1.9

# Classifying Matter

Tens of thousands of different chemical substances make up the Earth. Some of these substances appear to be quite similar, while others are very different from one another. Have you ever thought about the clothes people wear, for example? Some are made from cotton, which comes from the cotton plant. Others are made from wool, which comes from an animal.

Some clothes are also made from substances that are **synthetic**—invented and produced by people. Nylon, polyester, and Gore-Tex are all synthetic materials used to make clothing. Which of the materials in **Figure 1** are natural, and which are synthetic?

Organizing chemical substances into two groups, those that are natural and those that are synthetic, is the first step in classifying matter.

Figure 1

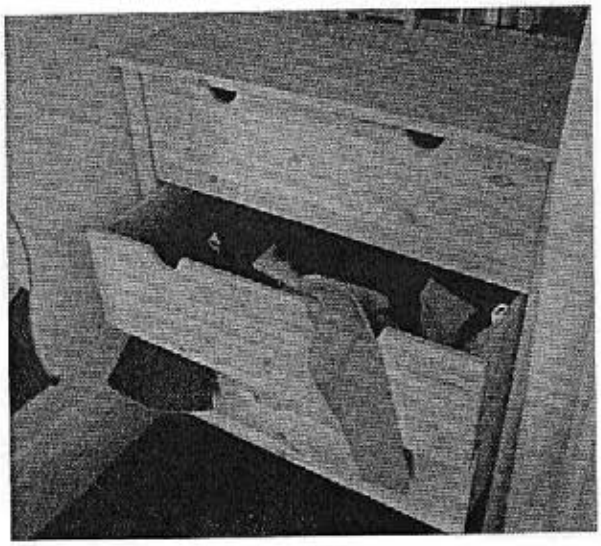
## Try This Activity Classification

Think about the last time you went shopping. How did the stores you visited organize their merchandise for sale? If you visited a music store, how were the CDs or tapes organized? If you visited a clothing store, how were the articles of clothing organized?

For this activity, pick one of the following places and describe how the items are organized there. Your description may be a paragraph or a labelled sketch.

- the place where you keep your clothes (for example, a chest of drawers, a closet)
- the place where food is kept in your home (for example, cupboards)
- your favourite music store
- your favourite clothing store

(a) For the place that you chose to investigate, (F1) name the categories into which items were sorted.



(b) Did students who investigated the other choices observe the same categories? Why or why not?



SKILLS HANDBOOK: (F1) Qualitative Observations

## Pure Substances

All substances, whether natural or synthetic, are made of the same building blocks—atoms or molecules. A substance that contains only one of these building blocks is called a **pure substance**. Pure substances that consist only of atoms are called **elements**. The element carbon, for example, which makes up the soft, dark core of a pencil, consists of atoms of carbon. Oxygen is an element that consists of pairs of atoms joined together as diatomic (two-atom) molecules (**Figure 2**).

Pure substances that consist of molecules that are not diatomic are called **compounds**. Each of the atoms that make up the molecules of a compound are from different elements. The air around the pencil in **Figure 2**, for example, contains a compound called carbon dioxide. The molecules that make up this compound consist of one carbon atom linked to two oxygen atoms. The air will also likely contain some water vapour, which is composed of single oxygen atoms, each linked to two hydrogen atoms.

The number of possible chemical compounds is almost endless. Atoms of the elements carbon, hydrogen, and oxygen combine in unique ways (**Figure 3**) that produce more compounds than those of all the other elements combined!

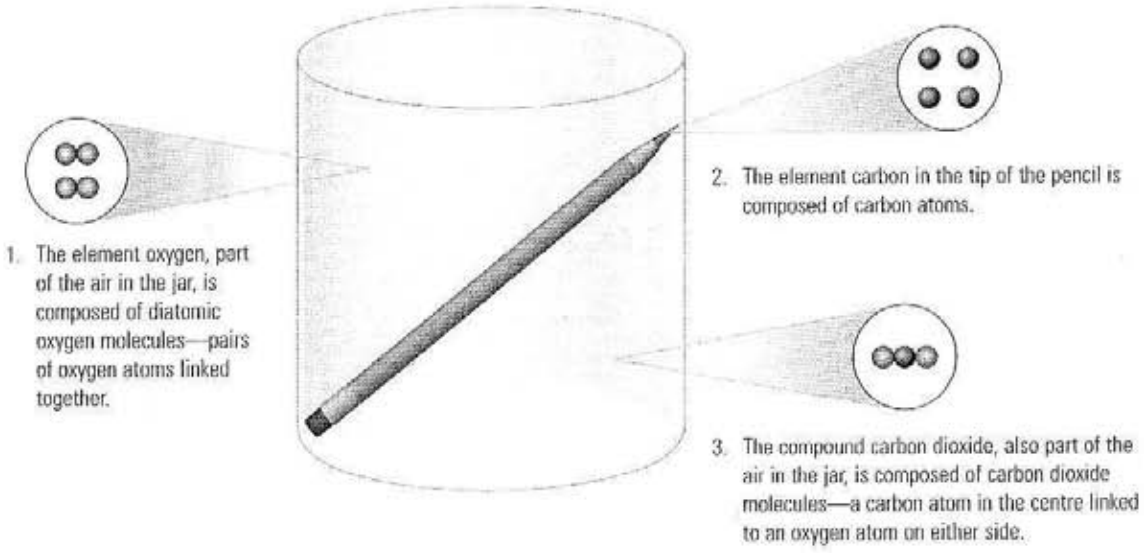



Figure 2

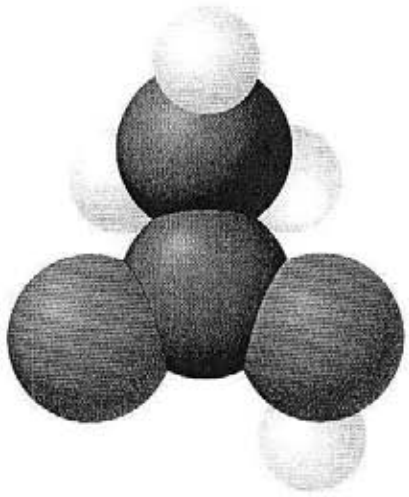


Figure 3

## Mixtures

Metal ores are examples of mixtures. A **mixture** generally consists of two or more pure substances. Almost all the natural substances found on or in the Earth are mixtures. So are most human-made and manufactured products. Mixtures can be any combination of solids, liquids, and gases. For example, soft drinks (**Figure 4**) are mixtures of liquid water, solid sugar, and carbon dioxide gas.

**Figure 4**

## Heterogeneous and Homogeneous Mixtures

In a mixture like granola, you can clearly see separate pieces. Each spoonful of granola looks different (**Figure 5**). The composition and properties of one spoonful may differ from another—they are not pure substances. This type of mixture is called a **heterogeneous mixture**. Heterogeneous means "different kinds." In these mixtures two or more substances can be seen or felt.

In other mixtures, the particles of the pure substances mix together so completely that the mixture looks and feels like it is made of only one substance. This is called a **homogeneous mixture**. Steel, composed of iron and carbon, is a homogenous mixture. No matter where you cut a steel bar, it always looks the same. However, the amount of carbon and iron used may change from one steel bar to another, depending on the intended use of the steel. For this reason, homogeneous mixtures are not pure substances.

Just as you organize your clothing and just as merchants organize products for sale in their stores, science organizes matter. Observe this classification of matter in **Figure 6**.

**Figure 5**

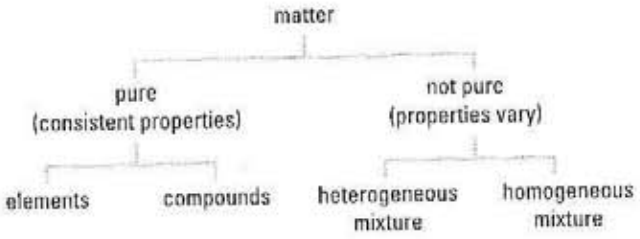



**Figure 6**
Classification of matter

## Understanding Concepts

1. **(a)** What is meant by the term "natural" when describing a substance? Give two examples.
   **(b)** What is meant by the term "synthetic substance"? Give two examples.
2. How are elements and compounds
   **(a)** the same?
   **(b)** different?
3. **(a)** What is a pure substance? Give an example.
   **(b)** What is a mixture? Give an example.
4. Explain the difference between heterogeneous and homogeneous mixtures.
5. Give an example of a homogeneous mixture that is
   **(a)** a solid
   **(b)** a liquid
   **(c)** a gas

## Making Connections

6. The company you work for has asked your team to come up with a new mixture that can be made using two or more substances from the following list. Invent a use for your mixture.

| Substance | Useful property |
|---|---|
| A | sticks to plastic |
| B | is bright blue |
| C | boils at 20°C |
| D | smells like bananas |
| E | is elastic |
| F | glows in the dark |
| G | conducts electricity |
| H | bends without breaking |
| I | repels insects |

## *Work the Web*

Joseph Priestly, who lived in the 1700s, is famous for his discovery of the element oxygen. Did you know that Priestly also discovered soda water? You can read about Priestly at www.nelson.science.com. Follow the links from *Science 9: Concepts and Connections*, 1.9.

## *Challenge*

1 Most chemical substances exist in either the solid, liquid, or gas states. A fourth state, plasma, has been observed. Which state does your material exist as?

3 Joseph Priestly is recognized for the discovery of the element oxygen. Check out other chemical elements. Were they always recognized as elements from the day they were first observed in nature, or were they "discovered" as well? For those elements that were discovered, find out who is credited with the discovery. Was that person recognized for any other scientific work?