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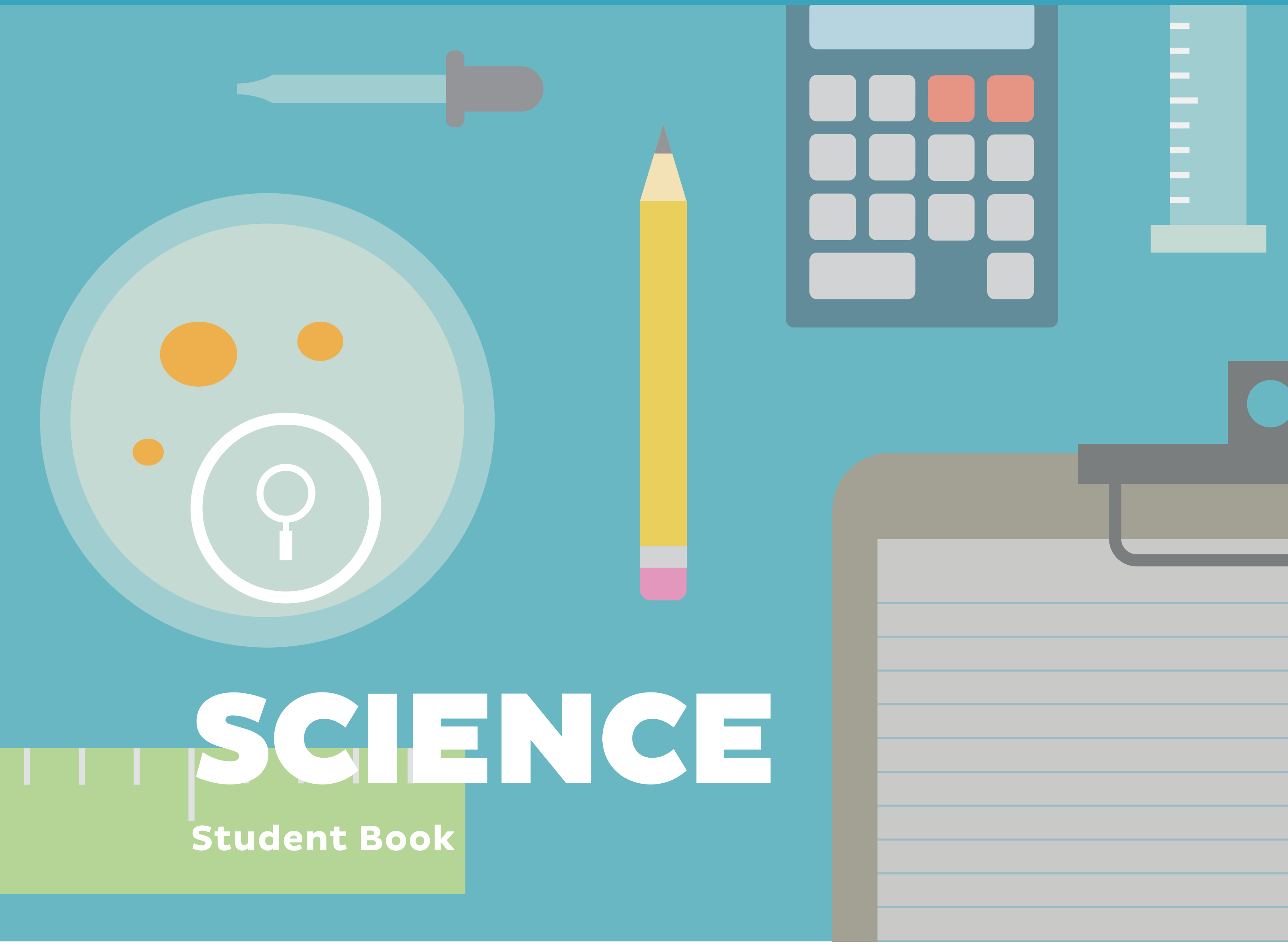

SCIENCE

Student Book

5th Grade | Unit 9

Alpha Omega
PUBLICATIONS

SCIENCE 509
CYCLES IN NATURE

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Alpha Omega PUBLICATIONS

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CYCLES IN NATURE

God has created and designed our world with great love, care, and wisdom. He has placed a great amount of order within His creation. We can also observe that there are many ordered *cycles* within God's creation. These signs of God's order and creation's cycles are all around us in nature. For example, in previous LIFEPACs, you learned about the water cycle, carbon cycle, and chemical cycle in nature. You also learned about life cycles of plants and animals. Yet, there are many more cycles than these in God's creation. The four seasons of the year—spring, summer, fall, and winter—are one example. The seasons change, yet they return again in a cycle from year to year.

In fact, the substance of all things that we can sense and observe — called *matter*—goes through change. Matter can also go through cycles. In this LIFEPAC®, you will study more about matter and the properties of matter. You will learn about the structure of matter and how matter changes. You will also learn about other cycles in nature—like the seasons of the year. Finally, you will learn more about God's order in all things that He has created.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. Each section will list according to the numbers below what objectives will be met in that section. When you have finished this LIFEPAC, you should be able to:

1. Identify the properties of matter.
2. Tell about the changes in matter.
3. Describe the structure of matter.
4. Explain the relationship between matter and the cycles of nature.
5. Describe some natural cycles.
6. Explain Bible accounts of God's order in creation.

1. MATTER

God created everything that exists, both seen and unseen. All that is seen includes the physical universe. Things that are unseen include spiritual beings, like the angels. Our focus in this LIFEPAC will be on things seen — the physical universe that God created. Every *thing* in the physical universe consists of *matter*. Matter is the substance of which all things in the physical universe are made. From the smallest living cell to the greatest galaxy in the universe, all things are made of matter.

You are surrounded by matter. You stand on it. You breathe it. In fact, your physical body is made of matter. All objects consist of matter. They may differ a great deal in size, shape, and appearance, but they all consist of matter.

Matter has *properties*. Some properties of matter are *common* to all matter. Other properties are *special* or specific to each kind of matter. This means similar types of matter have certain special characteristics that are common to all other matter of the same kind. For instance, all matter composed of the metal iron has similar characteristics, or *special properties*. These special properties help us to **distinguish** one kind of matter from another. You will learn more about common properties and special properties of matter in this section of the LIFEPAC.

Matter can *change*. Matter changes in many ways, including form, shape, and state. The changes in matter are very orderly because of the properties of matter. You will learn more about changes in matter in this section of the LIFEPAC.

All matter has *structure*. Matter consists of tiny particles that give matter its basic structure. You will learn more about the particles of matter and the motion of these particles in this section of the LIFEPAC.

By studying the *properties*, *changes*, and *structure* of matter, you should better understand the importance of matter in the cycles of nature. You should also be able to better appreciate the loving care and order that God has put into His creation.

Objectives

Review these objectives. When you have completed this section, you should be able to:

1. Identify the properties of matter.
2. Tell about the changes in matter.
3. Describe the structure of matter.
4. Explain the relationship between matter and the cycles of nature.

Vocabulary

Study these new words. Learning the meanings of these words is a good study habit and will improve your understanding of this LIFEPAC.

atom (at′ əm). The small particle that makes up molecules. Each atom is unique for a chemical element.

brittleness (brit′ l nəs). The physical property of being broken easily or of being broken with a snap.

characteristics (kar′ ik′ tə ris′ tiks). Special features of something that help set one thing apart from another.

combustibility (kəm bus′ tə bil′ ət ē). The ability of a material to burn. It is a chemical property of matter.

conduct (kən dukt′). To channel through; heat or electricity can be channeled through conductors.

conservation (kon′ sər vā′ shən). The state of not being used up.

density (den′ sə tē). The condition of being closely packed together. It is the amount of matter in a given volume of material.

displace (dis plās′). To take the place of something else.

distinguish (dis ting′ gwish). To perceive as being separate or different.

exist (eg zist′). To be; to have being.

hydrogen (hī′ drə jən). A colorless element commonly found in gas form. It burns easily, and its mass is less than all other elements.

inertia (in er′ shu). To remain still if still, or continue moving if moving unless acted upon by an outside force.

molecule (mol′ ə kyül). The smallest part of matter that can still exist without a chemical change. It is made up of atoms of elements.

normally (nôr′ mə lē). In a regular way; commonly.

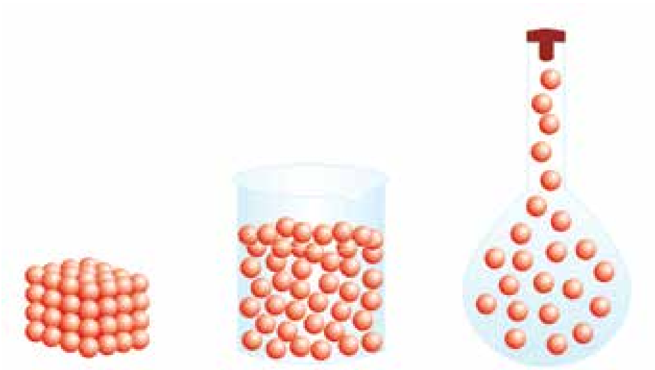
symbol (sim′ bəl). Something that stands for, or represents, something else.

volume (vol′ yəm). The amount of space taken up by matter.

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.*

Pronunciation Key: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /ŦH/ for **th**en; /zh/ for mea**s**ure; /u/ or /ə/ represents /a/ in **a**bout, /e/ in tak**e**n, /i/ in penc**i**l, /o/ in lem**o**n, and /u/ in circ**u**s.

Properties of Matter



| Solids, liquids and gasses behave diffrently when put in containers.

All matter has *properties*. These properties are the **characteristics** of matter. They are the various ways in which we describe matter. Some of these properties are *common* to all matter. Other properties are *special* or specific to each kind of matter. Let's explore these common and special properties of matter.

Common properties. All matter in the universe has some common properties. Three of these common properties are **volume**, *mass*, and **inertia**. We can describe any matter as having volume, mass, and inertia. Let's first consider the property of volume.

Volume is the space taken up by matter. In fact, some scientists define matter as anything that occupies space. Objects of small volume do not take up much space. Objects with larger volumes take up more space. Does a tiny ant take up space? Yes. Its volume is small, though. An elephant has much more volume than an ant and takes up more space.

| Your hand and your pencil cannot occupy the exact same space together

Volume is measured in units like pints, liters, gallons, cubic feet, or cubic meters. For example, when your parents or friends fill their car with 10 gallons of gasoline, they are putting a certain volume of gasoline into the car's gas tank. The volume of the gasoline is 10 gallons. It would occupy 10 gallons of space in the gas tank. Can two objects occupy the same space at the same time? Try this exercise to find out. Place your pencil on a desk. Now try to put your hand in exactly the same place. Can you do it? No. The pencil is taking up space so that your hand cannot occupy the exact same space. Two objects cannot occupy the same space at the same time. However, two objects can occupy the same space at different times. If you remove your pencil from the desk, you can rest your hand in the exact same place that the pencil previously occupied. In this case, we say that you **displace** the pencil with your hand. The volume of your hand now occupies part of the space formerly occupied by the volume of the pencil. In the experiment that follows, you will learn more about volume and how one object might displace another object.

509.A VOLUME

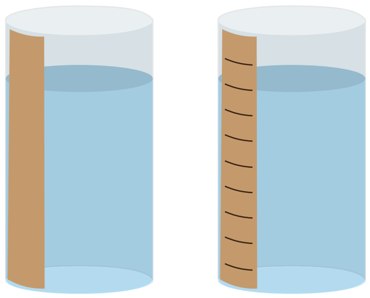
View 509 VOLUME EXPERIMENT: Grade 5 Science experiments video

You will use two marbles of different size to demonstrate how the volume of an object can be measured by displacing the same volume of another substance (in this case, water).

These supplies are needed:

- a tall, thin glass jar **or** a graduated cylinder
- water
- small marble
- large marble
- masking tape
- pen, pencil, or marker
- ruler with centimeter markings

Follow these directions carefully. Put a check mark in the box when each step is completed. (**NOTE:** If using a graduated cylinder, there is no need to make markings on tape with a ruler. Simply use some of the markings already imprinted on the cylinder for your measurements and record them on a sheet of paper for each step. Proceed with step 3 below.)



☐ **1.** Place a piece of masking tape on the jar from top to bottom.

☐ **2.** Using a ruler to measure, make marks one centimeter apart on the strip of tape, from bottom to top.

☐ **3.** Pour water into the jar until it reaches your fifth mark.

☐ **4.** Carefully drop the small marble into the water. Put a small mark on the tape where the new water level is located. Label it "X."

☐ **5.** Remove the small marble. Make sure the water level is the same as step 3. Add more water if necessary.

☐ **6.** Drop the large marble into the water. Put another mark on the tape where the water level is located. Label it "Z."

Answer these questions.

1.1 Why did the water level change when you dropped the marbles in the water?

____

____

____

1.2 Which marble caused the most change in water level? ______________________

____

____

Complete this activity.

1.3 Compare the volume of the two marbles. ______________________

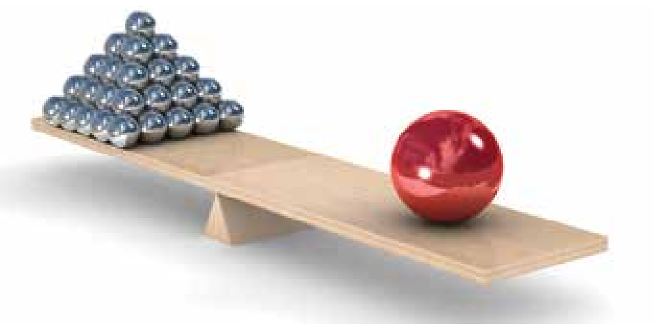
____

____

____

Mass is a second common property of all matter. The quantity of matter in an object is called its *mass*. Mass is measured in units such as grams and pounds (mass). The mass of an object will be the same no matter where it is measured.

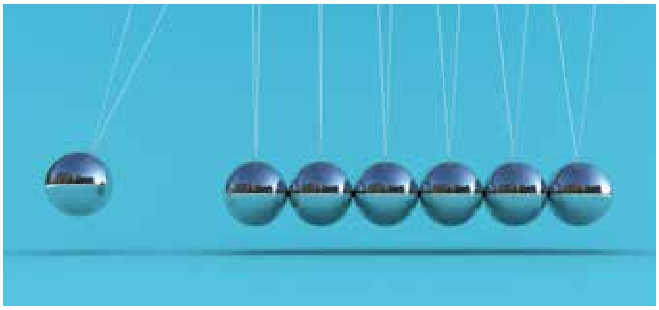
Mass should not be confused with an object's *weight*. The weight of an object of a given mass is directly related to the earth's gravitational pull on the object. Therefore, an object's weight can change depending upon the pull of gravity on the object. Since the force of gravity decreases as one moves away from earth, the weight of the object would also decrease as one moves away from earth. For example, a person with a mass of 75 pounds (mass) would weigh 75 pounds (force) on Earth; however, that person would weigh very little in outer space. That same 75 pound person would weigh about 12 pounds (force) on the moon because the force of gravity on the moon is less than that on Earth. However, the person would still have the same mass—75 pounds (mass)—whether on the earth, in outer space, or on the moon.



| A balance measures the mass of an object.

The mass of an object is usually measured on a balance by comparing it with another object of known mass. The mass tells us the amount of matter present in the object.

The third common property of matter is called *inertia*. All matter has inertia. This means that it resists any change in its condition of rest or of motion. Inertia means that an object remains still if still or continues moving if moving, unless acted upon by an outside force. For example, if you place a book on your desk, the book will remain still on your desk unless some force acts upon it to remove it. The inertia of the book at rest makes it remain at rest. Inertia keeps it from moving.



| Inertia can keep a body in motion.

On the other hand, inertia will keep a moving object moving until another force acting upon it causes it to slow down or stop. For example, if you kick a soccerball into the air, inertia keeps the ball moving until it hits something (like someone's foot) or the force of gravity pulls the ball to the ground.

Complete this list.

1.4 What are three common properties of all matter?

a. ______________________

b. ______________________

c. ______________________

Write the correct letter and answer on each line.

1.5 The substance of all things that we can sense and touch is called ______________ .

a. matter b. volume c. color

1.6 The space taken up by matter is called ______________ .

a. mass b. volume c. a box

1.7 All matter has ______________ .

a. cells b. seeds c. properties

1.8 The quantity of matter in an object is called its ______________ .

a. volume b. mass c. measure

1.9 _________________ means that matter resists any change in its condition of rest or of motion.

a. Inertia   b. Toughness   c. Stillness

1.10 The _________________ of an object measures the pull of gravity on its mass.

a. stability   b. weight   c. inertia

Special properties. There are many kinds or varieties of matter in the universe. One kind of matter differs from another kind. For example, a rock differs from cheese. Both a rock and cheese differ from water. Therefore, there are some properties of matter that are specific to the different kinds of matter. These are called *special properties* of matter.

There are two main categories of special properties of matter: (1) *physical properties* and (2) *chemical properties*. Let's explore each of these special properties of matter.

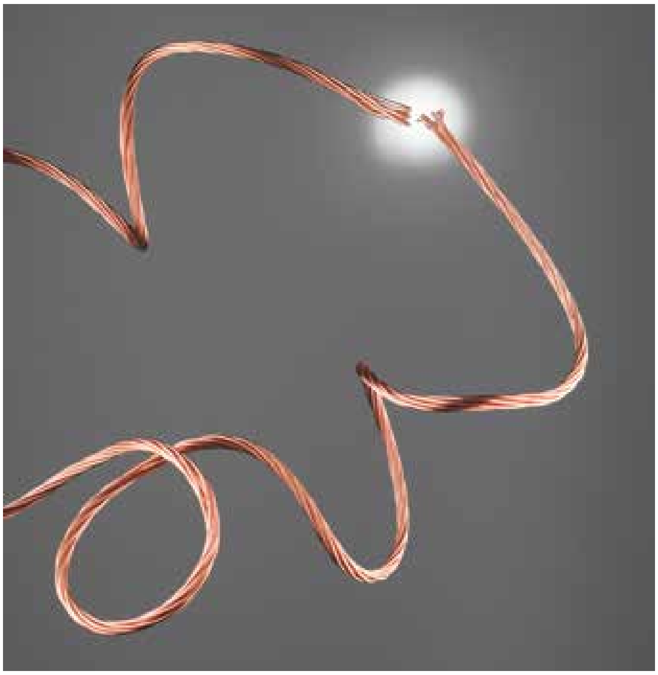
Physical properties help us to recognize different kinds of matter by the five senses. Our sight, smell, touch, taste, and hearing allow us to distinguish between a great variety of matter. For example, by sight, we can recognize gold by its *color*. It would look different from silver because silver has a different color than gold. Therefore, *color* would be a physical property of matter. Another physical property using one of the five senses would be *odor*. We could tell the difference between gasoline and water by the odor of each.

There are other physical properties that can be used to distinguish matter of different kinds. An important one of these other physical properties is **density**. Density is the amount of mass in a given volume of matter. It is measured in units like pounds (mass) per cubic foot or kilograms per cubic meter. Density is a physical property that varies among different kinds of matter. For example, the density of steel metal would be much greater than the density of cork. There would be more mass in a cubic inch of steel than in a cubic inch of cork because the density of steel is greater than that of cork.

Brittleness is another physical property of matter. Suppose you threw a ball through a closed window. What would happen? The glass in the window would break into many pieces, but the ball would not break. By easily breaking into many pieces, the glass shows that it has the physical property of *brittleness*. Like other physical properties, brittleness differs from one kind of matter to another.

| The glass breaks because of its brittleness.

Two other physical properties of matter will be mentioned before we go on to the chemical properties of matter. One of these is *solubility*. This is the ability of one kind of matter to dissolve in another. For example, some materials will more readily dissolve in water than others. We would say that the materials that dissolve more readily would have greater solubility than the others. Another important physical property of matter is its ability to **conduct** heat or electricity. This physical property is called *conductivity*. Copper wire is an example of matter that has a higher conductivity than many other materials. Both heat and electricity are easily conducted through copper.



| Copper conducts both heat and electricity.

|A drop of ink showing its solubility in water.

509.B DETERMINE A PHYSICAL PROPERTY

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You will determine the identity of a physical property of matter in this experiment.

These supplies are needed:

- 2 glass containers of water
- small piece of wood (toothpick)
- spoonful of sugar
- spoon or stir stick

Follow these directions carefully. Put a check in the box when each step is completed.

☐ **1.** Place the wood in one container of water. Stir it around.

☐ **2.** Place the sugar in the other container of water. Stir it around.

Answer these questions.

1.11 What happened to the wood? ____________________

____

1.12 What happened to the sugar? ____________________

____

1.13 What physical property of matter is involved in this experiment? ____________________

____

1.14 Which material is greater in this physical property? ____________________

____

Teacher check:

Initials ____________________ Date ____________________

Answer *true* or *false*.

1.15 __________ Our five senses can help us to recognize some of the physical properties of matter.

1.16 __________ Color and odor are examples of common properties of all matter.

1.17 __________ Density is the amount of mass in a given volume of material.

1.18 __________ Brittleness is a physical property that differs from one kind of material to another.

1.19 __________ The ability of one kind of matter to dissolve in another is called *conductivity*.

1.20 __________ Copper wire has a high electrical conductivity.

As you have learned, physical properties are one kind of special property of matter. A second special property of matter involves the *chemical properties* of that particular matter. Chemical properties of matter describe how a substance acts when it undergoes chemical change. All matter has chemical properties. Some of these chemical properties of matter cannot be observed unless that material is tested. Let's consider a couple of examples of chemical properties of matter.

One well-known chemical property of matter is the *ability to burn*. This chemical property is sometimes called **combustibility**. You have probably seen wood, paper, and candlewicks burning. These materials can burn easily when a flame of fire touches them. When materials burn, they combine with oxygen to produce other chemicals. There is a chemical change in the original material. Other materials have a very low combustibility. For example, rock will not burn when a normal flame touches it.

Another chemical property found in some materials is the *ability to rust*. Have you ever seen a nail or a piece of metal containing iron that was left outdoors for some time? More than likely, the material had formed a reddish brown coating on it. This coating is called *rust*. Rust forms when iron in the metal combines with oxygen in moist air to form iron oxide. The iron oxide is the rust. Therefore, the metal undergoes a chemical change when rust is formed. Many other materials do not form rust. Plastics and rubber are examples of matter that do not form rust. Therefore, the ability to rust is a chemical property that differs from one material to another.

| Rust is an iron oxide coating.

Complete these lists.

1.21 What are two kinds of special properties of matter?

a. ______________________________

b. ______________________________

1.22 What are two kinds of chemical properties of matter?

a. ______________________________

b. ______________________________

Answer these questions.

1.23 What is the combustibility of matter? ______________________________

____

____

____

1.24 What is "rust" and how does it form? ______________________________

____

____

____

1.25 How can you weigh more on the earth than you would on the moon and still have the same mass in both places? ______________________________

____

____

____

1.26 Would your density be the same on the earth as it would be on the moon? Explain your answer. ______________________________

____

____

____

Changes in Matter

Matter can change. In fact, we see cycles in nature because matter changes. God has designed all matter in the universe to be able to change. Normally, matter can be changed in two basic ways: *physical changes* and *chemical changes*. We will explore both types of changes in this section of the LIFEPAC.

Physical changes. Matter undergoes many physical changes. Physical change happens to matter whenever it changes in *size*, *shape*, or *location*. For example, breaking a rock into smaller pieces would change the size of the rock. Cutting off a slice of margarine would change the size of the stick of margarine. Rolling out a piece of modeling clay would change the shape of the clay. Pouring water from a glass into a bowl would change the shape and location of the water. All of these changes represent physical changes.

Clouds are water in gas state (water vapor). When cooled, the cloud produces rain (liquid state).

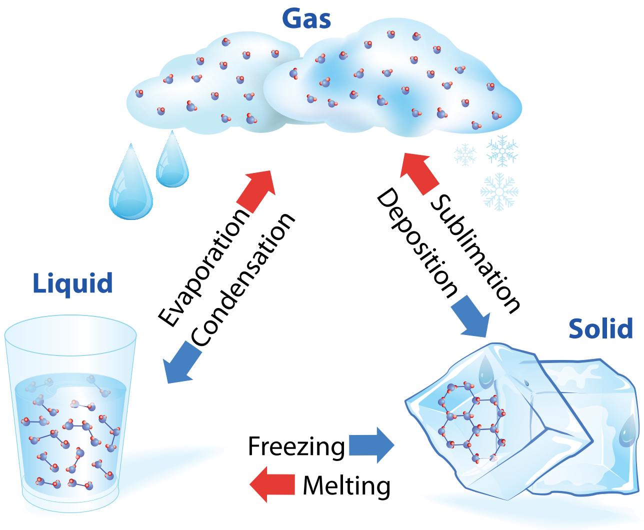
In previous LIFEPACs, you have studied other physical changes occurring in nature. Plants and animals change in size through growth. Living things change when they move, breathe, or reproduce. The earth's crust changes, too.

Rocks are formed in sediment. Rocks wear away by weathering. Mountains are changed by folding and faulting. These changes are also examples of physical changes of matter in nature.

Another important physical change to matter happens when it changes its *form* or *state*. Normally, matter is found in three states: *solid*, *liquid*, or *gas*. Matter can change from one state to another; for example, from a solid to a liquid. In a way, matter has a cycle when it changes from one state to another and back again. When ice melts and forms water, it changes state from a solid to a liquid. If the water is now heated, it forms steam—which is water in the gas state. If the steam is cooled, it returns to water. If it is cooled further, it freezes and becomes ice again. Therefore, the water cycles from solid to liquid to gas and back again. This is a cycle of nature.

Many things that we see around us are **normally** solid. Your pencil is in a solid state. Your chair is solid, too. Things that are solid usually have a fixed form and shape. If you simply move a solid to another location, it will still have the same form and shape as before. As you learned previously, a solid can be changed physically by breaking it into smaller pieces or changing its size or shape. However, it will still be solid.

A material will change from solid to liquid state by adding heat to it and changing its temperature. If ice is heated to just above 32 degrees Fahrenheit (0 degrees Celsius), it will melt into water. A solid metal spoon will become liquid metal if it is heated to a temperature hot enough for it to melt. You may remember from a previous LIFEPAC that magma is the liquid form of certain rocks. The magma is at a very hot temperature! Some solids require much more heat than other solids to change to the liquid state. It takes much more heat to change solid rocks to liquid than it does to change ice into water.



| Matter can change from one state to another.

Some materials in nature are normally in liquid form. Water is a good example. Liquids do not have a fixed shape or form. Liquids take the shape of the container in which they are held. Liquids usually change shape when they are moved from one location to another since the container will be different. A liquid will change to another state by adding or taking away enough heat. If enough heat is added to water to raise its temperature to 212 degrees Fahrenheit (100 degrees Celsius), it will boil and turn to

| Nitrogen is a gas at room temperature but a liquid at very cold temperature.

steam—or water in the gaseous state. However, if enough heat is removed from water, it will freeze and become ice—water in the solid state.

Finally, some matter is normally in the gaseous state. The air around us is gas. In fact, air consists of several gases mixed together, mainly nitrogen gas and oxygen gas. You should also recall that water is found in the air. This water found in air has evaporated from oceans, lakes, and other bodies of water on earth as part of the water cycle in nature. This water in the gaseous state found in air is also called water vapor.

A gas takes the shape and size of its container. A gas does not have a fixed shape and size of its own. A gas can be changed to a liquid by removing heat from the gas. For example, if oxygen in the air is cooled low enough, it becomes liquid oxygen. Liquid oxygen is sometimes used in industry and to provide combustion in rockets.

Complete these statements.

1.27 Matter that has its own size and shape is in the ______________ state.

1.28 Matter that takes the size and shape of its container is in the _________________ state.

1.29 Adding enough heat to a solid will change it to the ____________________ state.

1.30 Removing enough heat from a gas will change it to the _______________ state.

1.31 Changing matter from one state to another is a ___________________ change.

1.32 Matter changing states is an example of a ______________ in nature.

509.C WATER IN LIQUID STATE

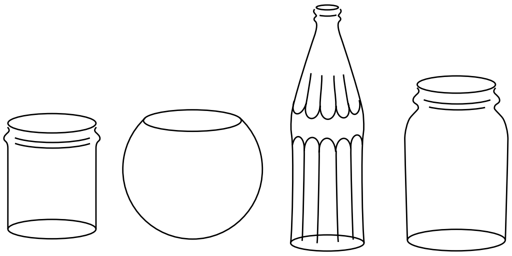
View 509 WATER IN LIQUID STATE: Grade 5 Science experiments video

Water will be poured into four different types of containers in order to demonstrate some things about liquids.

These supplies are needed:

a baby-food jar or similar small container

4 other differently shaped clear containers (see examples below)



Follow these directions carefully. Put a check in the box when each step is completed.

☐ **1.** Draw a picture of a different container in the boxes below.

Container 1	Container 2	Container 3	Container 4

☐ **2.** Fill the baby-food jar (or other small container) full with water and pour one full jar of water into each one of the other four containers.

☐ **3.** In each of your drawings, shade the area that now contains the water.

Complete these activities.

1.33 Compare the water level in each of the containers. ______________________

____

____

____

1.34 Compare the volume of water in each of the containers. ______________________

____

____

____

1.35 Compare the shape of the water in each of the containers. ______________________

____

____

____

1.36 Why is the water level different for some of the containers? ______________________

____

____

____

1.37 What does this experiment show about matter in the liquid state? ______________________

____

____

____

Complete this activity.

1.38 Place each of the following items under the correct state in which it normally occurs.

pencil	steam	fingernail	apple juice	
ink	hammer	cotton	milk	
gasoline fumes	needle	cookie	blood	oxygen

Solid	Liquid	Gas

Chemical changes. As you read previously in this section, burning and rusting cause *chemical changes* in matter. Chemical changes are much different than physical changes in matter. In chemical changes, the matter transforms into a different kind of matter. The chemical makeup of the material changes. However, physical changes in matter can also occur at the same time as chemical changes occur.

| Rusted iron chains

When paper is burned, it is no longer paper. It changes into another material—mainly carbon ash. When iron gets rusty, it is no longer pure iron. It changes into a new material—iron oxide, or "rust." The paper and iron change into new materials. The new materials will have different physical and chemical properties. They will usually look, smell, or feel differently than their original forms, because the matter has been changed both chemically and physically.

Answer *true* or *false*.

1.39 __________ When water is changed into steam, a chemical change occurs.

1.40 __________ Physical change and chemical change can happen at the same time.

1.41 __________ Sometimes new materials are not formed during chemical change.

1.42 __________ Burning only causes a physical change in paper.

1.43 __________ Rust is not the same material as iron.

509.D CHEMICAL AND PHYSICAL CHANGES

View 509 CHEMICAL AND PHYSICAL CHANGES: Grade 5 Science experiments video

NOTE: This experiment should be done with adult supervision.

____
Adult Signature

You will burn a candle and observe any physical and chemical changes that occur.

These supplies are needed:

- candle in candle holder
- large glass plate or pan
- match or lighter

Follow these directions and complete the activities. Put a check in the box when each step is completed.

☐ **1.** Light the candle with the match. Observe it for several minutes. Answer 1.44.

☐ **2.** *Be careful not to burn your hand in this step*. Hold the glass plate (or pan) about a decimeter (or 3–4 inches) above the flame. What happens? Record your observation in 1.45 and 1.46.

☐ **3.** *Be careful not to burn your hand in this step.* Hold the glass plate (or pan) just above the flame for a short time. What do you observe? Record these things in items 1.47 and 1.48.

1.44 List the changes you observe taking place in the candle. ______________________

1.45 What happened to the plate when held about a decimeter (or 3–4 inches) above the flame? ______________________

1.46 What caused this particular thing to take place? ______________________

1.47 What happened to the plate when held just above the flame? ______________________

1.48 What do these results show? ______________________

1.49 List all the changes that took place in this experiment. Label them *ch* (chemical) or *ph* (physical).______________________

| The total mass before and after burning is the same.

Conservation of matter. You have seen things burn. You have observed ice melting. Perhaps you have seen glass break. What happens to the matter during all these changes? Is matter lost? Is it used up?

Matter often appears to be lost when it changes. For example, when paper burns, it seems like only a small amount of ash is left. The ashes are much smaller in volume than the original paper. The paper appears to have been destroyed. However, the matter has not been lost in this case. The matter has changed to different materials. The same amount of mass remains as before.

Scientists have learned how mass is not lost through burning. They have conducted experiments with burning to show this **conservation** of matter. The scientists use an airtight container to conduct the experiments so that no mass can escape from it. The mass of the matter to be burned and the mass of the air inside the container are measured. Then the material is burned within the container. After burning, the mass of the burned matter (the ashes), the unburned matter, the gases, and smoke is measured. The scientists always find that the total mass inside the container is exactly the same before burning and after burning. Chemical changes do not change the total mass of materials. There is *conservation of matter* during chemical changes.

The same results happen during physical changes of matter. When matter changes from one state to another, the total mass is conserved. For example, when water is boiled, the level of water in the container appears to get lower. It appears that there is less mass of the water as it boils. However, experiments conducted in airtight containers show that no mass is lost when water boils and changes from the liquid to gas state. One kilogram of water could be changed into steam inside an airtight container. However, the mass of the resulting steam would also be one kilogram. No mass is lost or destroyed during the boiling of water. There is *conservation of matter* during physical changes and changes from one state to another.

The earth has a certain amount of matter. Matter cannot be created or destroyed by nature. Except for the small amounts of mass sent into space by rockets and the mass changed in nuclear reactions (described in the next part of this section), the same amount of mass exists on Earth today as did 100 years ago! This same amount of mass cycles through nature constantly on Earth. Matter changes from one state to another and from one material to another. This cycle of matter in nature is an ongoing process. This cycle of matter in nature is even necessary for life to continue on Earth.

| Earth is the same mass as 100 years ago.

If no matter is created or lost, how did it get here on Earth? This question has puzzled people for many years. Yet, the answer is found in the Bible. The Bible says that God created the earth. God created all the matter that exists today. It is the same amount of matter that existed when God created the earth long ago. Matter was created once by God. It has been cycling constantly through nature ever since.

Write the correct letter and answer on each line.

1.50 Matter is not created or destroyed when it ____________________ .

a. changes state b. is made c. is lost

1.51 The ____________________ of matter means that matter is not created or destroyed.

a. conservation b. consecration c. concentration

1.52 A thousand years ago, the same amount of ____________________ was on earth as today.

a. oil b. volume c. mass

1.53 When water changes state from a gas to a liquid, the ____________________ of the water remains the same.

a. mass b. color c. volume

1.54 Matter ____ lost when it burns.

a. does get b. does not seem to be c. appears to get

Complete this activity. Sometimes it is necessary to make *predictions* after reading some information. To predict accurately, the reader must understand the information. The prediction is made as a result of the understanding. A prediction is more than a guess. A prediction is based upon information understood by the person making the prediction. However, the person making the prediction is not certain of the results. After an event happens and the results are certain, a prediction can be tested for accuracy.

In this activity, you will make some predictions. Your predictions will be based on the information contained in the section you have just finished reading titled *Conservation of matter*. Read the next experiment (Experiment 509.E). Then *predict* the answers to the questions below:

1.55 How will the ice change? ____

____

____

____

1.56 How will the mass of the ice respond to the change? ____________________

____

____

____

1.57 Why will the mass respond in this way? ____________________________

____

____

____

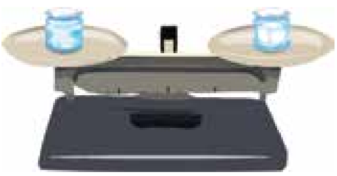
509.E CONSERVATION OF MATTER

View 509 CONSERVATION OF MATTER: Grade 5 Science experiments video

Using an equal-arm balance to measure mass, you will see if conservation of matter occurs when ice melts.

These supplies are needed:

equal-arm balance (see illustration below)
ice cube
2 baby-food jars with equal mass
dropper
2 baby-food jar lids with equal mass



Follow these directions carefully. Put a check in the box when each step is completed.

☐ **1.** Place the ice cube in one jar. Tightly close the lid. Put the jar on one side of the balance.

☐ **2.** Pour some water into the remaining jar. Place it on the other side of the balance. Put the lid beside the jar on the balance pan.

☐ **3.** Use the dropper to add or remove water from the jar until the balance is equal. Place the lid tightly on the jar or water.

- ☐ **4.** Allow the ice to melt in the closed jar. You may go ahead to the next step while the ice is melting.
- ☐ **5.** Go back and review your predictions in Questions 1.55, 1.56, and 1.57. Change your predictions, if necessary. Then, when the ice is melted, complete the questions and activities.

Answer these questions.

1.58 What happened to the mass of ice after it melted? ______________________

____

____

1.59 Why did this thing happen? ______________________

____

____

Complete this activity.

1.60 Compare the results of this experiment with your earlier predictions.

____

____

____

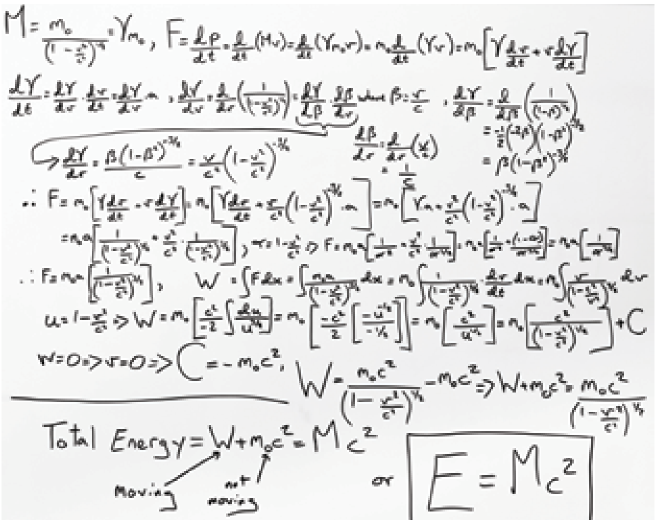
Use the Internet or the library.

1.61 A French scientist named Antoine Lavoisier made some important observations. Use the Internet or library to learn more about him. On another piece of paper, write a summary of his observations and findings. Explain how his studies relate to your study of matter. Take this LIFEPAC and your summary to your teacher for a teacher check over this section.

Teacher check:

Initials ______________ Date ______________

Matter and energy. In 1905 a German-born scientist named Albert Einstein developed some mathematical formulas to explain the relationship between mass and energy. For several centuries before Einstein developed his formulas (contained in his "special theory of relativity"), scientists believed that matter could neither be created or destroyed. However, Einstein showed that matter can be changed into energy and energy into matter.



| Einstein's special theory of relativity

In a previous LIFEPAC, you studied the *transformation of energy* and learned that chemical changes can give off heat and light, as in the process of fusion in the sun. Einstein's formulas showed that whenever a chemical change occurs to give off heat and light, then the substances that changed must have lost some mass. However, in all the normal chemical reactions that have taken place in factories, laboratories, and homes in history, the total amount of mass lost so far is too small to be significant! Einstein's formulas show that measurable quantities of mass are changed into energy only in nuclear reactions such as those that occur in nuclear reactors and atomic bombs. Since Einstein's work in the 20th century, scientists now speak of a *law of conservation of mass and energy* which states: "Neither mass (matter) nor energy can be created or destroyed, but each may be converted into the other." Isn't it amazing that God has even created a cycle between matter and energy!

Match these items.

1.62 __________ mass

1.63 __________ volume

1.64 __________ conductivity

1.65 __________ Lavoisier

1.66 __________ Einstein

a. a special physical property of matter

b. a special chemical property of matter

c. measures inertia

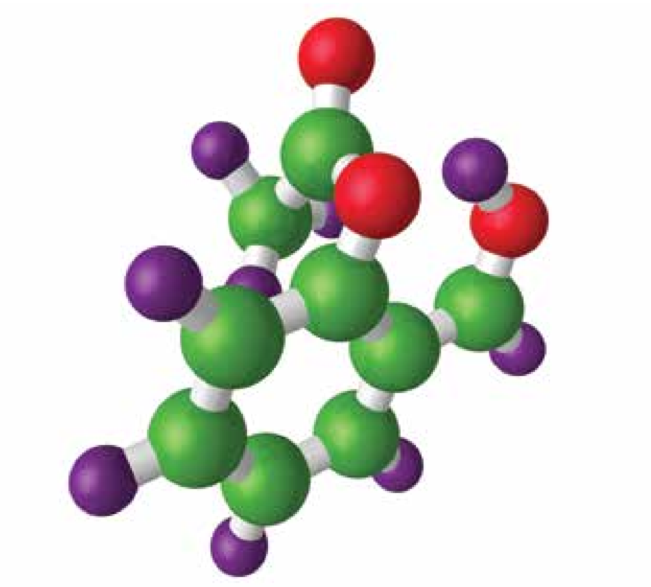
d. the quantity of matter

e. the space taken up by matter

f. showed conservation of matter

g. showed relationship between matter and energy

Structure of Matter



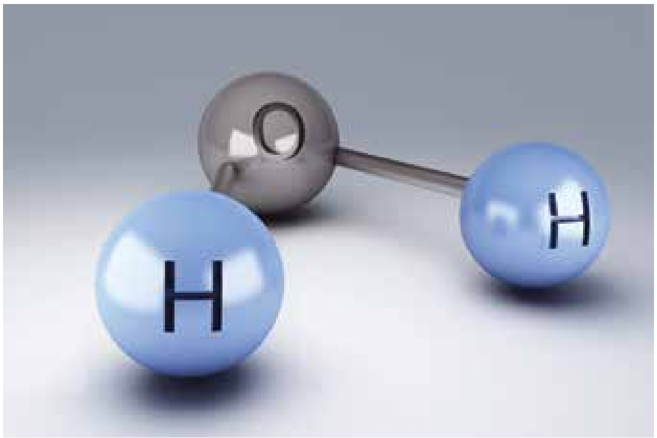
| Molecule model

What is the basic substance of matter? How is matter structured? In the remainder of this section of the LIFEPAC, you will study the basic structure of matter. You will learn about the basic particles that make up all matter. You will also learn about some ways these particles are in motion.

Particles of matter. Matter consists of basic particles called **molecules**. You learned in a previous LIFEPAC that all living things are made of cells and that most cells are microscopic. Well, molecules are much smaller than cells. In fact, cells are made up of these very small particles of matter called molecules. These molecules are so tiny that only the largest of them can be seen with the most powerful electron microscopes!

Molecules are the smallest bits of matter that can **exist** without a chemical change. They are the smallest particles into which a substance can be divided and still have the chemical identity of the original substance. Water is made up of water molecules. One drop of water contains billions of water molecules. If one molecule from that drop of water was separated from the rest, it would still be water. However, if that one water molecule was divided further, it would no longer be water. It would be something else.

Each molecule of matter is made up of particles that are even smaller. These smaller particles are called **atoms**. Atoms are very, very tiny. They are more than a million times smaller than the thickness of a human hair! Atoms are the basic building blocks of all matter. They form the most basic substances of nature called the chemical *elements*. There are about 103 chemical elements. Copper, **hydrogen**, carbon, and oxygen are examples of common elements.



| A water molecule is H_2O.

When atoms of elements combine, they form molecules. Atoms join together in different ways to make millions of different kinds of molecules. One example is the water molecule. Each water molecule contains three atoms. Two of these are hydrogen atoms, and the other one is an oxygen atom. Since the chemical **symbol** for hydrogen is "H" and the chemical symbol for oxygen is "O," water is sometimes written as H_2O.

This means that the water molecule has two atoms of hydrogen and one atom of oxygen. All molecules can be represented by the chemical symbols for the number and types of atoms contained in each molecule. Carbon dioxide, for example, is written as CO_2 and contains one atom of carbon (C) and two atoms of oxygen (O). Water and carbon dioxide are examples of *chemical compounds*. They are called chemical compounds because they are made up of molecules that are formed by the combination of different atoms.

| CO_2 being emmitted from a factory

Both molecules and atoms can combine in chemical reactions to form other chemical compounds. Compounds can also split in chemical reactions to form elements and other compounds. The new compounds or elements from chemical reactions have different chemical properties than the original elements or compounds. As compounds are formed or split, matter is cycled through nature.

Motion of particles. Molecules are always in motion. They are so tiny that we cannot see them move, but they are always moving. Molecules are in motion when the material is in the solid, liquid, or gas state.

In solids, the molecules are grouped very close together. The molecules hold their positions, but they still move around very fast. Even though the whole solid material keeps a fixed size and shape, the tiny molecules within the material are moving ever so slightly and at a very fast rate.

When heat is transferred to a solid material, the molecules within the material begin to move faster and farther apart. Eventually, when enough heat is transferred to the solid material, it becomes a liquid. The molecules of a liquid are farther apart and move faster than those in a solid.

| Melted gold (liquid) is poured into a mold. When the gold cools, it becomes a solid bar.

If still more heat is transferred to the liquid material, the molecules move even faster and farther apart. When enough heat is transferred to the material, it becomes a gas. Molecules in a gas are very far apart and move very fast. The molecules of a gas material are farther apart and move faster than the same material in liquid state.

Whether matter is in solid, liquid, or gas state, the molecules of the material are moving. You cannot see them move because they are so small. However, you can observe their movement in other ways. For example, when your family members prepare popcorn to eat, the molecules moving from the heated popcorn can be smelled in other parts of your house! Also, the heat absorbed by ice cream causes its molecules to move faster and farther apart, and the ice cream begins to melt. The motion of particles within matter helps to continue the cycles in nature.

Complete these statements.

1.67 ______________________________ are the smallest particles of matter that can exist without a chemical change.

1.68 ______________________________ form the most basic substances of nature called the chemical elements.

1.69 Chemical ______________________________ are made up of molecules that are formed by the combination of different atoms.

1.70 Molecules are always in ______________________________ .

1.71 Molecules in the liquid state move ______________________________ than in the solid state.

1.72 A gas has molecules that move faster and are ______________________________ than in the liquid state.

1.73 The motion of particles helps to continue the ______________________________ in nature.

Review the material in this section to prepare for the Self Test. The Self Test will check your understanding of this section. Any items you miss on this test will show you what areas you will need to restudy in order to prepare for the unit test.

SELF TEST 1

Match these items (each answer, 3 points).

1.01 __________ color

1.02 __________ volume

1.03 __________ odor

1.04 __________ mass

1.05 __________ density

1.06 __________ inertia

1.07 __________ brittleness

1.08 __________ measurement

1.09 __________ solubility

1.10 __________ liquid

a. common property of matter

b. special property of matter

c. not a property of matter

Answer *true* or *false* (each answer, 2 points).

1.011 __________ Matter is the substance that we can sense and observe.

1.012 __________ Matter does not go through change or cycles.

1.013 __________ All matter in the universe has some common properties.

1.014 __________ Ten gallons of water is a measurement of its mass.

1.015 __________ An object's weight is always the same as its mass.

1.016 __________ Inertia causes an object at rest to remain at rest.

1.017 __________ Density is the amount of mass in a given volume of material.

1.018 __________ Changing from liquid to gas is a chemical change.

1.019 __________ Gas molecules of material move slower than those of a liquid of the material.

Write the correct answer on each line (each answer, 3 points).

1.020 An example of a physical change in a material is ______________________________ .
a. breaking it b. rusting c. a nuclear reaction

1.021 An object in motion will keep moving because of its ______________________________ .
a. size b. speed c. inertia

1.022 The ability to conduct heat is a ______________________________ property of matter.
a. chemical b. physical c. common

1.023 The chemical symbol for water is ______________________________ .
a. H_2O b. CO_2 c. CH_2

1.024 A chemical ______________________________ is made up of all the same atoms.
a. element b. compound c. shape

1.025 Matter can ______________________________ when it changes from one state to another and back again.
a. disappear b. be created c. cycle

List the three common states of matter (each answer, 3 points).

1.026 ______________________________

1.027 ______________________________

1.028 ______________________________

Complete these statements (each answer, 3 points).

1.029 Matter that has its own size and shape is in the ____________ state.

1.030 Changing matter from one state to another is a _________________ change.

1.031 A ______________ change always produces new materials.

1.032 When matter changes from one state to another, the total mass is _____________ .

1.033 ______________ form the most basic substances of nature called the chemical elements.

Answer these questions (each answer, 5 points).

1.034 What is the *law of conservation of mass and energy*? ________________________________

____

____

____

____

1.035 How can heat change matter from a solid to a liquid to a gas? ____________________

____

____

____

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Teacher check: Initials ____________

Score ____________________ Date ____________

80/100

SCI_Gr3-5

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