

Solutions and Suspensions

(Sessions I and II)

BROWARD COUNTY ELEMENTARY SCIENCE BENCHMARK PLAN

Grade 5—Quarter 1

Activities 3 & 4

SC.A.1.2.4

The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

SC.A.2.2.1

The student knows that materials may be made of parts too small to be seen without magnification.

SC.H.1.2.2

The student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results.

SC.H.1.2.3

The student knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions.

SC.H.1.2.4

The student knows that to compare and contrast observations and results is an essential skill in science.

ACTIVITY ASSESSMENT OPPORTUNITIES

The following suggestions are intended to help identify major concepts covered in the activity that may need extra reinforcement. The goal is to provide opportunities to assess student progress without creating the need for a separate, formal assessment session (or activity) for each of the 39 hands-on activities at your grade.

- 1. Session I—Activity 3:** Have students predict what would happen if they made a mixture of sand and iron filings and stirred them together well. Ask, *Could this mixture be separated using only water and a filter? Could this mixture be separated by some other means?* (The water and filter would not work because neither sand nor iron filings would dissolve. Using a magnet might help in separating the parts of the mixture.)
- 2. Session II—Activity 4:** Ask students what they think would happen if, instead of a mixture of salt, sand, and water, they repeated their investigation with a cup of coffee to which two teaspoons of sugar had been stirred in. Be sure students' descriptions include the terms *filtrate*, *solute*, *solvent*, *solution*, and *suspension*. (The filter would be of little value because both substances would be in solution; evaporating the water also would be of limited value because the two powders left behind after evaporation would still end up mixed together—the materials might have to be manually separated as solids.)

3. Use the Activity Sheet(s) to assess student understanding of the major concepts in the activity.

In addition to the above assessment suggestions, the questions in bold and tasks that students perform throughout the activity provide opportunities to identify areas that may require additional review before proceeding further with the activity.

Solutions and Suspensions

OBJECTIVES

This activity introduces students to two kinds of mixtures: solutions and suspensions. Students use evaporation and filtration techniques to separate the components of a mixture.

The students

- ▶ differentiate between solutions and suspensions
- ▶ separate a suspended material from a solution
- ▶ separate a solute from water

SCHEDULE

Session I—Activity 3 About 40 minutes

Session II—Activity 4 About 10 minutes, 1-2 days later

VOCABULARY

evaporation
filtrate
heterogeneous
homogeneous
solute
solution
solvent
suspension

MATERIALS

For each student

- 1 Activity Sheet 3
- 1 pr safety goggles*

For each team of four

- 2 cups, plastic, 1-oz



- 1 pc filter paper
- 1 funnel
- 1 pie pan, aluminum
- 2 stirrers, wooden

For the class

- 1 pitcher, 1-L*
- 1 cont salt
- 1 bag sand
- 1 spoon, plastic
- water, tap, warm*
- DSR Matter and Change*

*provided by the teacher

PREPARATION

- 1 Make a copy of Activity Sheet 3 for each student.
- 2 For each team of four, put a spoonful of salt in one plastic cup and a spoonful of sand in another plastic cup. Each team of four will also need one piece of filter paper, one funnel, one aluminum pie pan, two wooden stirrers, and some warm tap water.
- 3 Put a pitcher of warm water at a distribution station so that it is accessible to the students.
- 4 Identify a place in the classroom where students can leave their pie pans of salt water undisturbed overnight.

BACKGROUND INFORMATION

A mixture is a combination of two or more substances that are not chemically combined. Some mixtures look like a single substance and have the same properties throughout.

These are called **homogeneous** mixtures. For example, when salt is mixed with water, it dissolves, resulting in a **solution**. The salt—or the material to be dissolved—is known as the **solute**; the water—or the material in which something is dissolved—is known as the **solvent**. A solution is always a homogeneous mixture. When a solution **evaporates**, the solvent changes to a gas and the solute is left behind as solid residue.

Unlike homogeneous mixtures, **heterogeneous** mixtures are easier to identify. For example, a mixture of sand and water is clearly made up of two separate elements, and the properties of the mixture are not the same throughout. A **suspension** is a heterogeneous mixture in which solid particles are suspended in a liquid (such as sand in water). In a suspension, the solid particles may settle out. The solid particles may also be separated by **filtration**.

▼ Activity Sheet 3

WARNING — This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

(The chemical used in this activity is salt.)

Solutions and Suspensions

Session I—Activity 3

1. Add one-half cup of water to the cup containing sand. Add one-half cup of water to the cup containing salt. Stir the mixtures with separate stirrers. Describe the appearance of each mixture.

Salt and Water

The water is cloudy, but no solids are visible.

Sand and Water

The water is a little cloudy and sand has settled to the bottom.

2. Assemble the funnel and filter paper according to your teacher's instructions. Combine the sand/water and salt/water mixtures and pour through the filter and funnel. Describe the filtrate.

The filtrate is a somewhat cloudy liquid.

Session II—Activity 4

3. a. Once the filtrate has evaporated, retrieve your aluminum pan. What do you see in it?

salt

- b. Which of the two solids (salt and sand) was once part of a homogeneous mixture?

What is this kind of mixture called?

The salt. A homogeneous mixture is called a solution.

- c. Which of the two solids was once part of a heterogeneous mixture? What is this kind of mixture called?

The sand. A heterogeneous mixture is called a suspension.

- d. What property of salt allows it to be separated from sand using a filter?

Salt dissolves in water, but sand does not.

Guiding the Activity

Session I—Activity 3

1

Write *salt water*, *air*, and *food coloring* on the board. Challenge the students by asking, **What do these substances have in common?**

Write the words *solution* and *homogeneous* on the board. Ask, **What is a solution?**

Explain to the students that a **solution** is a mixture in which one substance is dissolved in another. A solution is **homogeneous**; that is, it has the same properties throughout. A sample taken from one place in the mixture will be the same as a sample taken from another place in the mixture. Ask, **What are some other examples of solutions?**

Additional Information

If no one is able to figure it out, tell the students that salt water, air, and food coloring are all examples of solutions.

Accept all responses at this time.

Students may suggest lemonade, coffee, perfume, and so forth. While the examples that come to mind first involve solutions made up of solids dissolved in liquids, inform students that a solution can also be a mixture of materials in other states of matter.

Guiding the Activity

- 2 Write the terms *suspension* and *heterogeneous* on the board. Explain that a **suspension** is another type of mixture in which solid particles are suspended in a liquid. The mixture is **heterogeneous**—it is not the same throughout—and the solid particles in a suspension may settle to the bottom. Ask, **What are some examples of mixtures that can be called suspensions?**

As appropriate, read or review page 15 of the Delta Science Reader *Matter and Change*.

- 3 Distribute a copy of **Activity Sheet 3** to each student and one plastic cup with salt, one plastic cup with sand, one piece of filter paper, one funnel, one aluminum pie pan, and two wooden stirrers to each team of four. Ask the students, **What do you predict will happen to the salt when it is mixed with warm water?**

Ask, **What do you predict will happen to the sand when it is mixed with warm water?**

- 4 Instruct the teams to take turns coming up to the distribution station, pouring warm water from the pitcher into their cups of sand and salt, and stirring each mixture with a separate stirrer.

Have the students record their observations in step 1 of the activity sheet. Then ask, **Which cup contains a solution? Which cup contains a suspension?**

Additional Information

Students may suggest a mixture of pebbles and water, orange juice that has particles of pulp in it, Italian salad dressing, and so forth.

Students may respond that the salt will eventually dissolve, but the solution may be cloudy.

The sand will not dissolve in the water, but will settle out instead.

Tell them to fill the cups only half-full, as they will need to combine the contents of both cups into one cup later.

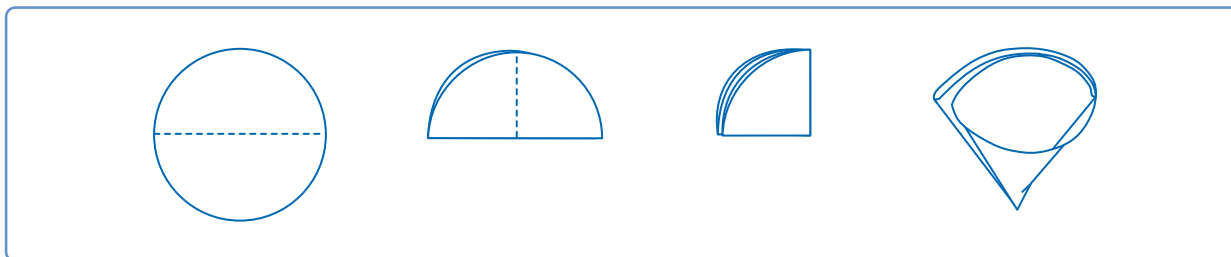
Students should see that, because the salt dissolved in water, the result is a homogeneous mixture, and therefore a solution. Because the sand did not dissolve in water, it is considered a heterogeneous mixture, and therefore a suspension.

Guiding the Activity

Additional Information

If students wet the cone of filter paper with water, it will retain the cone shape and not unfold.

- 5 Demonstrate for the students how to prepare the filter paper: Fold the filter paper in half and then in half again, as shown in Figure 3-1. Open the filter paper to form a cone, and place it in the funnel.



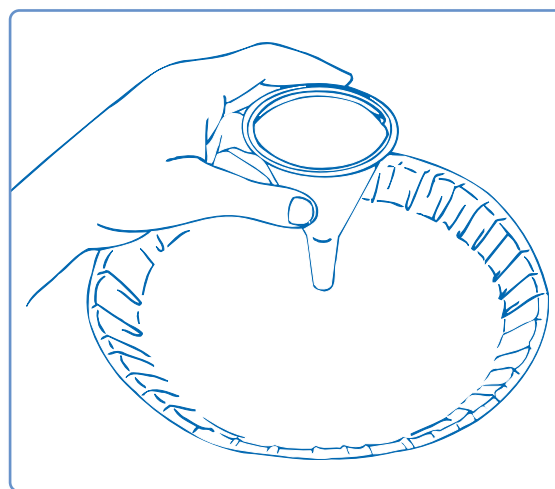
▲ *Figure 3-1. Folding the filter paper to form a cone.*

Tell the students to prepare their filters and place them in the funnel. Then instruct them to pour the salt solution into the cup containing the sand suspension and stir. Ask, **What do you predict will happen when you pour the salt/sand mixture through the filter paper?**

Write the word *filtrate* on the board. Explain that the **filtrate** is the material that passes through filter paper.

Students may suggest that the salt water will go through the paper and the sand will stay behind.

- 6 Have the students hold the funnel over the aluminum pie pan and pour the salt/sand mixture into the filter paper cone in the funnel. The filtration setup is shown in Figure 3-2. Have them record their observations in step 2 of the activity sheet.



▲ *Figure 3-2. The filtration setup.*

Ask the students, **What do you think is in the filtrate that drips into the pie pan?**

Students will probably respond that the filtrate is mainly water. Some may know that the water also contains dissolved salt.

Guiding the Activity

- 7 Tell the students that they will be putting aside their pie pans to allow the liquid to evaporate. Write the word *evaporation* on the board. Explain that **evaporation** is the process by which a liquid changes to a gas. Ask, **What liquid in your mixture will change to a gas? Where will the gas go?**

Write the terms *solvent* and *solute* on the board. Explain that in a solution, the **solute** is the substance that is dissolved, and the **solvent** is the substance in which the solute is dissolved. Ask, **When a liquid evaporates and leaves behind a solid residue, what does that tell you about which was the solvent and which was the solute in the solution?**

- 8 Show the students where to place their pie pans. Have the students discard the sand and filter paper. Rinse out the funnels and plastic cups and return them to the kit. Allow the water in the pie pans to evaporate overnight. Leave the vocabulary words on the board, if possible.

Session II—Activity 4

- 9 Begin this session after the water has completely evaporated from all the pans. Before students retrieve their pans, briefly review the definitions of solute and solvent. Ask students to compare and contrast the two terms.

Tell students that when a solute dissolves in a solvent, the particles of the solute are so small and evenly distributed that you can not see them. Ask, **How is the salt and water solution different from the sand and water mixture?**

Emphasize that one way to determine if there is a solute contained in a particular solvent is to evaporate the solvent and observe for residue, as students have done in this activity.

Additional Information

The water will evaporate and enter the air as water vapor.

The liquid that evaporates was the solvent and the solid that is left behind was the solute.

The length of time it takes for the water to evaporate will depend on the temperature of the area in which they have been placed.

Both terms refer to materials in a homogeneous solution. A solute is the material that dissolves. A solvent is the material in which something dissolves.

You can see the sand, and you can filter it out with filter paper.

Guiding the Activity

- 10** Have students retrieve their pans. Discuss their observations. Ask, **Why was the salt able to pass through the filter paper?**

What happened to the water?

Which material is the solute and which is the solvent?

Have students complete their activity sheet.

- 11** To wrap up, point to the following terms that were written on the board in Activity 3: filtrate, solute, solvent, solution, and suspension. Ask, **What substance or mixture from this activity corresponds to each of these terms?**

Additional Information

The salt passed through the filter paper because it was dissolved in the water.

It evaporated, leaving the salt behind.

Salt is the solute and water is the solvent.

The saltwater mixture was the filtrate, the salt was a solute, the water was a solvent, the saltwater mixture was a solution, and the sand/water mixture was a suspension.

REINFORCEMENT

Stir a teaspoon of colored powdered drink mix into a plastic cup filled with water. Pour the solution through a filter as before. Have the students note and identify the materials that collect on the filter, the filtrate, and the solute that is left behind after the water has evaporated.

SCIENCE NOTEBOOKS

Have students place their completed activity sheets in their science notebooks.

CLEANUP

Wash and air-dry the aluminum pie pans and plastic spoon and return them to the kit. Dispose of the wooden stirrers.

SCIENCE AT HOME

Find at least three household powders that become homogeneous or heterogeneous mixtures. For each, have students see if one teaspoonful will dissolve in a cup of cold water. If it doesn't, try a cup of hot water. Which powders dissolve better in hot water than in cold water? Which do not dissolve at all? Which powders form solutions? Which form suspensions?

Connections

Science Challenge

Add a few drops of iodine to a jar half-filled with water, secure the lid tightly, and shake the jar well. Students will see that the iodine is dissolved in the water. Then add about two tablespoons of mineral oil to the jar, shake it again, and let it stand. The water will clear as the iodine separates from it and is absorbed by the oil. Ask students to suggest an explanation for this result. (Most substances are more soluble in some liquids than in other liquids. In this case, iodine is more soluble in mineral oil than in water.)

Science Extension

Have each team label four drinking glasses *Water*, *Salt*, *Flour*, and *Milk* and then fill each glass with tap water. Tell them to add one of the following materials to each of three glasses and stir until thoroughly mixed: 0.5 teaspoon of table salt (forms a *solution*), 0.5 teaspoon of white flour (forms a *suspension*), and 0.5 teaspoon of milk (forms a *colloid*). With the classroom darkened as much as possible, have students shine a flashlight beam directly at each glass in turn and describe their observations. The light beam will pass through the plain water and the salt solution but not through the flour and milk mixtures because their larger particles reflect the light. Tell students the name for each type of mixture. Explain that the particles in a colloid are larger than the particles in a solution but smaller than the particles in a suspension. Also explain that this reflection of light by suspended particles is called the *Tyndall effect*, named for the British scientist, John Tyndall, who first investigated it as a way to differentiate between solutions and suspensions. Encourage students to research Tyndall and his work. Encourage students to consult science textbooks and library books to find different ways to grow crystals from a saturated solution of salt or sugar.

Science and Health

Ask interested students to investigate health problems caused by the contamination of drinking water by lead, salt, and other harmful substances. What are some common sources of each contaminant and its effect on people? How is drinking water in their community tested and treated to maintain its quality?

Science and Language Arts

Have students use a dictionary to determine the origin of the words *homogeneous* and *heterogeneous*. (from the Greek *homos*, meaning “same or like”; *heteros*, meaning “other”; and *genos*, meaning “kind”) Ask students to suggest (or look up) and define other words beginning with these prefixes.

Science, Technology, and Society

- ▶ Students may enjoy finding out about the desalinization process used to obtain fresh water from sea water or the process of salt panning used by various cultures throughout history to obtain salt from sea water for preserving and flavoring foods.
- ▶ Explain that solutions can be formed not only with a solid dissolved in a liquid but also with various other mixtures of solids, liquids, and gases. Tell students that a solid dissolved in a solid is called an *alloy*. Suggest that students investigate metal alloys such as brass, bronze, pewter, and alnico to find out the components, unique properties, and uses of each alloy.
- ▶ As appropriate, encourage supervised use of the Internet for research projects related to the atomic structure of matter, as well as to elements, compounds, mixtures, and the physical and chemical changes that alter their properties. A list of pertinent websites is provided in the References and Resources section.

