glass does not only contain water but a combination of water and mothballs.

In Procedure C, did you notice that at first, oil and water did not mix? But, when the egg yolk was added, they mixed! The egg yolk here acts as an emulsifying agent that allows the oil and water droplets to mix and form a colloid.

Sugar and water, mothballs and water, and oil and water and egg yolk have one thing in common, and that is, their components are just physically combined. In science, we call the physical combination of two or more pure substances as **mixture**. You have learned earlier in module 2 that sugar, naphthalene and water are just some of the examples of pure substances.

Can you now explain why air, salt solution, soft drinks, muddy water, and marsh mallows are classified as mixtures?

Other Characteristics of Mixtures

Aside from mixture being just a physical combination of two or more substances, can you cite other characteristics of mixture?

Let’s find out by doing activity 1.2!

What you will do

Activity 1.2

Materials Needed: sugar, water, 3 glasses, spoon

Procedure:

1. Label the glasses as Glass A, Glass B, and Glass C.
2. Fill Glass A with water and then add one tablespoon of sugar. Stir.
3. Fill Glass B with water and then add a pinch of sugar. Stir.
4. Half fill Glass C with water and then add one tablespoon of sugar. Stir.

Glass A, B, and C contain sugar solution. However, notice that in each glass, the amount of water and sugar vary. What does this indicate? It just shows that unlike the compounds, the components of mixture can be mixed in any proportion.

Let us further examine each of the three glasses. Compare the appearances of the sugar solution in Glass A, Glass B, and Glass C. What do you observe? Yes, the mixture are all colorless! Why? Because water is colorless. Now, why don't you taste each of the sugar solution in the three containers? What have you discovered? Yes, they are all sweet! Why? Simply because sugar is sweet. What does this tell us regarding mixtures? This only proves that the characteristics of the components of a mixture are retained in the mixture.

To further describe mixtures, why don't you perform activity 1.3?

What you will do

Activity 1.3

Materials Needed: salt, water, glass, spoon, casserole

Procedure:

1. Put a tablespoon of salt in a glass of water. Stir. Describe what happens to the salt.

   _____

   _____

2. Put the mixture of salt and water in a casserole.
3. Heat the casserole. Caution: Be Careful!
4. While heating, observe what happens to the solution.

As what you have noticed, salt dissolves in water. Salt and water is more popularly known as salt solution and it is an example of mixture.

What happens when the salt solution is heated? When the solution is heated, the water evaporates. After some time, a white residue can be seen in the casserole. Do you know what the white residue is? Right! It is the salt. Notice that when heat is applied to salt solution, its components (salt and water) are recovered. What does this imply? It implies that mixtures can be separated by ordinary physical process i.e. evaporation. Why? Because mixture is just a physical combination of pure substances.

You'll be learning about ways of separating components of mixture in lesson 3.

Remember!

- Mixture is a physical combination of two or more pure substances.
- The components of mixture can be mixed in any proportion.
- The characteristics of the components of mixture are retained in the mixture.
- Mixture can be separated by ordinary physical processes.

What you will do

Self-Test 1.1

Which of the following can be classified as a mixture?

1. Sinigang
2. Rubbing alcohol
3. Vinegar
4. Ice
5. Copper wire

Key to answers on page 16.

Lesson 2. What are the Types of Mixture?

Mixtures can be further grouped into three, namely: solution, colloid, and suspension. The three types of mixtures have actually been introduced in activity 1.1. Sugar solution (sugar and water) is an example of a solution whereas mothballs in water is a suspension. On the other hand, the mixture of oil, water, and egg yolk is an example of a colloid.

To compare and contrast the three types of mixtures, let us perform Activity 2.1.

What you will do

Activity 2.1

Materials Needed: flash light, salt solution, sand in water, glue or paste, 3 glasses

Procedure:

1. Label the glasses as glass A, B, and C.
2. Put salt solution in Glass A, sand and water in Glass B, and glue in glass C.
3. Using the flashlight, let a beam of light pass through the mixture in glass A. Record your observations.

   _____
   _____
   _____

   Note: For best results, do this in a dark room or you can do it at night.
4. Repeat step 3 to glass B and C.

As you have discovered in Activity 2.1, only the glue or paste scatters light. Why? Glue or paste is an example of a colloid. Among the types of mixtures, only colloids exhibit Tyndall effect that is best described as the scattering of light. This characteristic of colloid is responsible for the magnificent view that one can see when sunlight penetrates a cloud cover.

Why is it that only colloids exhibit Tyndall effect? Let us carefully observe again the mixtures that you have prepared in Activity 2.1……..What can you say regarding the particles of salt in water? What about the sand in water? How about in glue or paste?

On Particle Size

The particles of salt are too small to be seen by the naked eye. These particles are also uniformly distributed in water thus a homogeneous single phase is yielded. Because of the smallness of the particles, the beam of light just passed through them. The beam of light is not that visible. Thus, scattering of light is not exhibited by solutions.

Aside from sugar solution, air, salt solution and rubbing alcohol are some examples of solutions.

What you will do

Self-Test 2.1

Can you name five more examples of solution?

Key to answers on page 17.

The particles of suspension (i.e. sand in water) are relatively large and are visible to the naked eye. These particles usually settle on standing, which is a proof that it is influenced by gravity. Moreover, the rate of settling is dependent on particle size. Between coarse and fine sand, the former is expected to settle at a faster rate than the latter. Since suspension has more than one distinct phase, this kind of mixture is considered heterogeneous. Now, what happens to light as it passes through a sample of suspension? Right! The light is blocked due to the relatively large size of the particles of suspension. Thus, just like solution, suspension does not demonstrate Tyndall effect.

Aside from sand in water, halo-halo, sinigang and bulalo are other examples of suspension.

What you will do

Self-Test 2.2

Can you cite 5 more examples of suspension?

Key to answers on page 17.

The particle size of colloids is intermediate between solution and suspension. It is not as small as the particles of solution but not as big as the particles of suspension. Generally, the colloidal particles are ten to 100 times bigger than that of the particles of solution. The typical range of the colloidal particle size is from about 1 nm (nanometer) to 1000 nm. These particles are evenly distributed or dispersed in another substance and unlike suspension, the particles do not settle on standing. This is because the colloidal particles are charged and they carry the same charge. As such, they repel one another and they do not combine to form particles that are large enough to precipitate. A simple analogy that you can think of here is when you have two magnets that are of the same pole. Do you

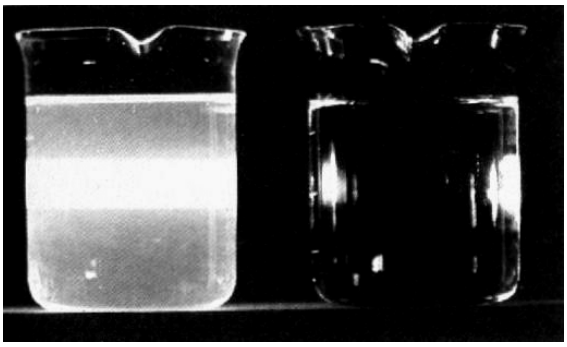
expect them to attract one another? Of course not! Similarly, the behavior of colloidal particles would be like that of the magnets!

What you will do

Self-Test 2.3

Is a colloid homogeneous or heterogeneous? Briefly explain you answer.

The size of the colloidal particles gives colloids some unique characteristics that can be used to distinguish them from solutions. One of which is Tyndall effect. Notice that the beam of light that passes through the sample of colloid becomes visible. The light also becomes wider! Why is this so? The light is partially scattered and reflected by the evenly distributed colloidal particles. Thus, only colloid exhibits Tyndall effect.



Picture of a beam of light that passes through a sample of colloid

Aside from glue, mayonnaise, gelatin and marshmallow are some examples of colloids. Based from these examples, it would appear that colloids are homogeneous but actually they are not. Just like suspension, colloid is made up of more than one distinguishable phase and as such it is also heterogeneous. However, the distinguishable phases of matter in colloid can only be seen under the microscope since, as earlier described, the colloidal particles are small as well.

What you will do

Self-Test 2.4

Can you cite at least three examples of colloids?

Key to answers on page 17.

What you will do

Self-Test 2.5

Classify the following mixtures as to its type.

1. milk
2. paint
3. mongo seeds in water
4. brine
5. sago at gulaman

Key to answers on page 17.

Remember!

- There are three types of mixtures, namely: solution, suspension and colloid.
- The particles of solution are very small while those in suspension are relatively large.
- The size of colloidal particles is intermediate between solution and suspension.
- The size of colloidal particles gives colloid some unique characteristics that can be used to distinguish it from solution.
- Only colloids exhibit Tyndall effect, which is the scattering of light.

Lesson 3. What are the Ways of Separating Components of Mixtures?

Do you still recall your observations in Activity 1.3? Do you still remember some key concepts that you have learned from the activity? Correct! In Activity 1.3, you have discovered that salt solution could be separated into its components (salt and water). Were you able to recover the salt? Yes! It was the white residue left on the casserole. The white residue was the same salt that you mixed with water to come up with salt solution. What about the water? Were you able to recover it? You were not able to recover it since what you used in separating the components of salt solution was evaporation. Naturally, the water in the solution absorbed heat and after some time it evaporated. So, the water went into the surroundings in the form of water vapor.

From Activity 1.3, you realize that the components of mixture can be separated by ordinary physical processes like evaporation. By separating mixtures, useful substances can be recovered. For instance, if we run out of salt we can just get seawater and boil off the water in the solution so as to recover salt which can be used as seasoning. Now, do you want to know other methods of separating the components of mixture? Then, please proceed to Activity 3.1.

What you will do

Activity 3.1

Materials Needed: yellow mongo seeds
green mango seeds
bowl/container

Procedure:

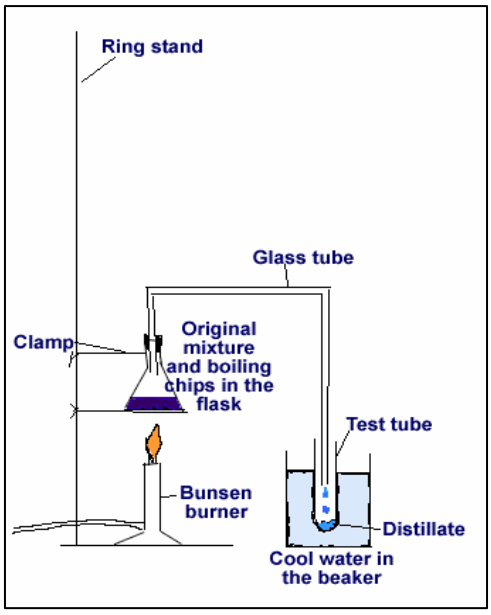
1. Put the yellow and green mongo seeds in a bowl. Then, mix them well.
2. Now, think of a way by which you could best separate the yellow from the green mongo seeds.

How did you separate the green from the yellow mongo seeds? Very good! The best way to separate them is through hand picking. Hand picking is considered as one of the methods of separating components of a mixture. Can you think of other mixtures that can be separated by the said method?..... What about halo-halo? How would you be separating the components of halo-halo? Would you resort to hand picking? Somewhat similar to hand picking can be used, but instead of using your bare hands, a utensil, e.g. spoon, can be used. Thus, the process is known as scooping.

What about if you have a mixture of a metallic and a nonmetallic substance? How will you separate them? Let us say that you have pulverized charcoal combined with very small pieces of copper wire, how will you separate these components? Will you be using hand picking or scooping? Of course not! What can you use to separate the two? Right! You may use a magnet. Since one component is metallic and the other is nonmetallic, then the magnet will only be attracting the copper wire, and presto! The pulverized charcoal will be left in the container.

Salt solution can be separated by evaporation. However, a more appropriate method can be used to separate its components. This method is known as **distillation**. Just like evaporation, distillation is also used to separate solids that are soluble in a liquid.

At the right is a simple distillation set-up that you can do when you go back to school. Notice that in the set-up, the test tube containing the solution is covered with a cork/rubber stopper. The stopper has a hole in the center and inserted in the hole is a glass tubing. The glass tubing maybe connected to a rubber tubing which in turn is placed in another test tube. The second test tube, which is the receiving container, is submerged in a beaker with cold water.



Simple Distillation Set-up
(Adapted from:http://www.saskschools.ca/curr_content/science10/images/distillation.gif)

Why should the set-up be like this? Let us say that the first test tube contains salt solution. When heat is applied to the first test tube, the water in the solution will evaporate. Since the test tube is covered, the water vapor will not be able to escape and instead it will be directed towards the glass tubing and eventually into the second test tube. The second test tube is immersed in cold water thus the temperature of water vapor is lowered until it condenses back to the liquid phase. So, in the second test tube you are able to get back the water. And when all the water in the solution evaporated, what will be left in the first test tube is the salt.

Caution: You can do this activity in school! Make sure that the heat is applied evenly in the first test tube or else the test tube may crack. Use only Pyrex test tubes and make sure that you seek for your teacher's consent and supervision when doing this activity!

Earlier, it was mentioned that distillation is a more appropriate method in separating the components of salt solution. Why? In distillation, you can recover both the salt and the water!

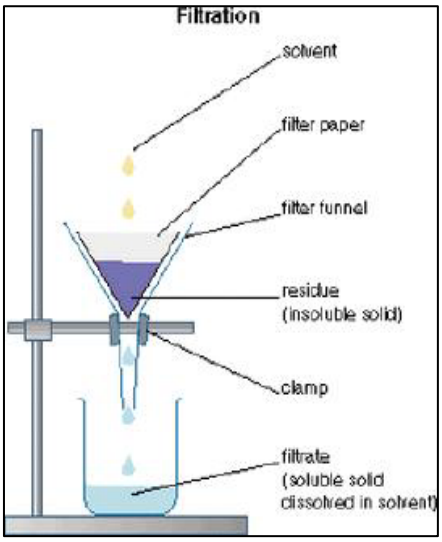
Mixtures that are made up of insoluble solids in a liquid can be separated by **filtration** or **decantation**. Examples of mixtures that can be separated by the said processes are muddy water and sand in water.

You can do this at home! Try this and have fun!

How is decantation done? For instance, you have sand in water. To separate the components of this mixture, let the sand settle down. When all the particles have settled down, carefully pour off the liquid into another container. And presto, you will be able to get back both the sand and water!

What about filtration? **Filtration** is a process that separates the insoluble solid in liquid by letting it pass through a filter paper, which is placed inside a funnel. You may look at the set-up below for reference. However, you cannot do this set-up at home since you may not have a filter paper. You may just do this when you go back to school.

In this setup, the small particles of the liquid will pass through the filter paper while the bigger solid particles will be left on the filter paper. The one left on the filter paper is the residue while the liquid that is collected is the filtrate.



(Image adapted from:
http://www.tiscali.co.uk/reference/encyclopaedia/hutchinson/images/0008n027.jpg)

Do This!

Sedimentation and **centrifugation** can also be used in separating mixtures, which are composed of an insoluble liquid in water. Now, why don't you go to your library and read more about these two processes. Make sure that you'll be able to differentiate these two from decantation and filtration.

Write whatever you have discovered in a sheet of paper and submit it to your teacher.

Is ink a mixture? If it is a mixture then how do we separate its components? Let us perform Activity 3.2.

What you will do

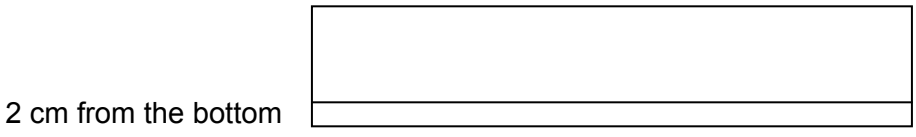
Activity 3.2

Materials Needed:

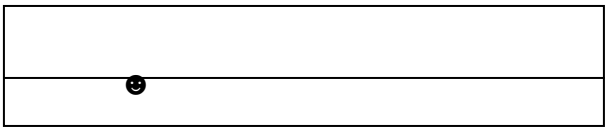
jar
rubbing alcohol
mimeographing paper (if this is not available, you can use an ordinary bond paper)
ball pens – red and black
ruler
pencil
pair of scissors

Procedure:

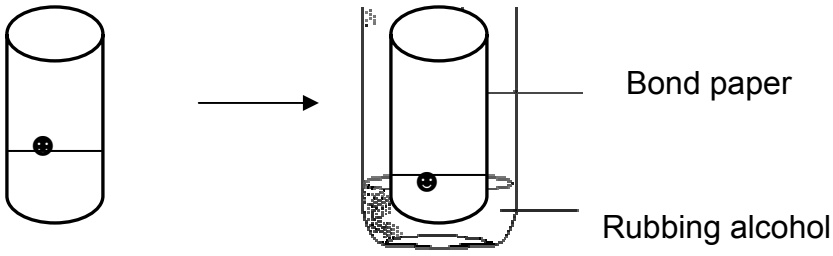
1. On the bond paper or mimeographing paper, draw a rectangle whose measurements are 6 in by 8 in.
2. Cut the rectangle. Then, draw a line 2 cm from the bottom of the rectangle. Use pencil in drawing the line.



3. Cut the ball point of the pen and then let the tip of the ink tube touch the line on the bond paper. Notice that you are able to put some ink. Put some more ink on the same spot and then let it dry.



4. Do step 3 but this time use the other ball pen.
5. Then attach both ends of the paper with the use of the staple wire.



6. Put the paper into a jar with rubbing alcohol. Make sure that the rubbing alcohol does not touch the ink.

Did you notice the different colors that make up your red ink? What about the black ink? These different colors are actually the components of the ink and you are able to separate them by paper chromatography. **Paper chromatography** is a separation technique that uses paper as the stationary phase and a liquid solvent (in our experiment, it's the rubbing alcohol!) as the mobile phase.

The solvent is the mobile phase since it moves slowly along the surface of the paper. And since the ink spot, which is on the paper, is soluble in rubbing alcohol then the ink will be dissolved once the solvent moves over it. The ink will move along with the solvent. Each component of the ink has its own characteristic and will be moving along the solvent at its own rate. The difference in the rates of the components of the ink makes it possible for the components of the mixture to be separated.

Let's Summarize

Did you enjoy reading the module? I hope so….Now, it is time to summarize what you have learned from the lessons and activities.

1. Mixture is a physical combination of two or more pure substances.
2. The components of mixture can be mixed in any proportion.
3. The characteristics of the mixture are a blend of the characteristics of the pure substances comprising the mixture.
4. Mixtures can be further grouped into three, namely: solution, colloid, and suspension.

5. The particles of a solution are too small to be seen by the naked eye. Because of the smallness of the particles, the beam of light just pass through them. The beam of light is not that visible. Thus, scattering of light is not exhibited by solutions.
6. The particles of suspension (e.g. sand in water) are relatively large and are visible to the naked eye. These particles usually settle on standing, which is a proof that it is influenced by gravity. Just like solution, suspension does not demonstrate Tyndall effect.
7. The particle size of colloids is intermediate between solution and suspension. It is not as small as the particles of solution but not as big as the particles of suspension.
8. The size of the colloidal particles gives colloids some unique characteristics that can be used to distinguish them from solutions. One of which is the Tyndall effect.
9. Only a colloid exhibits Tyndall effect, which is the scattering of light.
10. Ordinary physical processes like evaporation, distillation, use of magnet, hand picking, filtration, decantation, scooping and paper chromatography can be used in separating the components of mixture.

Posttest

A. Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following is **NOT** a characteristic of a mixture?
    a. It may be homogeneous or heterogeneous.
    b. Its components are present in any proportion.
    c. It is a physical combination of two or more elements.
    d. Its components can be separated by simple chemical processes.

2. Which is an example of a mixture?
    a. wine
    b. table salt
    c. table sugar
    d. baking soda

3. Which is an example of a suspension?
    a. glue
    b. gelatin
    c. soft drink
    d. muddy water

4. Which does not belong to the group?
    a. Salt : Solution
    b. Gel : Colloid
    c. Salad : Mixture
    d. Muddy water : Suspension

5. Which of the following gives colloids some unique characteristics that can be used to distinguish them from solution and suspension?
   a. Its density.
   b. Its volume.
   c. Its boiling point.
   d. Its particle size.

B. Matching Type. Match the mixture in Column A with the separation method in Column B.

Column A	Column B
1. Dye	a. Evaporation
2. Vinegar	b. Filtration
3. Sand in water	c. Decantation
4. Muddy water	d. Use of magnet
5. Iron filings and powdered charcoal	e. Distillation
	f. Chromatography
	g. Hand picking
	h. None of these

Key to answers on page 17.

Key to Answers

Pretest

Part A	Part B
1. d	1. e
2. d	2. d
3. a	3. f
4. c	4. b
5. b	5. g

Lesson 1

Self-Test 1.1

1, 2 and 3 are mixtures.

Lesson 2

Self-Test 2.1

Answers may vary. Probable answers are vinegar, soft drink, bronze, jewelry, alloy and many others

Self-Test 2.2

Answers may vary. Probable answers are sago at gulaman, apog in water, bagoong na isda, gawgaw in water, black pepper in water and others.

Self-Test 2.4

Answers may vary. Probable answers are smoke, fog, paint, paste and others.

Self-Test 2.5

1. colloid
2. colloid
3. suspension
4. solution
5. suspension

Posttest

Part A	**Part B**
1. d	1. f
2. a	2. e
3. d	3. c
4. a	4. b
5. d	5. d

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