

# Understanding the Structures and Properties of Matter

## Introduction

The word “matter” comes from the Latin word that means “stuff.” Matter is the “stuff” that our universe is made out of. The air we breathe, the food we eat, the products we buy, and even our bodies are all made of matter.

In this unit of study, you will explore elements, the building blocks of matter, how these blocks make up everything in our universe, and how they undergo changes to make new substances.

By the end of this unit, you will –

### Know these concepts:

- Physical and chemical properties of matter
- Melting point, boiling point, and density
- Physical and chemical changes of matter
- Basic organization of the Periodic Table of Elements
- Metals, nonmetals, and metalloids
- Elements and compounds
- Chemical symbols
- Chemical formulas

### Do these things:

- Demonstrate safe practices
- Make connections to prior knowledge
- Construct a concept map
- Collect and organize data
- Measure temperature
- Analyze patterns in data
- Identify patterns on the Periodic Table of Elements
- Make predictions based on observations
- Construct and analyze a graph
- Analyze models and evaluate their limitations
- Use problem-solving skills
- Draw conclusions based on evidence
- Classify matter based on its physical and chemical properties
- Represent information through visuals
- Design a fair investigation using variables and constants

# Understanding the Structures and Properties of Matter

## Warm Up Activity

### Journal Entry

See how many of the riddles below you can answer. If you get stuck, discuss it with your partner.

*Let's Engage*

### Riddles

1. I am the only nonmetal that has to hang around the table with the metals. Who am I?
2. I am the element that sits at the top of the stair steps. Who am I?
3. I am the only one in Period 3 that cannot decide if I am a metal or a nonmetal. Who am I?
4. I am the only element in Group 16 that stays in the same period as carbon. Who am I?
5. Without my next-door-neighbor, I would not be worth 6 cents. Who am I?
6. I have the highest atomic number in Period 5. Who am I?

## Reading to Learn

### Molecules

Molecules form when atoms are chemically joined together. The size of a molecule depends upon the size and number of atoms that make it up. For example, the oxygen molecules we breathe are made out of only two atoms joined together and can be represented by the chemical formula of  $O_2$ . On the other hand, one molecule of aspirin is made of twenty-one atoms and is represented by the chemical formula of  $C_9H_8O_4$ .

*Let's Explore*

Molecules are classified into two major types: elements and compounds. If a molecule is made out of only one type of atom, it is an element. Molecules that have more than one type of atom are called compounds. All molecules are made of atoms that have been

## Understanding the Structures and Properties of Matter

### Discussing to Learn

- Share your answers with a partner.
- If you have differences in answers, revisit the reading passage and discuss your reasoning.
- You may or may not want to revise your answers based upon the discussion.
- Beneath your answers, explain any revisions you want to make to your original thinking.

*Let's  
Explain*

### Reading to Learn

#### Chemical Formulas

Just like every element has its own chemical symbol, every compound has its own chemical formula. A formula tells us two important things about a compound:

- What elements the compound is made out of
- How many atoms of each element are in one molecule of the compound

An example of a compound and its chemical formula is NaCl or table salt. One molecule of salt has one atom of Na (sodium) and one atom of Cl (chlorine). Although there is not a 1 listed by the chemical symbol in the formula, it is understood to be one sodium atom plus one chlorine atom joined together for a total of two atoms in the molecule.

Sometimes, however, a small number is written next to a chemical symbol to tell how many atoms there are of that element. For example, in H<sub>2</sub>O (water) there are two hydrogen atoms and one oxygen atom for a total of three atoms in the molecule. The small number is called a subscript and is written just slightly lower than the symbol.

Generally, the order of the symbols in a chemical formula follows a left to right pattern on the Periodic Table of Elements. For example,

*Let's  
Elaborate*

## Understanding the Structures and Properties of Matter

### Discussing to Learn

- Share your group's results with the class.
- After the discussion, you may or may not want to revise your answers based upon the discussion.
- Beneath your answers, explain any revisions you want to make to your original thinking.

*Let's  
Explain*

### Group Lab Activity

#### Experimental Design

In an investigation, it is important to change only ONE variable at a time. Otherwise, you will not have a fair test.

The one factor that you change on purpose is called the independent variable and is abbreviated as **IV**.

The factor that is the measured response is called the dependent variable and is abbreviated as **DV**.

The constants (**C**) are the factors that you prevent from changing, or keep the same, so that you will have a fair test.

To design an investigation, it is important to identify and record the IV, DV, and C.

*Let's  
Elaborate*

#### Task:

You and your group will design and conduct an investigation to determine how the addition of an extra compound affects the amount of suds produced in a mixture of shampoo and water.

#### Procedures:

1. Pour 25 mL of water into the test tube. Add 2 drops of shampoo. Shake the test tube 30 times as you hold your thumb over the opening.

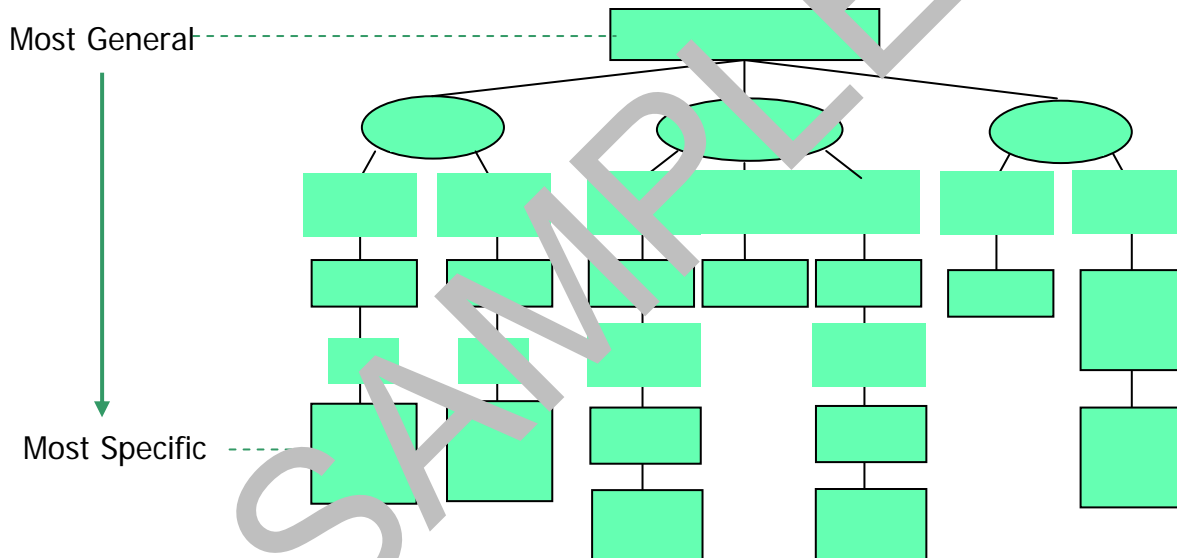
# Understanding the Structures and Properties of Matter

## Individual Assessment

### Task:

- Complete the concept map provided by your teacher.
- Fill in the empty spaces with words from the Word Bank.
- Organize the concepts from the most general ones at the top to the most specific ones at the bottom.
- Make sure the map accurately represents your knowledge about the properties of elements and the Periodic Table of Elements.

*Let's  
Evaluate*



### Word Bank

always capitalized

atomic number

brittle

electrical conductor

groups

malleable

metalloids

metals

never capitalized

nonmetals

dissimilar

periods

electrical insulator

similar

# Understanding the Structures and Properties of Matter

## Individual Assessment

*Let's  
Evaluate*

Record the one best answer for questions 1-10. Refer back to the chart on page 22 as needed.

- 1** Which of these is not a physical property of matter?
- A** ability to burn
  - B** boiling point
  - C** density
  - D** state of matter
- 2** Which of these is a solid at room temperature?
- F** bromine
  - G** oxygen
  - H** mercury
  - J** sulfur
- 3** If the density of 100 grams of a substance is  $20 \text{ g/cm}^3$ , what is the density of 50 grams of the substance?
- A**  $2 \text{ g/cm}^3$
  - B**  $10 \text{ g/cm}^3$
  - C**  $20 \text{ g/cm}^3$
  - D**  $170 \text{ g/cm}^3$
- 4** In general, which type of matter has the lowest density?
- F** metalloids
  - G** solids
  - H** metals
  - J** gases
- 5** Which one of these elements is most likely to be brittle?
- A** chlorine
  - B** neon
  - C** sulfur
  - D** oxygen
- 6** The amount of matter in an object is its
- F** weight
  - G** volume
  - H** density
  - J** mass