

Assess Your Understanding

Describing Matter

What Properties Describe Matter?

1a. **CLASSIFY** The melting point of table salt is 801°C. Is this a physical or chemical property? _____

b. **DRAW CONCLUSIONS** Helium does not usually react with other substances. Does this mean that helium has no chemical properties? Explain. _____

got it?

I get it! Now I know that matter is described by its _____

I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summary

Describing Matter

What Properties Describe Matter?

Matter is anything that has mass and takes up space. All the "stuff" in the natural world is matter.

Matter can have many different properties, or characteristics that are used to describe, identify, and classify it. Materials can be hard or soft, hot or cold, liquid, solid, or gas. Some materials catch fire easily, but others do not burn. **Chemistry** is the study of matter and how it changes. Substances are one type of matter.

A **substance** is a single kind of matter that is pure, meaning it has a specific composition. That composition gives it specific properties. **Every form of matter has two kinds of properties—physical properties and chemical properties.**

A **physical property** is a characteristic of a substance that can be observed without changing it into a different substance. Examples of physical properties include state, freezing point, melting point, boiling point, luster, flexibility, ability to conduct heat and an electric current, hardness, temperature, texture, and color.

A **chemical property** is a characteristic of a substance that describes its ability to change into different substances. In order to observe the chemical properties of a substance, the substance must be changed into a different substance. Examples of chemical properties include rusting, tarnishing, and flammability.

On a separate sheet of paper, explain what matter is and how the physical and chemical properties of matter are alike and different.

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Lesson Quiz

Describing Matter

Write the letter of the correct answer on the line at the left.

1. ___ The physical property that makes metal pots good for cooking is
A flexibility
B electrical conductivity
C flammability
D heat conductivity
2. ___ Which of the following is true about matter?
A It is a solid that takes up space.
B It has mass and takes up space.
C It has mass and is usually a liquid.
D It is always a substance.
3. ___ Which of the following is **not** true about a pool of water and a piece of ice?
A They have the same composition.
B They are in different states of matter.
C They have different chemical properties.
D They have different physical properties.
4. ___ Characteristics used to describe matter are called
A physical properties
B chemical properties
C both A and B
D neither A nor B

Fill in the blank to complete each statement.

5. Solid, liquid, and gas are the three _____ of matter.
6. The metal tungsten is used in incandescent light bulbs because of its property of _____.
7. _____ is the study of matter and the changes in matter.
8. The ability of iron to rust is a(n) _____ property.
9. A(n) _____ is a single kind of matter that has a specific composition.
10. Another term for the ability to burn is _____.

Assess Your Understanding

Classifying Matter

What Is Matter Made Of?

- 1a. **REVIEW** What holds the hydrogen and oxygen atoms together in a water molecule? _____
- b. **IDENTIFY** Table sugar has the chemical formula $C_{12}H_{22}O_{11}$. What is the ratio of carbon atoms to oxygen atoms in this compound? _____
- c. **DRAW CONCLUSIONS** Two formulas for compounds containing hydrogen and oxygen are H_2O and H_2O_2 . Do these formulas represent the same compound? Explain. _____

got it?

- I get it! Now I know that all matter is made up of _____
- I need extra help with _____

What Are Two Types of Mixtures?

got it?

- I get it! Now I know that the two types of mixtures are _____
- I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Classifying Matter

What Is Matter Made Of?

Scientists know that all matter in the universe is made of more than 100 different substances, called elements. An **element** is a substance that cannot be broken down into any other substances by chemical or physical means. Elements are the simplest substances. Each element has specific physical and chemical properties, which can be used to identify it. Elements are represented by one- or two-letter chemical symbols.

According to the particle theory, all matter is made up of atoms. An **atom** is the basic particle from which all elements are made. An atom has a positively charged center, or nucleus, surrounded by a negatively charged "cloud."

Atoms of most elements can combine with other atoms by forming chemical bonds. A **chemical bond** is a force of attraction between two atoms. The result of a chemical bond is often a **molecule**, or a group of two or more atoms held together by chemical bonds. A molecule can be made of atoms of different elements or atoms of the same element. A compound is another type of substance. A **compound** is made of two or more elements that are chemically combined in a set ratio. A compound is represented by a **chemical formula**, which shows the elements in the compound and the combining ratios of their atoms. When elements combine chemically, they form compounds with properties different from those of the elements.

What Are Two Types of Mixtures?

Elements and compounds are substances, but most materials are mixtures. A **mixture** is made of two or more substances that are together in the same place but whose atoms are not chemically combined. Each substance in a mixture keeps its own properties and is not combined in a fixed ratio. A mixture can be heterogeneous or homogeneous. In a heterogeneous

mixture, the different parts can usually be seen and easily separated. The substances in a homogeneous mixture are so evenly mixed that they cannot be seen and are difficult to separate. A solution is a homogeneous mixture. Methods used to separate mixtures include filtration, distillation, evaporation, and magnetic attraction.

On a separate sheet of paper, explain how the following terms are related: element, atom, molecule, chemical bond, compound, mixture, and substance.

Lesson Quiz

Classifying Matter

Write the letter of the correct answer on the line at the left.

1. ____ A molecule is the smallest part of
 - A an element
 - B a compound
 - C a substance
 - D an atom
2. ____ A mixture of iron and sulfur can be separated by
 - A magnetic attraction
 - B distillation
 - C evaporation
 - D filtration
3. ____ Compounds are formed as a result of
 - A physical combination
 - B chemical combination
 - C distillation
 - D filtration
4. ____ The ratio of hydrogen atoms to sulfur atoms in sulfuric acid, H_2SO_4 is
 - A 2 to 4
 - B 1 to 2
 - C 2 to 1
 - D 1 to 4

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ Salad dressing is an example of a homogeneous mixture.
6. _____ The simplest type of substance is a(n) compound.
7. _____ When elements combine to form compounds, their properties do not change.
8. _____ The chemical symbol for water is H_2O .
9. _____ Substances in a mixture keep their own properties.
10. _____ The substances in a heterogeneous mixture can usually be seen and are easily separated.

Assess Your Understanding

Measuring Matter

What Units Are Used to Express Mass and Volume?

1a. **EXPLAIN** Why is mass more useful than weight for measuring matter? _____

got it?

I get it! Now I know that the SI unit for mass is _____ and the SI unit for volume is _____

I need extra help with _____

How Is Density Determined?

2a. **IDENTIFY** Maple syrup will (float/sink) in water because its density is greater than 1 g/cm³.

b. **CALCULATE** What is the mass of a sample of a substance with a volume of 120 mL and a density of 0.75 g/mL? _____

c. **CHALLENGE** Liquid water and ice are the same substance, H₂O. How would you explain why ice floats in water? _____

got it?

I get it! Now I know density is calculated by _____

I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Measuring Matter

What Units Are Used to Express Mass and Volume?

Weight is a measure of the force of gravity on an object. Weight varies with location in the solar system. A more massive object will exert a greater gravitational force, so the weight of an object on that more massive planet or moon will be greater. Weight is measured with a scale.

Mass is the amount of matter in an object. It does not change with location. Mass is constant. For this reason, scientists prefer to describe matter in terms of mass rather than weight.

To measure the properties of matter, scientists use the **International System of Units**, or SI. The SI

unit of mass is the kilogram (kg). If a smaller unit of mass is needed, the gram (g) is used. There are 1,000 grams in a kilogram or 0.001 kilogram in a gram. Another measurable property of matter is **volume**, or the amount of space matter occupies. **The SI unit of volume is the cubic meter (m³).** Other common SI units of volume are the cubic centimeter (cm³), the liter (L), and the milliliter (mL). There are 1,000 milliliters in a liter or 0.001 liter in a milliliter. One milliliter is the same volume as 1 cm³. The volume of a rectangular solid is calculated according to the following formula.

$$\text{Volume} = \text{Length} \times \text{Width} \times \text{Height}$$

How Is Density Determined?

Density is a measure of the mass of a material in a given volume. Density is expressed as the number of grams in one cubic centimeter, or g/cm³. Because one milliliter is the same volume as one cm³, density can also be expressed as g/mL. **You can determine the density of a sample of matter by dividing its mass by its volume.**

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

The density of water is 1 g/mL, or 1 g/cm³. Objects with greater densities will sink. Objects with lesser densities will float. Density is a physical property of a substance. It can be used to identify an unknown substance.

On a separate sheet of paper, describe what mass and volume are, in what units they are measured, how they determine density, and why density is important.

Lesson Quiz

Measuring Matter

Write the letter of the correct answer on the line at the left.

1. ___ A balloon filled with air does not rise as high as a balloon filled with helium. What does this tell you about the density of helium?
 - A Helium is more dense than air.
 - B Helium is less dense than air.
 - C The two gases have the same density.
 - D When heated, helium becomes more dense.
2. ___ The amount of matter in an object is a measure of its
 - A volume
 - B density
 - C weight
 - D mass
3. ___ The formula for calculating density is
 - A $\text{Mass} \times \text{Volume}$
 - B $\text{Mass} \times \text{Weight}$
 - C $\frac{\text{Mass}}{\text{Volume}}$
 - D $\frac{\text{Volume}}{\text{Mass}}$
4. ___ Which of the following statements about the mass of an object is correct?
 - A Mass changes with location.
 - B Mass remains constant.
 - C Mass changes with altitude.
 - D Mass changes with gravity.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ The SI unit of mass is the cubic meter.
6. _____ One liter is equal to 100 milliliters.
7. _____ An object's weight is less on the moon than on Earth. On the moon, the object's mass decreases.
8. _____ An object that floats in water has a density less than 1 g/mL.
9. _____ Four measurable properties of matter are mass, weight, volume, and pressure.
10. _____ The SI unit of volume is the kilogram.