

SAMPLE PAGES FOR  
CHALLENGE THE  
8TH GRADE SCIENCE

**F**lorida **C**omprehensive **A**ssessment **T**est

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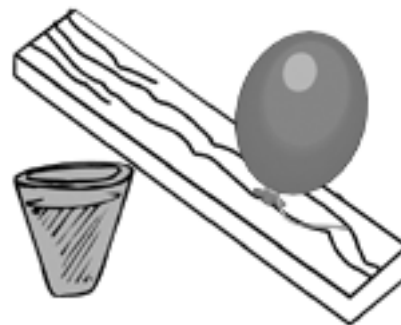
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## DESCRIBING MATTER

**How is matter classified?**

What do air trapped in a balloon, water held in a glass, and a block of wood have in common? All are made up of matter. **Matter is anything that has mass and fills a space.** The air in the balloon, the water and the block of wood all have mass and take up space. **Volume** is the amount of space that a material occupies. So regardless of the phase a substance is in solid, liquid or gas, it has characteristics that can help to classify it. What are some other ways that



matter may be classified? The shape, texture, and density of materials help people distinguish between some substances. You can tell the difference between a piece of sandpaper and a plastic cup with your eyes closed. The sandpaper and the plastic cup have different textures. You can also tell a nail from a ball by touch, by using the shape of the object to identify the material.

**What is mass?**



**electronic balance**

**Mass** is the amount of matter in an object. Some students have a hard time applying this concept. Although mass can be estimated, a balance or scale is usually needed to determine an object's mass. To measure the mass of a watch, place the watch on a balance. The measurement is usually reported in units of grams or kilograms. Two different objects can have the same mass if they both have the same amount of matter. The mass of an object does not change based on its location.

**What is weight?**

**Weight** is often confused with mass. The weight of an object tells how hard the force of gravity is attracting an object. Weight is usually measured with a scale. The common unit for weight is pounds. The weight of an object does depend on the object's location. For instance, if an astronaut travels into space, he/she has moved farther away from the source of gravity, the Earth. The Earth's gravity pulls less on the person and so his/her weight is less than when on the surface of the Earth. The astronaut has not lost any mass, but his/her weight has been reduced.



**What is volume?**

**Volume**, as stated earlier, is the amount of space occupied by an object. The more “room” or “space” an object fills, the larger the object’s volume. A balloon half-filled with air has a smaller volume than a similar balloon completely filled with air. Common units used to measure volume are liters, milliliters, cubic centimeters, cubic feet, cubic meters, gallons, and quarts. In the laboratory, graduated cylinders, pipettes, and beakers can be used to measure volumes.

**What is density?**

**Density** is another concept that is sometimes confusing. Think of density as a measure of the compactness of a material. A sponge is easily squished, so its density is low. A brick is hard to squeeze, so it has a higher density. The mass and volume of a material, like a piece of gold, can change depending on how much of the material you have. A small piece of material would have a smaller mass and volume than a larger piece of the same material. But the density of the pure material always remains the same. It doesn’t matter if you have a small piece of gold or a huge block, the density of both pieces would be the same. Density is defined as the mass of an object divided by its volume. In equation form:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

**How is density measured?**

Since density is found by dividing the mass by the volume of an object, density’s units will be similar to the ones used for mass and volume. The common units of measure for density include grams/milliliter, kilograms/cubic meter and any other mass unit divided by a volume unit. Density can be used to identify materials that otherwise look similar. For instance, a piece of aluminum foil and steel spoon about the same size look much alike until you pick them up. The steel spoon has a greater density than aluminum so the spoon feels much heavier than the piece of foil.

**Further Study**

<b>matter</b>	<b>mass</b>	<b>volume</b>	<b>shape</b>	<b>texture</b>
<b>density</b>	<b>units</b>	<b>weight</b>		

**Questions for you to answer**

1. What is matter? Give an example of matter.

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2. What is mass?

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3. Two objects have the same mass. Does this mean that both objects must have the same volume?

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4. A person who weighs 150 pounds travels to a new planet that has less gravity than the Earth. Does the person's weight change? Does the person's mass change?

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5. Name two materials that have different textures.

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6. Two objects have the same volume. Does this mean that both objects must have the same mass?

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7. Two objects have the same density and volume. Does this mean that both objects have the same mass?

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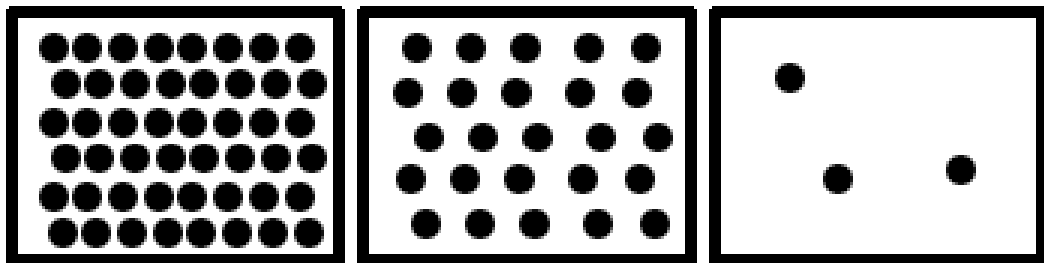
## PHASES OF MATTER

**What are the major phases of matter?**

On Earth most substances are found in one of three different **phases: solid, liquid or gas**. A few substances, like water, can exist in all three phases on Earth at the same time. Have you ever seen a snow-covered stream of water with steam rising from the stream's surface? If you have, you've seen water in all three phases of matter. The solid water is the snow, the liquid would be the stream and the gas phase would be the steam.

**How does a solid differ from a liquid or gas?**

The current phase of a substance depends on two factors: the movement of its particles and how close together the particles are. Particles in the solid phase cannot change positions; they can only vibrate in place. These particles are very closely packed together. To help you understand what the phases are like, imagine that you and your classmates are the particles of a substance. Think of everyone in your class packed inside a regular-sized car. That's about how closely the particles of a solid fit together. The only movement anyone could make would be to vibrate in his/her position. In the liquid phase the particles can slowly change positions with their nearest neighbors. These particles also vibrate in place. Particles in the liquid phase



**Solid**

**Liquid**

**Gas**

**Distance between particles in different phases**

are still very closely packed, although they have a little more room for moving around. Think of you and your classmates packed into a walk-in closet. You might be able to slowly squeeze across the closet, but you would not be able to quickly get to the other side. In the gas phase the particles move freely and very quickly. These particles are very far apart compared to those in the other phases. Imagine your classmates at a large theme park with no one else around. You and your classmates would rarely see each other and would be able to move around rapidly with few other "particles" getting in your way.

**What is temperature?**



Thermometer

**Temperature** gives a measure of how much the particles of a substance are vibrating and moving around. The greater the movement of the particles, the higher the temperature. Officially, temperature is the average **kinetic energy** of the particles of a substance. Kinetic energy is the amount of energy that particles have due to their motion. It's hard to believe that all substances have particles that vibrate, even ones in the solid phase, since you cannot see or feel those particles moving, but they do. Temperature is a way to tell the difference between the particles in the solid or any other phase that are not moving very much (a low temperature) and those in the same phase that are moving a little bit more (a higher temperature). The common units used to measure temperature are degrees **Celsius** ( $^{\circ}\text{C}$ ), degrees **Fahrenheit** ( $^{\circ}\text{F}$ ) and **Kelvin** (K). Thermometers measure temperature. Try to move away from the idea that temperature only tells you how hot or cold a substance is to a deeper understanding of temperature as a measure of particle motion.

**Further Study**

phase	solid	liquid	gas	kinetic energy
temperature	Celsius	Kelvin	Fahrenheit	

**Questions for you to answer**

1. What are the three phases of matter?

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2. Oxygen is a gas at room temperature. Does this mean that oxygen cannot exist in any of the other phases of matter?

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3. A substance goes from the liquid phase to the gas phase. Do the particles of the substance get closer together or farther apart? Explain your response.

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4. In which phase do particles move the fastest?

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5. Define kinetic energy.

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6. A third-grade student defines temperature as being the hotness or coldness of an object. In your own words, write a deeper definition for temperature that involves the idea of kinetic energy.

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## CHANGING MATTER

How is matter changed?

Matter may be changed in a couple of ways, either chemically or physically. A chemical change results in a substance with a new identity. In a chemical change a new material forms by changing how the atoms of a material or materials are arranged. For example, hydrogen is a highly explosive gas. Oxygen is a gas that supports explosions. Put hydrogen and oxygen together and the atoms rearrange into a substance with a new identity called water. Water can put out fires and explosions. The changing of how the atoms were arranged makes a new substance with very different properties from the original materials. To detect a chemical change, hunt for materials whose identity changes.



**HYDROGEN** and **OXYGEN**  
**GAS** and **GAS** form **WATER** and **ENERGY**

What is a physical change?

A physical change does not result in the forming of a new substance. Physical changes come from changing the size, shape, or phase of a material. Examples of physical changes include grinding up a powder, cutting a log in half, crushing an aluminum can or dissolving some sugar in a glass of water. In each of these cases, the material's size, shape or phase changed, but the change did not result in a new substance. Students usually have very few problems recognizing changes in shape or size as being physical changes. The change in phase is the area where students get tricked sometimes. When sugar dissolves in water, the sugar goes from the solid to being in the liquid phase. The sugar can easily be returned to the solid phase by boiling the water off. So the sugar's identity did not change. No identity change means that only a physical change took place.

**Further Study**

**matter      chemical change      physical change      phase**  
**identity      properties**

**Questions for you to answer**

1.      What is a chemical change?

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2.      What is a physical change?

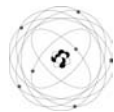
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3.      Identify the following as being a chemical or physical change.

- a.      a metal pole rusting \_\_\_\_\_
- b.      water boiling \_\_\_\_\_
- c.      salt dissolving in water \_\_\_\_\_
- d.      crushing a piece of wood \_\_\_\_\_
- e.      burning a piece of wood \_\_\_\_\_
- f.      polishing a CD \_\_\_\_\_
- g.      baking a cake \_\_\_\_\_



## ATOMIC THEORY

The **atomic theory** helps us understand the behavior of **atoms**. The following five ideas help explain how atoms behave.

What is the atomic theory?

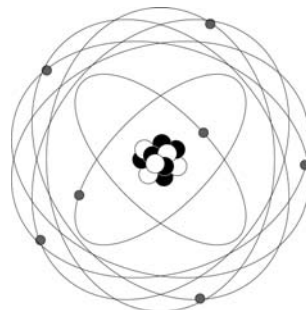
- All **matter** is made up of very small particles called atoms.
- Atoms of the same **element** are alike, while atoms of different elements are different. For instance, all sodium atoms have 11 protons and 11 electrons. A gold atom has a different number of protons and electrons.
- Atoms of the same element might not have the same mass. Even though all sodium atoms have 11 protons and 11 electrons, the atoms might have a different number of neutrons, which means they might have different masses.
- Atoms of different elements have different average masses.
- Atoms do not break down into smaller parts in an ordinary chemical reaction.

How big are atoms?

Atoms are incredibly small. The naked eye cannot come close to being able to see an atom. The radius of an atom is about one-millionth the length of a meter stick. Atoms have two major areas, the **nucleus** and the **electron cloud**. The electron cloud occupies most of an atom's space. This is the area around the nucleus that contains the electrons. Inside the central core, or nucleus, of an atom reside the protons and neutrons.

What's on the inside of an atom?

About 99% of an atom is empty space. The nucleus is a very small region in the middle of an atom. Although very small, the nucleus contains most of the mass of the atom. A single **proton** or **neutron** has a mass about 2000 times greater than the mass of an **electron**. The **atomic number** tells how many protons an atom contains. For instance, the atomic number of lithium is 3, so all lithium atoms have 3 protons. The **mass number** is the sum of the protons and neutrons for a given atom. Lithium's



Protons

Electron cloud

A model of an atom

most common form has 3 protons and 4 neutrons, so it would have a mass number of 7. Lithium also has a less common form that has 3 neutrons and has a mass number of 6. This form of lithium is called an **isotope** because it has the same number of protons, 3, but a different number of neutrons. The most common lithium has 4 neutrons, while this form of lithium has only 3 neutrons. Protons have a positive charge, electrons a negative charge, and neutrons have no net charge. An important rule that must be remembered about atomic theory is that all atoms are **neutral**. This means that atoms have the same number of positively charged particles as negatively charged ones. This does not mean that all atoms have the same number of positively charged particles. Some atoms might have five positively charged particles while most others have a different number of positive particles. Some objects and particles can be neutral or have a positive or negative charge, but atoms always have no net charge. Particles that have a net charge can **attract** or **repel** other charged particles. A good rule to remember is that like charges repel and opposite charges attract. An object with a positive charge would attract objects with a negative charge. This positively charged object would repel another positively charged object.

#### Further Study

<b>atoms</b>	<b>matter</b>	<b>atomic theory</b>	<b>elements</b>
<b>protons</b>	<b>neutrons</b>	<b>electrons</b>	<b>nucleus</b>
<b>isotope</b>	<b>attract</b>	<b>mass number</b>	<b>electron cloud</b>
<b>repel</b>	<b>neutral</b>	<b>atomic number</b>	

#### Questions for you to answer

1. What are the small particles called that make up all forms of matter?

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2. A student tells his teacher that he has seen an atom using a microscope at home. Do you think that this is possible?

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3. Name the two major regions of an atom.

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4. State the region in which each of the following particles would be located:

protons \_\_\_\_\_

electrons \_\_\_\_\_

neutrons \_\_\_\_\_

5. Helium has two protons and two neutrons. State the atomic number and mass number of helium.

\_\_\_\_\_

6. A student stated that an atom had a net charge of +1. Is this possible? Please explain your response.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

7. An object has a positive charge. Would a negatively charged object be attracted to or repelled by the positively charged object? Please explain your response.

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\_\_\_\_\_

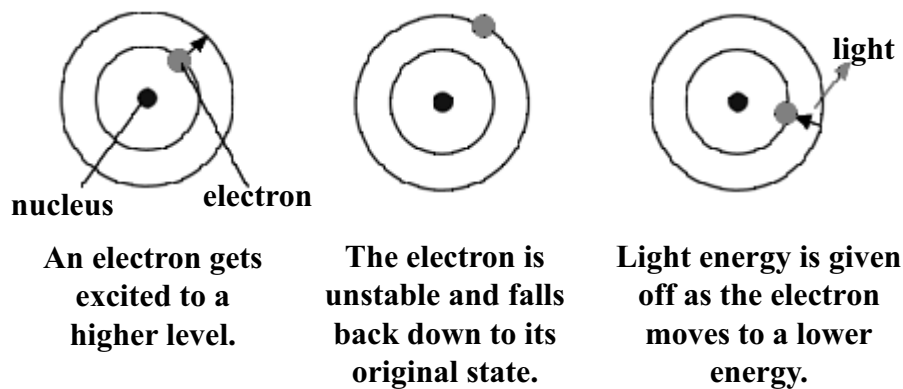


## NATURE OF ELECTRONS

Do atoms act like waves or particles?

When studying atoms and the particles that make them up, you need to understand that some particles have a dual nature. This means that sometimes these atoms act like **particles** and other times these same atoms act like **waves**. For instance, an electron inside an atom can bounce around and interact with other particles like the electron was a particle. Other times, these same electrons follow the rules that waves obey. Electrons cannot be found at any distance from the nucleus, they can be found only at specific distances that are related to wave properties. Electrons and their magnetic fields can be bent or move around objects like other types of waves.

As electrons change their position relative to the nucleus in an atom, they can store or emit energy. When an electron moves from a higher energy position to a lower one, energy in different forms can be given off. For instance, the light given off by a fluorescent bulb is due to exciting electrons and then getting them to fall back down to a lower energy state.



What are electromagnetic waves?

Electrons are associated with other waves that have a magnetic component and an electrical component. These waves, called **electromagnetic waves**, include light, microwaves, x-rays, and radio waves. Some of the extremely high frequency waves, like x-rays, have enough energy to do serious damage to the human body. Lower frequency waves, like radio waves, generally do not have enough energy to damage a body. Electromagnetic waves have many uses in the modern world. Microwaves, infrared waves and light can be used to heat and cook foods. Lasers, gamma rays and x-rays are often used in medicine to treat medical problems.

**Further Study**

<b>particle</b>	<b>wave</b>	<b>crest</b>	<b>trough</b>	<b>wavelength</b>
<b>frequency</b>	<b>amplitude</b>	<b>energy</b>	<b>electromagnetic waves</b>	
<b>vibration</b>	<b>cycle</b>	<b>medium</b>		

**Questions for you to answer**

1. Why is an electron said to have a dual nature?

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2. What happens to the energy of a wave as the wave's frequency increases?

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3. What is an electromagnetic wave?

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4. Give two examples of electromagnetic waves.

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5. Name a common use of a specific electromagnetic wave.

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# THE NATURE OF MATTER

The following 20 multiple-choice questions cover the topics presented in Chapter 1. In answering each question try to avoid guessing at answers. Make sure that you completely understand each question and answer. If not, review the material presented in the chapter.

1. The amount of matter in an object is called
  - a. volume.
  - b. density.
  - c. grams.
  - d. mass.
  
2. Two objects, A and B, have the same mass. Which of the following statements is true regarding objects A and B?
  - a. Object A weighs more than object B.
  - b. Object B weighs more than object A.
  - c. Objects A and B have the same volume.
  - d. Objects A and B might have the same or different volumes.
  
3. A wrench that has a mass of 250 grams is placed in a space shuttle and flown to outer space. Which of the following statements about the wrench is true?
  - a. The weight of the wrench remains at 250 grams.
  - b. The mass of the wrench remains at 250 grams.
  - c. Both statements a and b are true.
  - d. The wrench has a volume of 250 grams.
  
4. Object A has a volume of 50 milliliters. Object B has a volume of 100 milliliters. Which of the following statements is true regarding objects A and B?
  - a. Object B has a greater mass than object A.
  - b. Object A has a greater mass than object B.
  - c. Object B has a smaller volume than object A.
  - d. Objects A and B might have the same or different masses.

5. Object A has a density of 5.0 grams/milliliter and a volume of 25 milliliters. Object B has a volume of 25 milliliters and a density of 5.0 grams/milliliter. Which of the following statements about objects A and B is true?
- Objects A and B have the same mass.
  - Object B has a greater volume than object A.
  - Objects A and B have different masses.
  - Object A and B have different densities.
6. Which of the following is *not* a phase of matter?
- solid
  - liquid
  - molecule
  - gas
7. In which of the following phase changes do the particles move closer together?
- solid to gas
  - liquid to gas
  - gas to liquid
  - solid to liquid
8. The particles would be moving the fastest in which of the following materials?
- a block of ice at  $-20\text{ }^{\circ}\text{C}$
  - a glass of water at  $35\text{ }^{\circ}\text{C}$
  - a piece of solid steel at  $35\text{ }^{\circ}\text{C}$
  - some melted steel at  $400\text{ }^{\circ}\text{C}$
9. Which of the following is an example of a phase change?
- water reacting with sodium to form sodium hydroxide
  - iron combining with oxygen to form iron oxide
  - oxygen gas being converted to liquid oxygen
  - sugar being burned with oxygen to form carbon dioxide
10. Which of the following is an example of a chemical change?
- placing liquid water on a stove and boiling the water
  - adding some salt to water and stirring so dissolving takes place
  - a piece of metal combining with an acid to form hydrogen gas
  - crushing a large stone into many smaller pieces

11. Which of the following is an example of a physical change?
- a. wood that is rotting
  - b. milk that is souring
  - c. salt that is dissolving in water
  - d. gasoline that is burning
12. An electron in an atom behaves like
- a. a particle.
  - b. a liquid.
  - c. a wave.
  - d. both a and c.
13. What can be emitted if an electron moves from a higher energy level to a lower one?
- a. a proton
  - b. light
  - c. an electron
  - d. a neutron
14. True or false? All types of electromagnetic waves are harmful to humans.
- a. true
  - b. false
15. Which of the following is not an example of an electromagnetic wave?
- a. radio wave
  - b. sound wave
  - c. microwave
  - d. light wave
16. All forms of matter are made up of small particles called
- a. molecules.
  - b. atoms.
  - c. ions.
  - d. compounds.
17. In which region of an atom are electrons found?
- a. nucleus
  - b. neutrons
  - c. protons
  - d. electron cloud

18. Sodium has 11 protons and 12 neutrons. What is the atomic number of sodium?
- |       |       |
|-------|-------|
| a. 1  | b. 11 |
| c. 12 | d. 23 |
19. The mass number of an isotope of carbon is 14. If carbon has 6 protons, how many neutrons are contained in this isotope of carbon?
- |       |       |
|-------|-------|
| a. 6  | b. 8  |
| c. 14 | d. 20 |
20. A newly discovered particle has a negative charge. Which of the following particles would have the greatest attraction to this new particle?
- |             |             |
|-------------|-------------|
| a. proton   | b. neutron  |
| c. electron | d. molecule |