

7.1 Classification of Matter by Composition

Here is a summary of what you will learn in this section:

- Everything that we see is made up of matter.
- Matter can be classified as a pure substance or a mixture.
- Mixtures can be classified as solutions or mechanical mixtures.



Figure 7.3 Chocolate chip cookies and milk are made of matter.

Chocolate chip cookies, milk, the glass holding the milk, the plate under the cookies, and the air you breathe have something in common (Figure 7.3). They are all made of matter. **Matter** is anything that has mass and takes up space. **Mass** is the amount of matter in an object.

You may already know that matter can be classified by its physical state: solid, liquid, or gas. A **solid** is matter that has a definite shape and volume. Volume is the amount of space that matter occupies. Textbooks, trees, cars, and running shoes are all made up of solid matter. A **liquid** is matter that does not have a definite shape but does have a definite volume. A liquid takes the shape of its container. Rainwater, orange juice, mouthwash, and gasoline are all made up of liquid matter. A **gas** is matter that does not have a definite shape or volume. Air is made up of different types of gaseous matter, such as oxygen and nitrogen. You can also use an understanding of what makes up matter to classify substances by composition.

C4 Starting Point

Skills **A** **C**



Classify This

Look for similarities and differences in the physical appearance of 5 to 10 common substances (e.g., bread, juice, chocolate bar, butter, cereal). Come up with your own classification system, and provide reasons for how you classified each substance. Prepare a table like the one shown to record your reasons. Give your table a descriptive title.

Table 7.2 Classifying substances

Substance	Classification	Reasons for Your Classification
Milk	Liquid	Milk is a liquid.

Classifying Matter by Composition

Matter can be grouped in different ways. It can be classified as a solid, a liquid, or a gas. All matter can also be grouped into two basic categories: pure substances and mixtures.

Pure Substances

A **pure substance** is made up of only one type of matter. Sugar, distilled water, and copper wire are all types of pure substances. Figure 7.4 shows that all the parts of the packet of sugar are the same. Similarly, all the parts of distilled water are the same, and all the parts of copper wire are the same. A pure substance is the same throughout and has the same properties throughout.

Pure substances appear uniform, or **homogeneous** [pronounced “hoh-moh-JEEN-ee-uhs”], throughout. This means that every part of that substance has the same composition as every other part. When you look at a container of salt or a glass of distilled water, every part of that substance looks the same.

Mixtures

A **mixture** is made up of two or more different substances. For example, pizza is a mixture of different types of edible ingredients placed on a flat dough that is baked in an oven (Figure 7.5). The dough is also a mixture of different substances, such as flour, eggs, and water. Many soft drinks are mixtures that may contain the pure substances carbon dioxide and sugar mixed with water.

Each substance in a mixture keeps its particular properties, even though those properties may be difficult to identify. For example, when you look at a bowl of salad, you can see the different vegetables in the mixture, and you can taste the oil and vinegar in the salad dressing. However, when you pour a soft drink into a glass, you cannot see the sugar in the mixture, although you can probably taste the sweetness of the sugar.



Figure 7.4 All the parts in the packet of sugar are the same.

WORDS MATTER

The prefix “homo” comes from the Greek word “homos,” which means “same.”

Take It Further

Think of a common product found in a grocery store. Determine if its ingredients are pure substances or mixtures. Begin your search at ScienceSource.



Figure 7.5 This pizza is a mixture of different ingredients.

A Hypothesis Is a Prediction

The idea of making an “educated guess” based on prior knowledge is referred to by different names in different subject areas. In science, it is called hypothesizing.

In the Inquiry Activity on the following page, you are asked to consider which of the common substances in the following list are pure substances and which are mixtures:

aluminum foil, baking soda, water, salt, sugar, vinegar, olive oil, baking flour.

Think about what you already know or have just learned about pure substances and mixtures, as well as what you know about each of the common substances. Based on this knowledge, predict whether each substance is pure or a mixture. Briefly explain why you think so. You have now developed a hypothesis for science.



Figure 7.6 The snack food is a mechanical mixture of different substances.

WORDS MATTER

The prefix “hetero” comes from the Greek word “heteros,” which means “different.”



Figure 7.7 Sweetened tea is a solution of sugar and different chemicals extracted from tea leaves.

Classifying Mixtures

Mixtures can also be grouped into two basic categories: mechanical mixtures and solutions.

When you look at **mechanical mixtures** closely, they do not have the same appearance throughout. They are **heterogeneous** [pronounced “het-uh-oh-JEEN-ee-us”]. You can see the differences with the naked eye. There are differing amounts of different types of matter throughout the mixture. Snack food is an example of a mechanical mixture, as it contains different substances (Figure 7.6). Mechanical mixtures are also called **heterogeneous mixtures**. This means that they are made up of many different substances, each with different appearances and properties.

Solutions have the same appearance throughout, but are made up of two or more substances. When you mix one substance in another to form a solution, you **dissolve** one substance in the other. All solutions are **homogeneous mixtures** because they look the same throughout even though they are made up of different substances. For example, when you dissolve sugar in tea, the tea still looks the same throughout (Figure 7.7).

- Recording and organizing data
- Drawing conclusions

Classifying Substances by Composition



Figure 7.8 Looking closely at a substance can help you determine if it is a pure substance or a mixture.

Everything around you is made up of matter, including the food you eat, the air you breathe, and the liquids you drink. You will investigate the properties of common substances. Referring to these properties, you will classify each substance as either a pure substance or a mixture.

Question

Which of these common substances are pure substances, and which of them are mixtures?

Materials & Equipment

- common substances (e.g., aluminum foil, baking soda, water, salt, sugar, vinegar, olive oil, baking flour)
- hand lens (optional)
- microscope (optional)

CAUTION: Handle all substances as instructed by your teacher.

Procedure

1. Prepare a table like the one shown below to record your observations.

Table 7.3 Classifying substances by composition

Substance	Appearance	Pure Substance or Mixture
salt	white, granular	pure substance

2. Inspect each of the substances provided by your teacher. Note the appearance, using terms similar to the example. Relying on your observations and any other information available, classify each substance as a pure substance or a mixture of substances.
3. Return all substances and clean up your work area as instructed by your teacher. Wash your hands after the activity.

Analyzing and Interpreting

4. How did you determine if a substance was a mixture of more than one substance?
5. Was it possible to determine if a substance was pure just by its appearance? Please explain your answer.

Skill Builder

6. What findings did you use to draw the conclusions that you made?

Forming Conclusions

7. What must someone know about a substance in order to classify it as a pure substance?

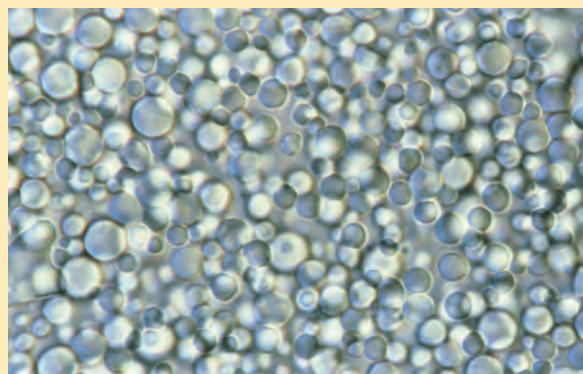
Key Concept Review

1. Explain the difference in appearance between a pure substance and a mixture.
2. How do the components of a mixture differ from the components of a pure substance?
3. What are the differences between sand and potting soil? Are they both mixtures? How do you know?
4. What are the key differences between solutions and mechanical mixtures? Give two examples of each.
5. Categorize each item as either a pure substance or a mixture.
 - (a) chocolate pudding
 - (b) gold necklace
 - (c) bleach
 - (d) helium gas
 - (e) unfiltered tap water

Connect Your Understanding

6. Many hockey sticks are made of composite materials instead of wood. How would you classify each type of hockey stick?
7. Explain why most foods and beverages are mixtures.

Practise Your Skills



8. The above photo is a microscopic view of homogenized milk. Determine if homogenized milk is a mechanical mixture or a solution. Explain your answer.

For more questions, go to ScienceSource. 

C7 Thinking about Science and Technology



Classifying Common Substances

At the beginning of this chapter, you created your own classification system to categorize common substances. This time, use the classification of matter flowchart to classify 5 to 10 common substances used in your home (Figure 7.9). Explain how each substance is commonly used.

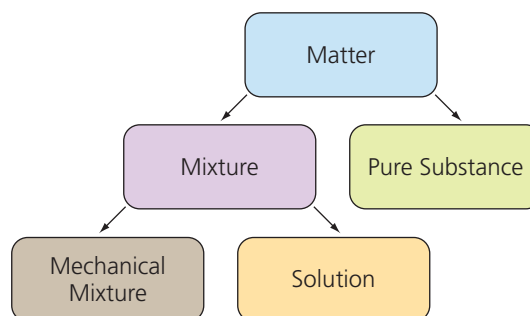


Figure 7.9 Standard classification diagram