Resources for AT-HOME LEARNING

K-12 CURRICULUM & INSTRUCTION

DURHAM
PUBLIC SCHOOLS

Science 6

Matter & Atoms

6.P.2.1, 6.P.2.2, 6.P.2.3

These materials are supplemental and will not be counted for a grade; students will not be penalized if the packet is not completed.

pages 44, 47 (br) Hutchings Photography/Digital Light Source

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EC Services: Each student with a disability has unique learning needs related to his/her disability, so it is very difficult to make recommendations for accommodations and how to differentiate learning that would be relevant to all students. If possible, referencing the supplementary aids and services (classroom accommodations) portion of each student's Individualized Education Program (IEP) to assist with access/accommodation needs may be helpful for parents who may be facilitating the supplementary work at home.

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6th Grade Science – Matter and Atoms

Week 1 – Substances & Mixtures

Day 1 – Read p. 41-41. Complete p. 40

Day 2 – Read p. 43-44. Complete p. 51

Day 3 – Read p. 45-47. Complete p. 52

Day 4 – Read p. 48-49. Complete p. 53

Day 5 – Complete p. 50,15-16

Week 2 – Substances Continued.

Day 6 – Complete 17-19.

Week 2 – The Structure of Atoms

Day 7 – Read p. 55-56. Complete p. 54

Day 8 – Read p. 57-59. Complete p. 60, 26

Day 9 – Complete 35-36.

Day 10 – Complete 27-28.

Matter and Atoms

Substances and Mixtures

Before You Read

What do you think? Read the three statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	1. Things that have no mass are not matter.	
	2. The arrangement of particles is the same throughout a mixture.	
	3. An atom that makes up gold is exactly the same as an atom that makes up aluminum.	

Read to Learn

What is matter?

Have you ever gone windsurfing? You lean back to balance the board as the force of the wind pushes the sail. You can feel the spray of water against your face. Everything around you, whether you are windsurfing or sitting at your desk, is made of matter. **Matter** *is anything that has mass and takes up space.* Matter is everything you can see, such as water and trees. It is also some things you cannot see, such as air. You know that air is matter because you can feel its mass when it blows against your skin. You can see that it takes up space when it inflates a sail or a balloon.

Anything that does not have mass or volume is not matter. Types of energy, such as heat, sound, and electricity, are not matter. Forces, such as gravity, are not forms of matter.

What is matter made of?

All solids, liquids, and gases are made of atoms. *An* **atom** *is a small particle that is the building block of matter.* In this chapter, you will read that an atom is made of even smaller particles. There are many types of atoms. Each type of atom has a different number of smaller particles. Atoms can combine with each other in many ways. It is the many kinds of atoms and the ways they combine that form the different types of matter.

Key Concepts

- What is the relationship among atoms, elements, and compounds?
- How are some mixtures different from solutions?
- How do mixtures and compounds differ?

Mark the Text

Identify Main Ideas
Highlight the main idea of each paragraph. Highlight two details that support each main idea with a different color. Use your highlighted copy to review what you studied in this lesson.

Reading Check

1. Identify two characteristics that a thing must have to be called matter.

Classifying Matter

All the different types of matter around you are made of atoms, so they must have characteristics in common. But why do all types of matter look and feel different? How is the matter that makes up a pure gold ring similar to the matter that makes up your favorite soda or your body? How are these types of matter different?

Scientists place matter into one of two groups—substances or mixtures. Pure gold is in one group. Soda and your body are in the other. What determines whether a type of matter is a substance or a mixture? The difference is in the composition.

Reading Check

2. Name the two groups into which scientists place matter.

What is a substance?

What is the difference between a gold ring and a can of soda? What is the difference between table salt and trail mix? Pure gold is always made up of the same type of atom, but soda is not. Similarly, table salt, or sodium chloride, is always made up of the same types of atoms, but trail mix is not. This is because sodium chloride and gold are substances.

A **substance** *is matter with a composition that is always the same.* A certain substance always contains the same kinds of atoms in the same combination. Soda and trail mix are another type of matter that you will read about later in this lesson.

Gold is a substance. So anything that is pure gold will have the same composition. Bars of gold are made of the same atoms as those in a pure gold ring. Sodium chloride is a substance. So the atoms that make up salt will be the same whether you are salting your food in Alaska or in Ohio. If the composition of a given substance changes, you will have a new substance.

Reading Check

3. Summarize Why is pure gold a substance?

Elements

Some substances, such as gold, are made of only one kind of atom. Others, such as sodium chloride, are made of more than one kind of atom. *An* **element** *is a substance made of only one kind of atom.*

All atoms of an element are alike, but atoms of one element are different from atoms of other elements. For example, the element gold is made of only gold atoms, and all gold atoms are alike. But gold atoms are different from silver atoms, oxygen atoms, and atoms of every other element.

Key Concept Check

4. Explain How are atoms and elements related?

Lesson 1 Substances and Mixtures

Skim *Lesson 1 in your book. Read the headings and look at the photos and illustrations. Select three things you want to learn more about as you read the lesson. Write your ideas in your Science Journal.*

Main Idea

What is matter?

I found this on page _____.

What is matter made of?

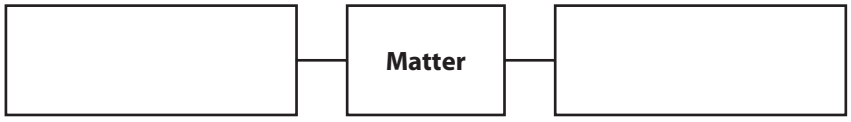
I found this on page _____.

Classifying Matter

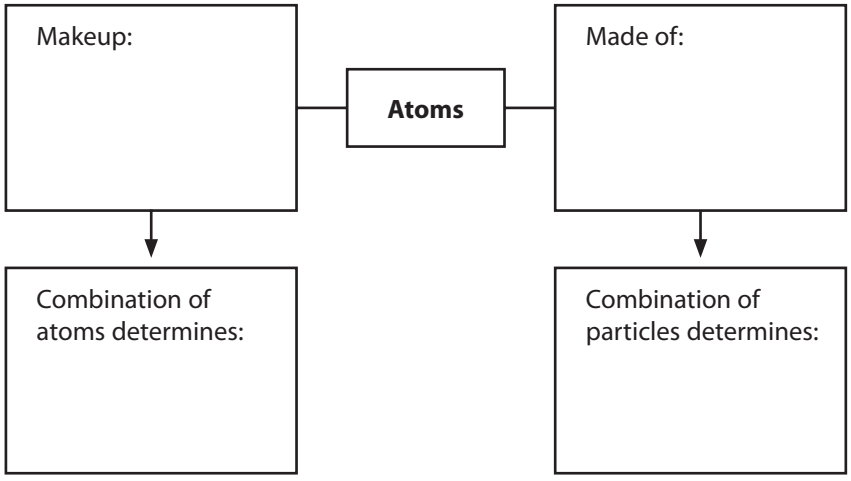
I found this on page _____.

Details

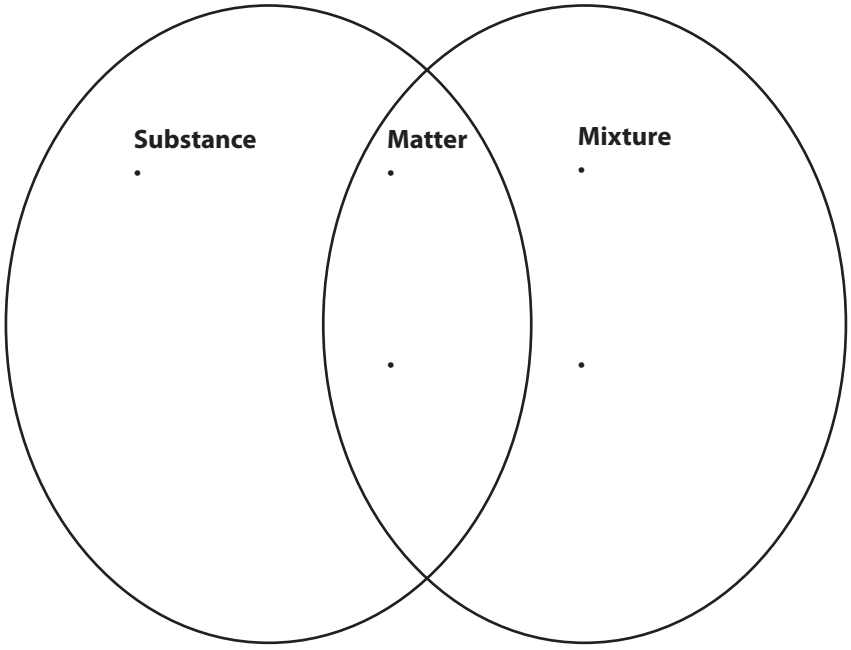
Identify *the defining characteristics of* matter.



Characterize atoms.



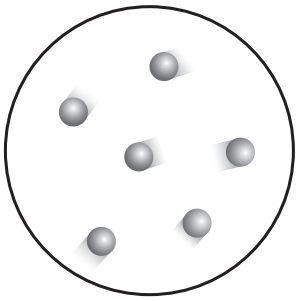
Differentiate *classifications of* matter.



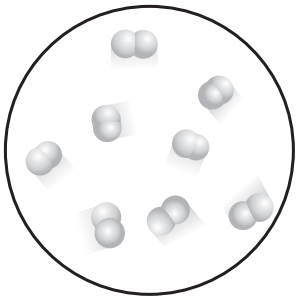
What is the smallest part of an element? If you could break down an element into its smallest part, that part would be one atom. Most elements, such as carbon and silver, are made up of a large group of individual atoms. Some elements, such as hydrogen and bromine, are made of molecules.

A **molecule** (MAH lih kyewl) *is two or more atoms that are held together by chemical bonds and act as a unit.* Examples of elements made of individual atoms and molecules are shown in the figure to the right.

Atoms and Molecules



Individual atoms



Molecules

Elements on the Periodic Table You probably can name many elements, such as carbon, gold, and oxygen. Did you know that there are about 115 elements? The figure below shows that each element has a symbol, such as C for carbon, Au for gold, and O for oxygen. Element symbols have either one or two letters. Temporary symbols have three letters. The periodic table printed in the back of this book gives other information about each element. You will learn more about elements in the next lesson.

Reading Check

5. Distinguish What is the smallest part of an element?

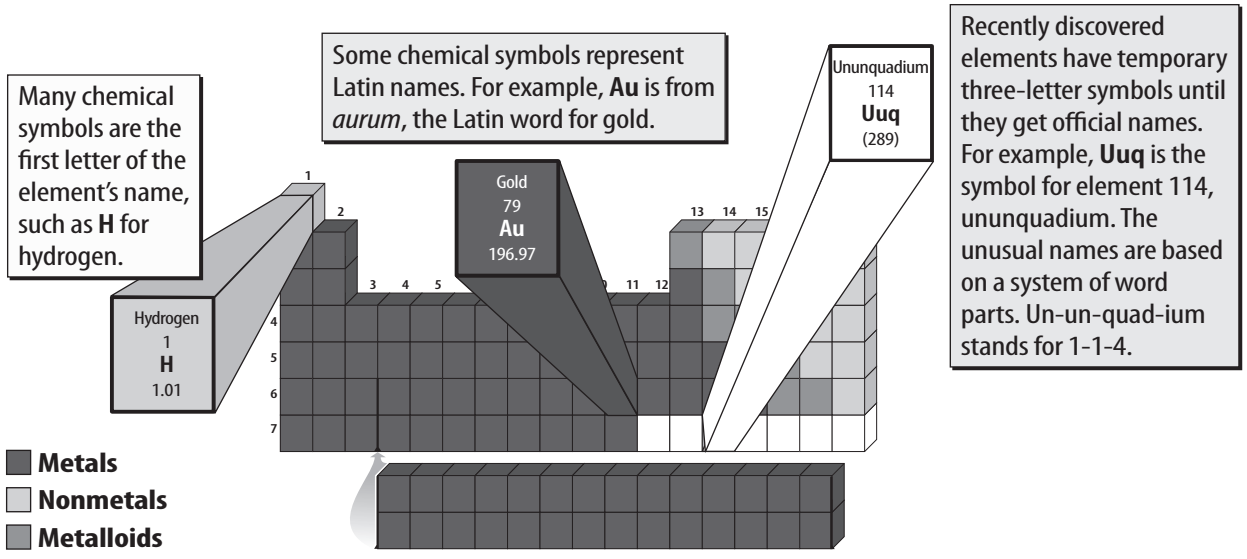
Visual Check

6. Analyze How many atoms does each molecule in the figure to the left have?

Visual Check

7. Draw Circle the blocks used for elements that have not yet been verified.

The Periodic Table



Compounds

Does it surprise you to learn that there are only about 115 different elements? After all, you probably can name many more types of matter than this if you think about all the different things you see each day. Why are there more kinds of matter than there are elements? Most matter is made of atoms of different types of elements bonded together.

A **compound** *is a substance made of two or more elements that are chemically joined in a specific combination.* A compound is a substance because it is made of atoms in a specific combination. Pure water (H_2O) is a compound. Every sample of pure water contains two hydrogen atoms to every oxygen atom. There are many types of matter because elements can join to form compounds.

Molecules Recall that a molecule is two or more atoms that are held together by chemical bonds and that act as a unit. Is a molecule the smallest part of a compound? A molecule is the smallest part of many compounds. Many compounds exist as molecules. One example is water. In water, two hydrogen atoms and one oxygen atom always exist together and act as a unit. Carbon dioxide (CO_2) and sugar ($C_6H_{12}O_{6)}$ are also compounds that are made of molecules.

But some compounds are not made of molecules. In some compounds, such as table salt, or sodium chloride, no specific atoms travel together as a unit. However, table salt (NaCl), is still a substance because it always contains only sodium (Na) and chlorine (Cl) atoms.

Properties of Compounds How would you describe sodium chloride, or table salt? Sodium chloride is a compound. The properties of a compound are usually different from the properties of the elements from which it is made. Table salt, for example, is made of the elements sodium and chlorine. Sodium is a soft metal, and chlorine is a poisonous green gas. These properties are much different from the table salt you sprinkle on food!

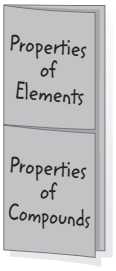
Chemical Formulas Just as elements have chemical symbols, compounds have chemical formulas. A formula includes the symbols of each element in the compound. It also includes small numbers called subscripts. Subscripts show the ratio of the elements in the compound. You can see the formulas for some compounds in the table at the top of the next page.

Key Concept Check

8. Contrast How do elements and compounds differ?

FOLDABLES®

Make a vertical two-tab book to review properties of elements and compounds.



Reading Check

9. Summarize What information do the subscripts in a chemical formula provide?

Main Idea

What is a substance?

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

Details

Differentiate *building blocks of* matter.

Matter	Description
Atom	
Substance	
Element	
Molecule	
Compound	

Determine *whether each statement is true or false. Write* T *for true statements. For false statements, write* F *and then rewrite the underlined word(s) to make the statement true.*

Statement	T/F	Corrections
1. Molecules are made of atoms of one type.		
2. All substances are elements.		
3. All compounds are substances.		
4. All elements are compounds.		
5. All matter is made up of molecules.		

Express *the relationship between properties of a* compound *and the properties of the* elements *which compose the* compound.

_____

Properties of Common Nitrogen Compounds	
Formula	**Properties/Uses**
N_2O Nitrous oxide	colorless gas used as an anesthetic
NO_2 Nitrogen dioxide	brown gas, toxic, air pollutant
N_2O_3 Dinitrogen trioxide	blue liquid

Different Combinations of Atoms Sometimes the same elements combine to form different compounds. For example, nitrogen and oxygen can form six different compounds. The chemical formulas are N_2O, NO, N_2O_3, NO_2, N_2O_4, and N_2O_5. Each compound contains the same elements, but because the combinations of atoms are different, each compound has different properties. Three examples are shown in the table above.

What is a mixture?

Can you tell whether the clear liquid in a glass is lemon-lime soda or water? Lemon-lime soda is almost clear. Someone might confuse it with water, which is a substance. Recall that a substance is matter with a composition that is always the same.

Sodas are a combination of substances such as water, carbon dioxide, sugar, and other compounds. In fact, most solids, liquids, and gases you see each day are mixtures. *A* **mixture** *is matter that can vary in composition.* A mixture is made of two or more substances that are blended but are not chemically bonded.

What would happen if you added more sugar to a glass of soda? You would still have soda, but it would be sweeter. Changing the amount of one substance in a mixture does not change the identity of the mixture or its individual substances.

Air and tap water are also mixtures. Air is a mixture of nitrogen, oxygen, and other substances. But the composition of air can vary. Air in a scuba tank usually contains more oxygen and less of the other substances. Tap water might look like pure water. However, tap water is a mixture of pure water (H_2O) and small amounts of other substances. The composition of tap water can vary because the substances that make up tap water are not bonded together. This is true for all mixtures.

Interpreting Tables

10. Analyze What is the ratio of nitrogen atoms to oxygen atoms in dinitrogen trioxide?

Think it Over

11. Apply Which pair of compounds has a ratio of one nitrogen atom to two oxygen atoms? (Circle the correct answer.)

a. NO_2 and N_2O_4

b. N_2O and NO_2

c. NO and N_2O_4

Reading Check

12. Restate Why does the composition of mixtures vary?

ACADEMIC VOCABULARY
individual
(adjective) single; separate

Types of Mixtures

How do trail mix, soda, and air differ? One difference is that trail mix is a solid, soda is a liquid, and air is a gas. This tells you that a mixture can be any state of matter. Another difference is that you can see the individual parts that make up trail mix. But you cannot see the parts that make up soda or air. This is because trail mix is a different type of mixture than soda and air.

Two types of mixtures can be made—one is heterogeneous (he tuh roh JEE nee us), and the other is homogeneous (hoh muh JEE nee us). The prefix *hetero-* means "different," and the prefix *homo-* means "the same." Heterogeneous and homogeneous mixtures differ in how evenly the substances that comprise them are mixed.

Heterogeneous Mixtures

Suppose you take a bag of trail mix and pour it into two identical bowls. What might you notice? At first glance, each bowl appears the same. But if you look closely, you might notice that one bowl has more nuts and another bowl has more raisins. The contents of the bowls differ because trail mix is a heterogeneous mixture.

A **heterogeneous mixture** *is a mixture in which the substances are not evenly mixed.* So if you take two samples from the same mixture, such as trail mix, the samples might have different amounts of the individual substances. Trail mix, granite, and smoke are examples of heterogeneous mixtures.

Homogeneous Mixtures

If you poured soda from a bottle into two glasses, the amounts of water, carbon dioxide, sugar, and other substances in the mixture would be the same in both glasses. Soda is an example of a **homogeneous mixture**—*a mixture in which two or more substances are evenly mixed, but not bonded together*.

Evenly Mixed Parts In a homogeneous mixture, the substances are so small and evenly mixed that you cannot see the boundaries between substances in the mixture. Brass is a mixture of copper and zinc. It is a homogeneous mixture because the copper atoms and the zinc atoms are evenly mixed. You cannot tell which atoms are which even under most microscopes. Lemonade and air are also examples of homogeneous mixtures for the same reason.

Think it Over

13. Explain why vegetable soup is classified as a heterogeneous mixture.

Reading Check

14. Classify Is yellow mustard a heterogeneous mixture or a homogeneous mixture?

Solution Another name for a homogeneous mixture is a solution. A solution is made of two parts—a solvent and one or more solutes. The solvent is present in the largest amount. The solutes dissolve, or break apart, and mix evenly in the solvent. In a mixture of water, salt, and pepper, salt is soluble in water. So water is the solvent and salt is the solute. But pepper does not dissolve in water. No solution forms between pepper and water, so it is insoluble in water.

Brass is a solution of solid copper and solid zinc. Brass is a metal often used to make musical instruments, such as trumpets and tubas. The natural gas used in a gas stove is a solution of methane, ethane, and other gases. Ammonia, often used as a cleaner, is a solution of water and ammonia gas. Note that a solvent or a solute in a solution can be any of the three states of matter—solid, liquid, and gas.

Key Concept Check

15. Apply How are some mixtures different from solutions?

Compounds v. Mixtures

Think again about the trail mix in two bowls. If you add peanuts to one bowl, you still have trail mix in both bowls. The substances that make up a mixture are not bonded. So adding more of one substance does not change the identity or the properties of the mixture. It also does not change the identity or the properties of each individual substance. Adding more peanuts to a mixture of peanuts, pretzels, and raisins will not change the properties of the individual parts. Peanuts and raisins don't bond and become something new.

In a solution of soda or air, the substances do not bond together and form something new. Carbon dioxide, water, sugar, and other substances in soda are mixed together. Nitrogen, oxygen, and other substances in air also keep their properties because air is a mixture. If air were a compound, the parts would be bonded and would not keep their separate properties.

Key Concept Check

16. Contrast How do mixtures and compounds differ?

Compounds and Solutions Differ

Compounds and solutions are alike in that they both look like pure substances. Think about lemon-lime soda. The soda is a solution. A solution might look like a substance because the elements and the compounds that make up a solution are evenly mixed. But compounds and solutions differ in one important way. The atoms that make up a given compound are bonded together. So the composition of a given compound is always the same. Changing the composition results in a new compound.

Main Idea

What is a mixture?

I found this on page _____.

Types of Mixtures

I found this on page _____.

I found this on page _____.

I found this on page _____.

Details

Differentiate *between* substances *and* mixtures.

Substance	Mixture

Categorize *information about* mixtures.

Mixtures

Which state of matter? _____

Two types

Prefix:
Means:

Prefix:
Means:

Contrast *the ways* homogeneous mixtures *and* heterogeneous mixtures *are combined*.

Mixture	Contrasting Characteristic
Heterogeneous	
Homogeneous	

Organize *information about solutions.*

Solution

Another name for:

Part: solvent
Definition:

Part:
Definition:

Differences Between Solutions and Compounds		
	Solutions	**Compounds**
Composition	Made up of substances (elements and compounds) evenly mixed together; the composition can vary in a given mixture.	Made up of atoms bonded together; the combination of atoms is always the same in a given compound.
Changing the Composition	The solution is still the same with similar properties. However, the relative amounts of substances might be different.	The compound has changed into a new compound with new properties.
Properties of Parts	The substances keep their own properties when they are mixed.	The properties of the compound are different from the properties of the atoms it is made from.

Interpreting Tables

17. Identify Which substance always has the same combination of atoms?

_____

However, the substances that make up a solution are not bonded together. So adding more of one substance in a solution will change the composition of the solution. It will just change the ratio of the substances in the solution. These differences are described in the table above.

Separating Mixtures

Have you ever picked something you did not like off a slice of pizza? If you have, you have separated a mixture. Because the parts of a mixture are not combined chemically, you can use a physical process to separate the mixture. One way to do this is to remove the parts by hand. The identity of the parts does not change. Separating a compound back into the parts from which it was made is more difficult. The elements that make up a compound are combined chemically. Only a chemical change can separate them.

REVIEW VOCABULARY
chemical change
a change in matter in which the substances that make up the matter change into other substances with different chemical and physical properties

Separating Heterogeneous Mixtures Separating the parts of a pizza is easy because the pizza has large, solid parts. Heterogeneous mixtures can also be separated in other ways. For example, a strainer, or sieve, can be used to filter larger rocks from a mixture of rocks and dirt. Oil and vinegar is also a heterogeneous mixture because the oil floats on the vinegar. You can separate this mixture by carefully removing the floating oil.

Reading Check

18. Name three methods of separating heterogeneous mixtures.

_____

_____

_____

_____

Other properties also might be useful for separating the parts. For example, if one of the parts is magnetic, you could use a magnet to remove it. In a mixture of solid powders, you might dissolve one part in water and then pour it out, leaving the other part behind. In each case, to separate a heterogeneous mixture, you use differences in the physical properties of the parts.

Separating Homogeneous Mixtures Imagine trying to separate soda into water, carbon dioxide, sugar, and the other substances it is made from. The parts are so small and evenly mixed that separating a homogeneous mixture such as soda can be difficult. But you can separate some homogeneous mixtures by boiling or evaporation. If you place a bowl of sugar water outside on a hot day, the water will evaporate slowly, leaving the sugar behind. Rock candy is made by evaporating water from a sugar solution.

Visualizing Classification of Matter

Think about all the types of matter you have read about in this lesson. As shown in the figure below, matter can be classified as either a substance or a mixture. Substances are either elements or compounds. The two kinds of mixtures are homogeneous mixtures and heterogeneous mixtures. Notice that all substances and mixtures are made of atoms. Matter is classified according to the types of atoms and the arrangement of atoms in matter. In the next lesson, you will study the structure of atoms.

Think it Over

19. Infer Sea salt is harvested by evaporating seawater. Is seawater a homogeneous mixture or a heterogeneous mixture?

_____

_____

Visual Check

20. Identify Circle the name of the mixture made of substances that might be seen without a microscope.

Classifying Matter

Matter
- Anything that has mass and takes up space
- Most matter on Earth is made up of atoms.
- Two classifications of matter: substances and mixtures

Substances
- Matter with a composition that is always the same
- Two types of substances: elements and compounds

Element
- Consists of just one type of atom
- Organized on the periodic table
- Each element has a chemical symbol.

Compound
- Two or more types of atoms bonded together
- Properties are different from the properties of the elements that make it up
- Each compound has a chemical formula.

Substances physically combine to form mixtures.

Mixtures can be separated into substances by physical methods.

Mixtures
- Matter that can vary in composition
- Substances are not bonded together.
- Two types of mixtures: heterogeneous and homogeneous

Heterogeneous Mixture
- Two or more substances unevenly mixed
- Different substances are visible by an unaided eye or a microscope.

Homogeneous Mixture—Solution
- Two or more substances evenly mixed
- Different substances cannot be seen even by a microscope.

Main Idea

I found this on page _____.

Compounds v. Mixtures

I found this on page _____.

I found this on page _____.

Visualizing Classification of Matter

I found this on page _____.

Details

Assess *whether all* mixtures *are solutions.*

_____

Compare and contrast *solutions and* compounds.

Detail	Solution	Compound
Appearance		
Composition		
Atoms bonded?		
Properties		
Changing the composition		

Identify *ways to separate* mixtures.

Type of Mixture	Possible Techniques
Heterogeneous	
Homogeneous	

Cite *two key factors in the classification of* matter.

1. _____
2. _____

Connect It Identify an element, a substance, a compound, a heterogeneous mixture, and a solution that you have encountered recently.

_____

_____

_____

_____

After You Read

Mini Glossary

atom: a small particle that is the building block of matter

compound: a substance made of two or more elements that are chemically joined in a specific combination

element: a substance made of only one kind of atom

heterogeneous (he tuh roh JEE nee us) mixture: a mixture in which the substances are not evenly mixed

homogeneous (hoh muh JEE nee us) mixture: a mixture in which two or more substances are evenly mixed, but not bonded together

matter: anything that has mass and takes up space

mixture: matter that can vary in composition

molecule (MAH lih kyewl): two or more atoms that are held together by chemical bonds and act as a unit

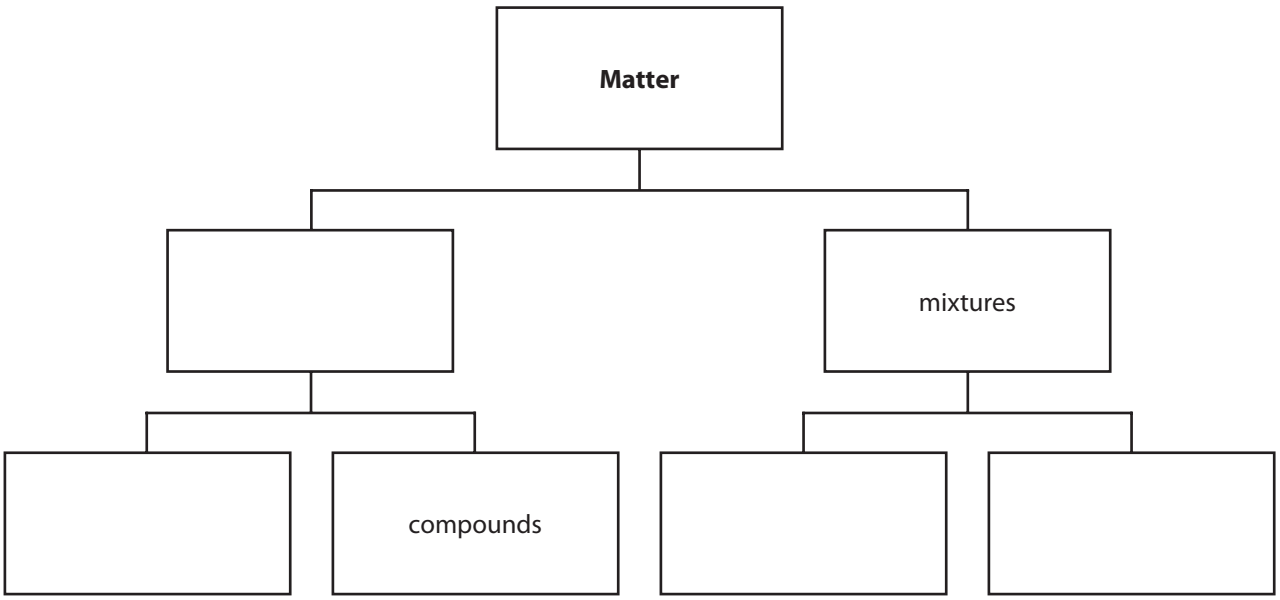
substance: matter with a composition that is always the same

1. Review the terms and their definitions in the Mini Glossary. Write a sentence to compare and contrast a mixture and a compound.

_____

_____

2. Use what you have learned about matter to complete the graphic organizer.



What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

ConnectED

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson's resources.

END OF LESSON

Name _____ Date _____ Class _____

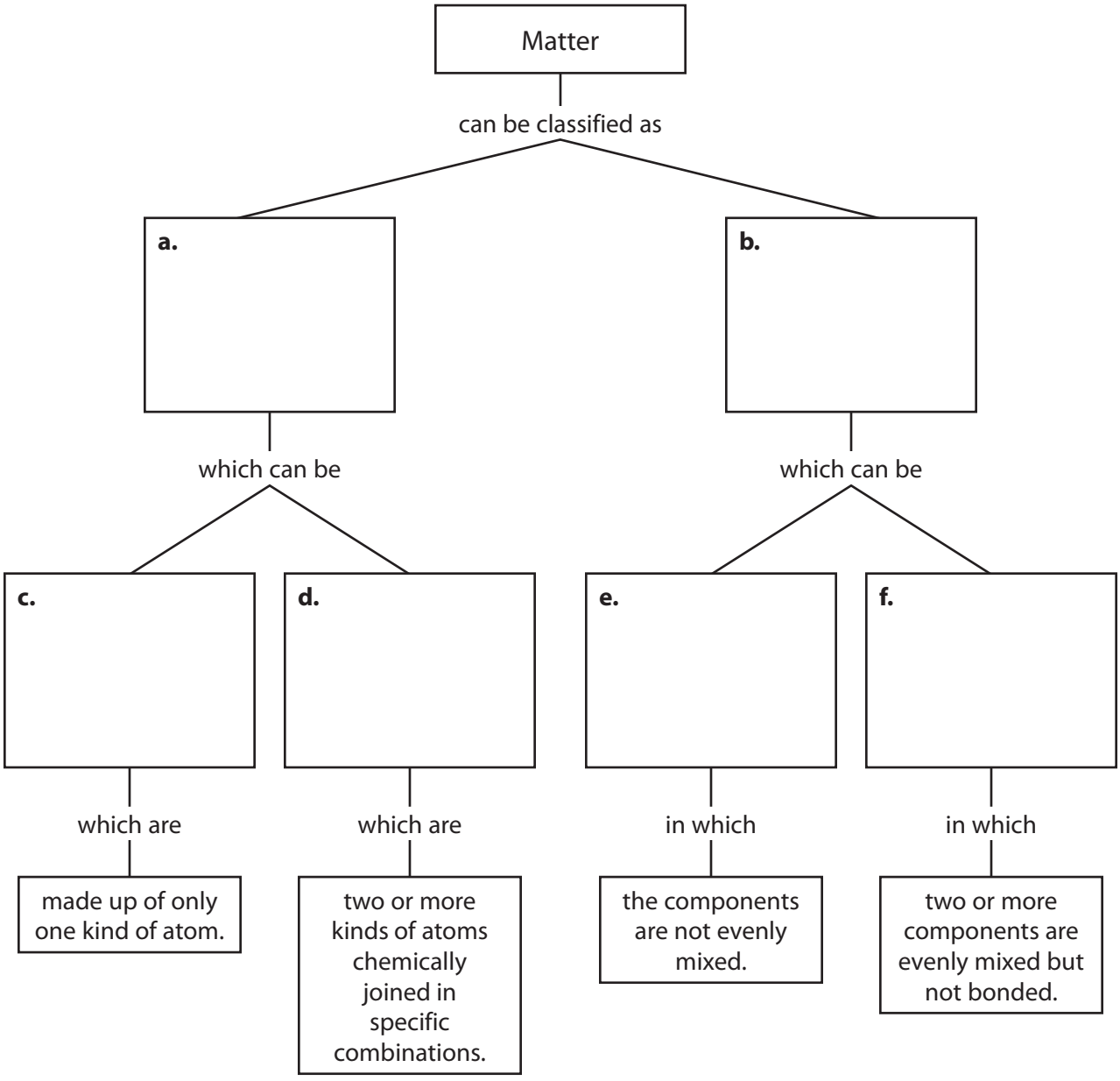
School to Home **LESSON 1**

Substances and Mixtures

Directions: *Use your textbook to complete the activity.*

Use the word bank below to complete the concept map describing how matter is classified.

compounds	**elements**	**heterogeneous mixtures**
homogeneous mixtures	**mixtures**	**substance**



Name _____ Date _____ Class _____

Key Concept Builder

LESSON 1

Substances and Mixtures

Key Concept What is the relationship among atoms, elements, and compounds?

Directions: *Answer each question or respond to each statement in the space provided.*

1. What is an atom?	
2. What happens when atoms combine?	
3. What is an element?	
4. Name three elements.	
5. What is the relationship among atoms, elements, and molecules?	
6. What is a compound?	
7. Name three compounds.	
8. What information about a compound is found in its chemical formula?	
9. How are atoms related to elements and compounds?	

Name _____ Date _____ Class _____

Key Concept Builder

LESSON 1

Substances and Mixtures

Key Concept How are some mixtures different from solutions?

Directions: *On the line before each item, write* HE *if the item represents a heterogeneous mixture or* HO *if the item represents a homogeneous mixture.*

1. _____ granite

2. _____ smoke

3. _____ soda

4. _____ brass

5. _____ trail mix

6. _____ air

7. _____ tap water

Directions: *Answer each question on the lines provided.*

8. What is the difference between a heterogeneous mixture and a homogeneous mixture?

_____

_____

_____

_____

9. Which mixtures listed in the activity above are solutions? Explain your answer.

_____

_____

_____

_____

Name _____ Date _____ Class _____

Key Concept Builder

LESSON 1

Substances and Mixtures

Key Concept How do mixtures and compounds differ?

Directions: *Complete the chart by writing the correct term from the word bank on the lines provided. Some terms may be used more than once or not at all.*

atoms	**compounds**	**elements**
heterogeneous mixture	**homogeneous mixture**	**mass**
matter	**mixtures**	**substances**

Matter

- anything that has **(1.)** _____ and takes up space
- most made of **(2.)** _____
- two classifications: **(3.)** _____ and **(4.)** _____

(5.) _____

- made up of one or more types of atoms in the same combinations
- two types: **(6.)** _____ and **(7.)** _____

(8.) _____

- made of only one type of atom
- organized on the periodic table
- have a chemical symbol

(9.) _____

- made of two or more types of atoms bonded together
- properties are different from the elements that make it up
- have chemical formulas

(10.) _____

- made of two or more **(11.)** _____ that are not bonded together
- Combinations of subtances can vary.
- two types: **(12.)** _____ and **(13.)** _____

(14.) _____

- two or more substances unevenly mixed
- different substances visible by unaided eye or microscope

(15.) _____

- two or more substances evenly mixed
- Different substances cannot be seen by a microscope.

Name _____ Date _____ Class _____

Key Concept Builder  **LESSON 1**

Substances and Mixtures

Key Concept How do mixtures and compounds differ?

Directions: *Put a check mark on the line before each property that is typical of a compound.*

_____ **1.** made of only one kind of atom

_____ **2.** made of unbonded substances

_____ **3.** is a substance

_____ **4.** made of elements that are bonded together

_____ **5.** represented by a chemical formula

_____ **6.** Identity is not changed by changing the amount of its substances.

_____ **7.** is the smallest part of an element

_____ **8.** is often made of molecules

Directions: *Respond to each statement on the lines provided.*

9. Compare the composition of a mixture and a compound.

_____

_____

_____

10. Compare what happens when you change the composition of a mixture and a compound.

_____

_____

_____

_____

Matter and Atoms

The Structure of Atoms

Before You Read

What do you think? Read the three statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	4. An atom is mostly empty space.	
	5. If an atom gains electrons, the atom will have a positive charge.	
	6. Each electron is a cloud of charge that surrounds the center of an atom.	

Read to Learn

The Parts of an Atom

Now that you have read about ways to classify matter, you can probably recognize the different types of matter you see each day. You might see pure elements, such as copper and iron. You also might see many compounds, such as table salt.

Table salt is a compound because it contains the atoms of two different elements in a specific combination. These elements are sodium and chlorine. You also probably see many mixtures. The silver often used in jewelry is a homogeneous mixture of metals. The metals are evenly mixed, but they are not bonded together.

As you read in Lesson 1, the many types of matter are possible because there are about 115 different elements. Each element is made up of a different type of atom. Atoms can combine in many different ways. They are the basic parts of matter.

What makes the atoms of each element different? Atoms are made of several types of tiny particles. The number of each of these particles in an atom is what makes atoms different from each other. It is what makes so many types of matter possible.

Key Concepts

- Where are protons, neutrons, and electrons located in an atom?
- How is the atomic number related to the number of protons in an atom?
- What effect does changing the number of particles in an atom have on the atom's identity?

Study Coach

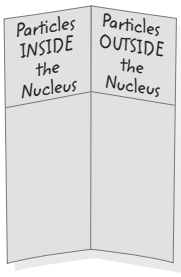
Identify the Main Ideas As you read, write one sentence to summarize the main idea in each paragraph. Write the main ideas on a sheet of paper or in your notebook to study later.

Reading Check

1. Contrast What makes the atoms of different elements different from each other?

FOLDABLES®

Make a two-column chart book to organize information about the particles in an atom.



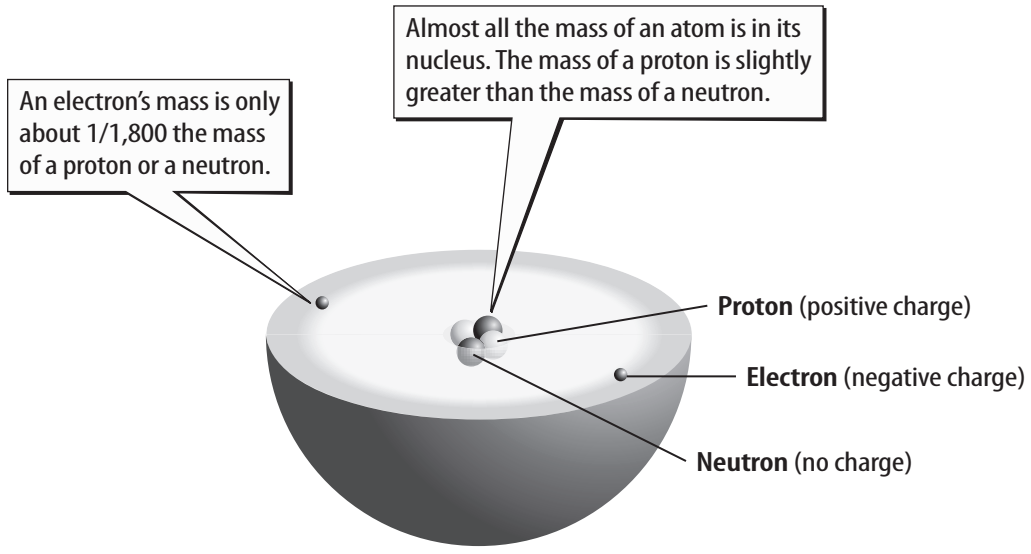
The Nucleus—Protons and Neutrons

The basic structure of all atoms is the same. The basic structure of an atom is shown in the figure below.

An atom has a center region with a positive charge. One or more negatively charged particles move around this center region. *The* **nucleus** *is the region at the center of an atom that contains most of the mass of the atom*.

Two kinds of particles make up the nucleus. *A* **proton** *is a positively charged particle in the nucleus of an atom. A* **neutron** *is an uncharged particle in the nucleus of an atom*.

Parts of an Atom



Visual Check

2. Identify How many protons and how many electrons does this atom have?

Electrons

Atoms have no electric charge unless they change in some way. So there must be a negative charge that balances the positive charge of the nucleus. *An* **electron** *is a negatively charged particle that occupies the space in an atom outside the nucleus*.

Electrons are small and move quickly. Because of this, scientists are unable to tell exactly where a given electron is located at any specific time. So scientists describe the positions of electrons around the nucleus as a cloud rather than specific points.

All atoms have a positively charged nucleus surrounded by one or more electrons. An electron is shown in the model of an atom in the figure above.

Key Concept Check

3. Identify Where are protons, neutrons, and electrons located in an atom?

Lesson 2 The Structure of Atoms

Scan *Lesson 2 in your book. Write three questions you have about the structure of atoms in your Science Journal. Try to answer your questions as you read.*

Main Idea

The Parts of an Atom

I found this on page _____.

I found this on page _____.

I found this on page _____.

Details

Assess *what makes the atoms of each element different.*

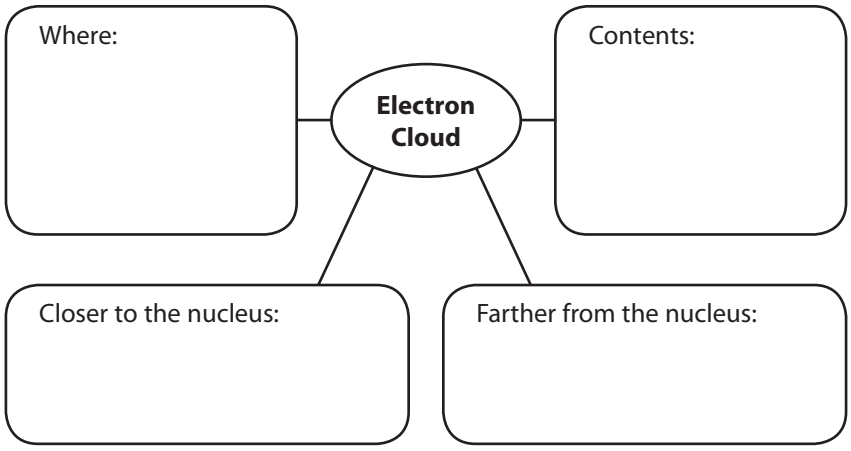
_____

_____

Describe *the parts of atoms, including each part's location and charge.*

Part	Description
Nucleus	
Proton	
Neutron	
Electron	

Characterize *the* electron cloud.



An Electron Cloud Drawings of an atom often show electrons circling the nucleus like planets orbiting the Sun. Scientists have conducted experiments that show the movement of electrons is more complex than this. The modern idea of an atom is called the electron-cloud model. *An* **electron cloud** *is the region surrounding an atom's nucleus where one or more electrons are most likely to be found*. It is important to understand that an electron is not a cloud of charge. An electron is one tiny particle. An electron cloud is mostly empty space. At any moment in time, electrons are located at specific points within that area.

Electron Energy You have read that electrons are constantly moving around the nucleus in a region called the electron cloud. But some electrons are closer to the nucleus than others. Electrons occupy certain areas around the nucleus according to their energy. Electrons close to the nucleus are strongly attracted to it and have less energy than electrons farther from the nucleus. Electrons farther from the nucleus are less attracted to the nucleus and have more energy than electrons closer to the nucleus.

The Size of Atoms

It might be difficult to visualize an atom. But every solid, liquid, and gas is made of millions and millions of atoms. Your body, your desk, and the air you breathe are all made of tiny atoms. Suppose you could increase the size of everything around you. If you could make everything larger by multiplying an object's width by 100 million, or 1×10^8, an atom would be the size of an orange, and an orange would be the size of Earth!

Differences in Atoms

In some ways, atoms are alike. Each has a positively charged nucleus surrounded by a negatively charged electron cloud. But atoms can differ from each other in several ways. Atoms can have different numbers of protons, neutrons, or electrons.

Protons and Atomic Number

Look at the periodic table in the back of this book. The number under the element name in each block shows how many protons each atom of the element has. For example, each oxygen atom has eight protons.

The **atomic number** *is the number of protons in the nucleus of an atom of an element*. If there are 12 protons in the nucleus of an atom, that element's atomic number is 12.

Math Skills

Scientists write very large and very small numbers using scientific notation. A gram of carbon has about 50,000,000,000,000,000,000 atoms. Express this in scientific notation.

a. Move the decimal until one nonzero digit remains on the left:

5.00000000000000000000

b. Count how the places you moved. In this case, 19 places left.

c. Show that number as a power of 10. The exponent is negative if the decimal moves right and positive if it moves left.

Answer: 5×10^{19}

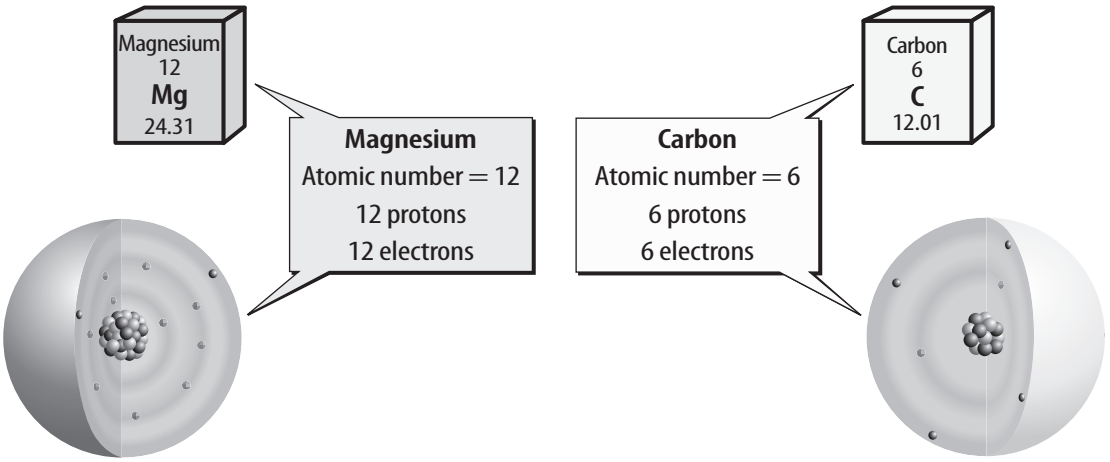
d. Reverse the process to change scientific notation back to a whole number.

4. Use Scientific Notation The diameter of a carbon atom is 2.2×10^{-8} cm. Write this as a whole number.

Key Concept Check

5. Recognize How is the atomic number related to the number of protons in an atom?

Protons and the Atomic Number



Visual Check

6. Locate In the figure above, circle the atomic number in the cube that represents the carbon atom.

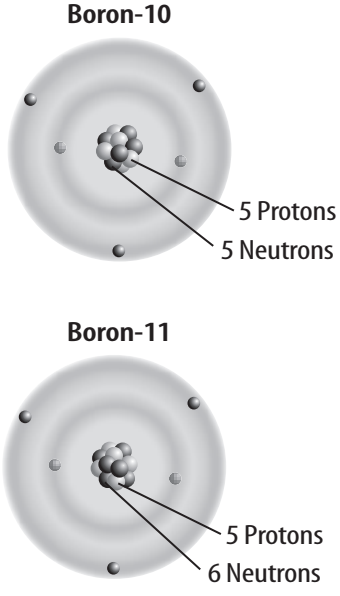
Examine the figure above. Notice that the atomic number of magnesium is the whole number above its symbol. The atomic number of carbon is 6. This means that each carbon atom has 6 protons. Every element in the periodic table has a different atomic number.

You can identify an element if you know either its atomic number or the number of protons its atoms have. If an atom has a different number of protons, it is a different element.

Neutrons and Isotopes

Each atom of an element contains the same number of protons, but the number of neutrons can vary. *An* **isotope** (I suh tohp) *is one of two or more atoms of an element having the same number of protons, but a different number of neutrons.* Boron-10 and boron-11 are isotopes of boron, as shown in the figure to the left. Notice that boron-10 has ten particles in its nucleus. Boron-11 has 11 particles in its nucleus.

Isotopes



Visual Check

7. Describe What makes boron-10 and boron-11 isotopes?

_____

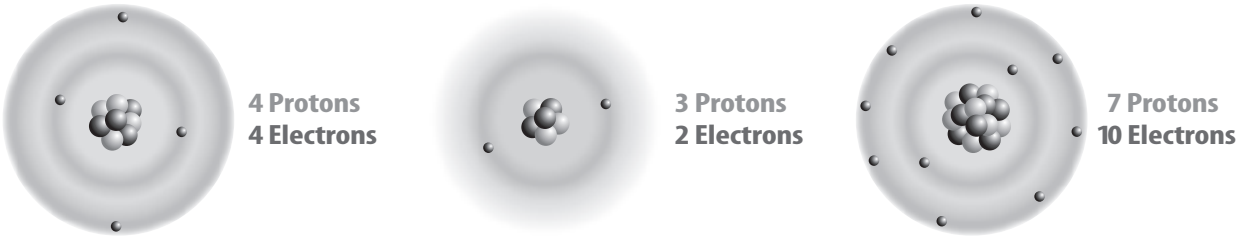
_____

Electrons and Ions

You read that atoms can differ by the number of protons or neutrons they have. The figure at the top of the next page shows a third way atoms can differ—by the number of electrons.

A neutral, or uncharged, atom has the same number of positively charged protons and negatively charged electrons. As atoms bond, their numbers of electrons can change. Because electrons are negatively charged, a neutral atom that has lost an electron has a positive charge. A neutral atom that has gained an electron has a negative charge. *An* **ion** (I ahn) *is an atom that has a charge because it has gained or lost electrons.* An ion is the same element it was before it gained or lost electrons because the number of protons is unchanged.

Ions



A neutral atom has the same number of electrons and protons. The atom has no charge.

If an atom loses an electron during chemical bonding, it has more protons than electrons. It is now positively charged.

If an atom gains an electron during chemical bonding, it has more electrons than protons. It is now negatively charged.

In the previous lesson, you read that each particle of a compound is two or more atoms of different elements bonded together. One of the ways a compound forms is when one or more electrons move from an atom of an element to an atom of a different element. This results in a positive ion for one element and a negative ion for the other element.

Atoms and Matter

You have read that a substance has a composition that is always the same, but the composition of a mixture can vary. All types of matter are made of atoms. The atoms of a certain element always have the same number of protons, but the number of neutrons can vary. When elements combine to form compounds, the number of electrons in the atoms can change. The different ways in which atoms can change are summarized in the table below. The ways in which the atoms combine result in the many different kinds of matter around you.

Possible Changes in Atoms

Neutral Atom	Change	Results
Carbon • 6 protons • 6 neutrons • 6 electrons	**Protons** add one proton	**New element—nitrogen** • 7 protons • 7 neutrons • 7 electrons
	Neutrons add one neutron	**Isotope** • 6 protons • 7 neutrons • 6 electrons
	Electrons add one electron	**Ion** • 6 protons • 6 neutrons • 7 electrons

Visual Check

8. Explain How can a neutral atom become a positive ion or a negative ion?

Key Concept Check

9. Relate What effect does changing the number of particles in an atom have on the atom's identity?

Interpreting Tables

10. Interpret Adding one proton to carbon creates what new element?

Mini Glossary

atomic number: the number of protons in the nucleus of an atom of an element

electron: a negatively charged particle that occupies the space in an atom outside the nucleus

electron cloud: the region surrounding an atom's nucleus where one or more electrons are most likely to be found

ion (I ahn): an atom that has a charge because it has gained or lost electrons

isotope (I suh tohp): one of two or more atoms of an element having the same number of protons, but a different number of neutrons

neutron: an uncharged particle in the nucleus of an atom

nucleus: the region at the center of an atom that contains most of the mass of the atom

proton: a positively charged particle in the nucleus of an atom

1. Review the terms and their definitions in the Mini Glossary. Write a sentence to explain how two atoms can form a compound by forming ions.

2. Use what you have learned about the particles of an atom to complete the table.

Particle	Charge	Location
electron		
		inside nucleus
	no charge	

3. How did studying your list of main ideas help you understand this lesson?

What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

Connect ED

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson's resources.

END OF LESSON

Name _____ Date _____ Class _____

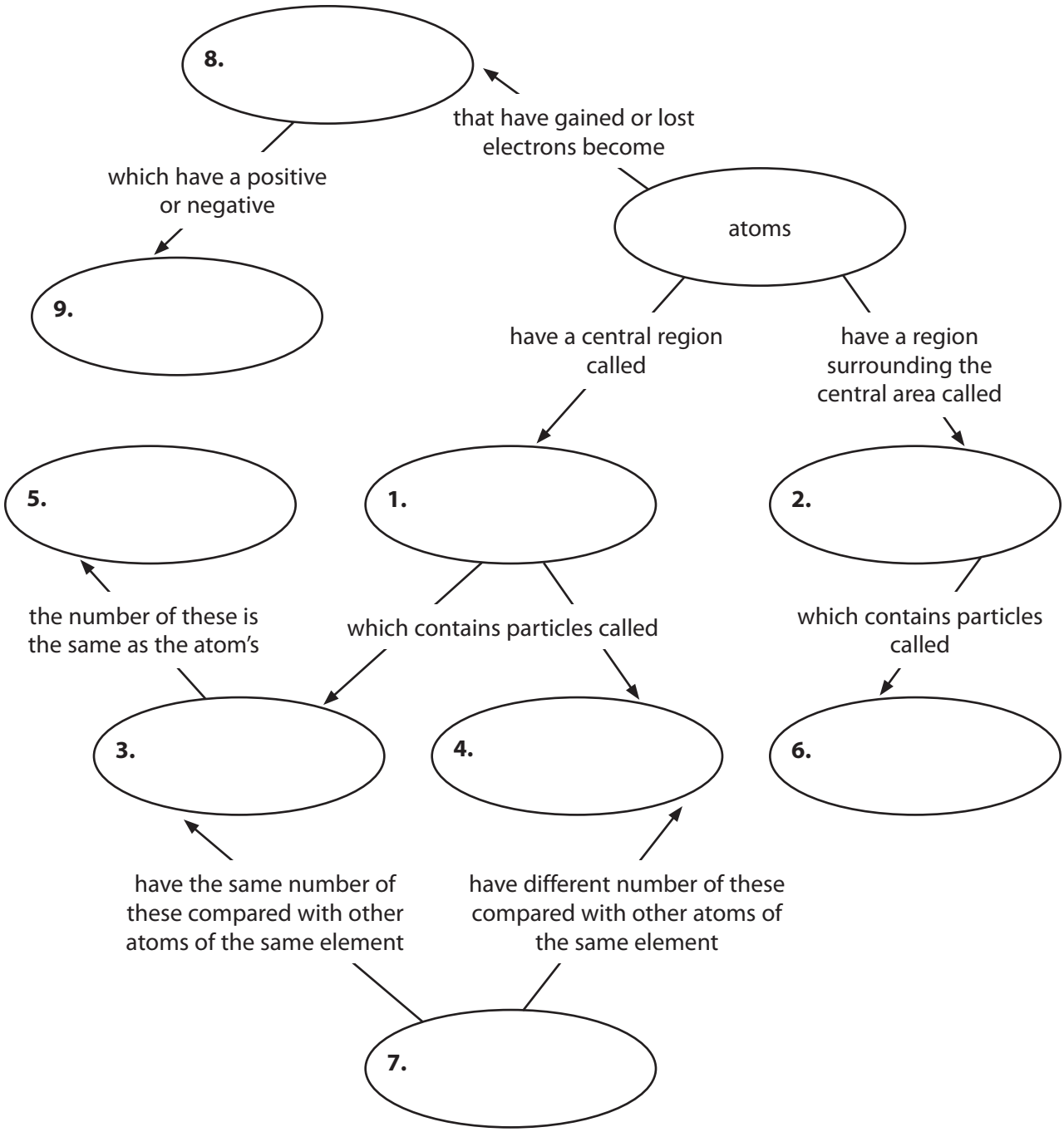
Content Vocabulary

LESSON 2

The Structure of Atoms

Directions: *Use the terms below to complete the concept map. NOTE: You may need to change a term to its plural form.*

atomic number	**charge**	**electron**	**electron cloud**	**ion**
isotope	**neutron**	**nucleus**	**proton**	



Name _____ Date _____ Class _____

Chapter Key Concepts Builder

Matter and Atoms

End-of-Chapter Practice

Directions: *Work with a group to create a poster about the elements found in common items.*

Use a copy of the periodic table and select one row to study in more depth. Classify the elements in your row as metals, metalloids, or nonmetals.

Metals:	Metalloids:	Nonmetals:

Assign at least one element to each group member. Then answer the following questions:

My Element: _____	
What common items are made from or contain my element?	What interesting facts can I find about my element?

As a group, compile your results and make the following decisions:

What form will our poster take?	What materials will we need?	Who will perform which tasks?

Share your poster with the class. Then hang your poster in your classroom or in the hallway.

Display requirements:

- organized in logical manner
- includes common items made from or containing elements
- includes interesting facts about elements
- includes contributions from all group members

Name _____ Date _____ Class _____

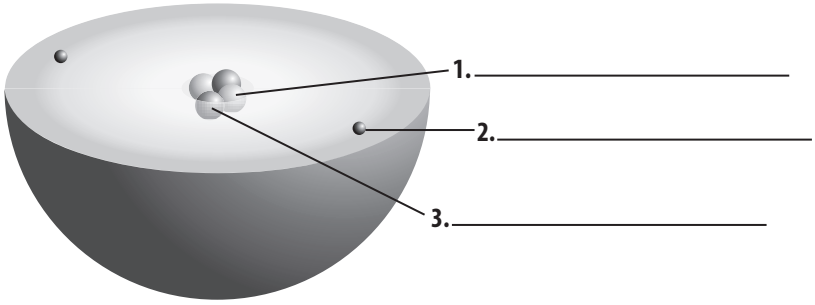
Key Concept Builder

LESSON 2

The Structure of Atoms

Key Concept Where are protons, neutrons, and electrons located in an atom?

Directions: *Label this diagram by writing the correct term on each line.*



Directions: *Answer each question or respond to each statement on the lines provided.*

4. Which particle in an atom has a positive charge? _____

5. Which particle in an atom has no charge? _____

6. Which particle in an atom has a negative charge? _____

7. Where is most of the mass of an atom found?

_____

8. Describe the structure of the atom in the diagram above. How many of each type of particle does the atom have?

_____

_____

Name _____ Date _____ Class _____

School to Home **LESSON 2**

The Structure of Atoms

Directions: *Use your textbook to respond to each statement.*

1. **All atoms have the same basic structure. The nucleus is the center region of the atom.**

   Describe the nucleus by identifying the particles that are inside of it, its overall charge, and its mass compared to the mass of an atom.

2. **Electrons are one of the components of atoms. They are found in a region of the atom called the electron cloud.**

   Describe electrons by identifying their charge and their relative mass compared to the atom as a whole.

3. **Elements are arranged in the periodic table in order of their atomic numbers.**

   Identify what can be learned about an atom of an element if its atomic number is known.

4. **Although every atom of an element has the same number of protons, the atoms of an element can vary in other ways.**

   Identify how atoms can vary and what these types of atoms are called.

5. **Atoms of an element can gain or lose electrons. An atom that has gained or lost electrons is called an ion.**

   Describe how gaining an electron changes the overall charge on an atom.

Name _____ Date _____ Class _____

Lesson Outline

LESSON 2

The Structure of Atoms

A. The Parts of an Atom

1. Every kind of element is made up of its own kind of _____.

2. Atoms are composed of several basic types of very small _____; the _____ of each of these particles gives the different kinds of atoms their unique identity.

3. The region at the center of an atom that contains most of the mass of the atom is called the _____.

a. A positively charged particle in the nucleus of an atom is called a(n) _____.

b. An uncharged particle in the nucleus of an atom is called a(n) _____.

4. A negatively charged particle that occupies the space in an atom outside the nucleus is called a(n) _____.

a. _____ are much smaller in size than _____ and neutrons, and they move very quickly.

b. The region surrounding an atom's nucleus where one or more electrons are most likely to be found is called a(n) _____.

c. An electron cloud is mostly made up of _____ space; it is not a cloud of _____.

d. The electrons closest to the _____ have the least energy; the electrons farthest from the _____ have the most energy.

B. The Size of Atoms

1. All the substances around you, including your body and the air you breathe are made up of millions and millions of _____.

2. If you could enlarge an atom to be 1 million times larger than its natural size, it would be the size of a(n) _____; this object enlarged to the same degree would be the size of _____.

Lesson Outline continued

C. Differences in Atoms

1. Every atom has a(n) _____ charged nucleus surrounded by a(n) _____ charged electron cloud; however, atoms can have different numbers of _____, neutrons, and electrons.

2. The number of protons in the nucleus of an atom of an element is called the _____.

a. Each _____ has a different atomic number.

b. The number of _____ in the nucleus of the atom determines the identity of the atom.

3. One of two or more atoms of an element having the same number of protons but a different number of neutrons is called a(n) _____.

4. A neutral atom has the same number of _____ in its nucleus as _____ in its electron cloud.

a. A neutral atom can gain one or more _____, giving the atom a(n) _____ charge; a neutral atom can lose one or more _____, giving the atom a(n) _____ charge.

b. An atom that has a charge because it has gained or lost electrons is called a(n) _____.

c. Ions have same number of _____and are the same element they were before gaining or losing electrons.

D. Atoms and Matter

1. All atoms of the same element have the same number of _____.

2. For each element, the number of _____ and the number of _____ can vary.

3. The properties of an element and the ways its _____ combine are determined mainly by the number and the arrangement of the _____ in its atoms.