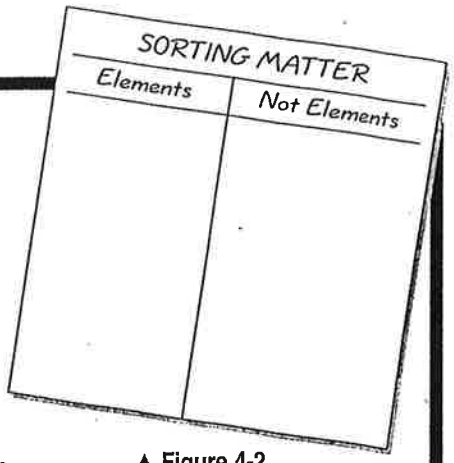
# 4-1 What are three types of matter?

## INVESTIGATE *Sorting Matter*

**HANDS-ON ACTIVITY**

1. Prepare a chart divided into two columns. Label one column "Elements" and the other column "Not Elements."
2. Your teacher will give you samples of several different types of matter. Observe each type of matter.
3. Write the name of each type of matter in one of the two columns. Refer to the periodic table on pages 66 and 67 to help you identify which ones are elements.

**THINK ABOUT IT:** What do you think the objects that are not elements are made of?




▲ Figure 4-2

### *Objective*

Describe similarities and differences among elements, compounds, and mixtures.

### *Key Terms*

**element:** substance that cannot be chemically broken down into simpler substances

**compound:** substance made up of two or more elements that are chemically combined

**mixture:** two or more substances that have been physically combined

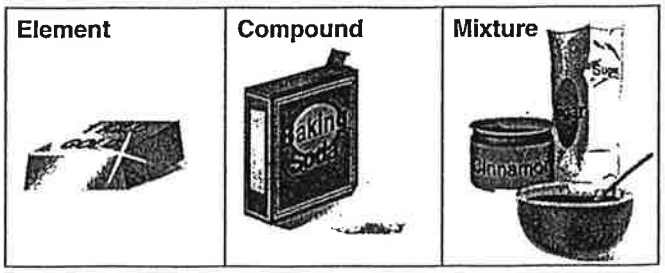
**substance:** any element or compound

**Organizing Matter** You may have items that you like to collect, such as rocks, stamps, sea glass, or baseball cards. If you do, you may sort your collection based on different or similar characteristics, such as size, shape, date, or team. Kinds of matter can be sorted, too. Just like you might sort your collection based on one characteristic, matter can be organized, or classified, into three groups based on the makeup of the matter.

1 **LIST:** What are some of the ways to organize a collection?

**Elements, Compounds, and Mixtures** Matter can be classified into three main types—elements, compounds, and mixtures. You have learned that an **element** is made up of only one kind of atom. For example, pure gold is always made up of atoms that contain 79 protons. A **compound** is made up of atoms of two or more elements that are chemically combined. The elements in a given compound are always combined in a fixed ratio. For example, every particle of the compound baking soda is made up of one atom of sodium, one atom of hydrogen, one atom of carbon, and three atoms of oxygen.

A **mixture** is made up of two or more kinds of matter that are physically combined, or mixed together. The kinds of matter in a mixture can be present in any amounts. A mixture of sugar and cinnamon can contain any amount of sugar and any amount of cinnamon.




▲ Figure 4-3 Examples of the three main types of matter

2 **IDENTIFY:** What are the three main types of matter?

**Substances** Elements and compounds share a similar characteristic. Every sample of an element has the same exact properties as every other sample. Similarly, all samples of a given compound have the same exact properties as every other sample of that compound. For example, the

copper used to make a teakettle will have the same properties as the copper used to make an electric wire. A sample of pure sugar, a compound used to sweeten coffee, will be identical to a sample of pure sugar used to make candy. Because they share this characteristic, elements and compounds are classified as substances. A **substance** is any element or compound.

3 **DEFINE:** What is a substance?

## CHECKING CONCEPTS

1. Matter is classified into three groups based on the _____ of the matter.
2. An _____ is made up of only one kind of atom.
3. A _____ is made up of atoms of different elements that are chemically combined.
4. The elements in a given compound are always combined in a _____ ratio.
5. A _____ is made up of two or more different kinds of matter that are physically combined.
6. The amounts of the different kinds of matter in a _____ can vary.
7. A _____ is any element or compound.

## THINKING CRITICALLY

8. **ANALYZE:** A sample of matter is made up of three different atoms that are chemically combined. What type of matter is it? How do you know?
9. **HYPOTHESIZE:** A substance is made up of two atoms of oxygen. Is it an element or a compound? How do you know?

### Web InfoSearch

**Properties** Substances can be recognized by their physical and chemical properties. These properties can be labeled as *extensive properties* and *intensive properties*. Extensive properties include weight and mass. Intensive properties include melting point and boiling point.

**SEARCH:** Use the Internet to find out more about these types of properties. List other intensive and extensive properties. Start your search at www.conceptsandchallenges.com. Some key search words are **intensive properties** and **extensive properties.**

## People in Science

### ROBERT BOYLE (1627–1691)

The Irish-born scientist Robert Boyle was the first scientist to establish the scientific method of experimentation to test hypotheses. He questioned the early belief that materials were made up of four elements—earth, air, fire, and water. He believed that the basic elements of matter were "corpuscles." These corpuscles, or particles, could be found in various types and sizes, and could arrange themselves into groups called mixtures and compounds. Robert Boyle also showed that the properties of a compound are different from those of the particles that it is made up of.

▲ Figure 4-4 Robert Boyle

Robert Boyle contributed a vast amount of knowledge to the scientific world. His work with gases and pressure led to Boyle's law. He is also credited with the invention of the match.

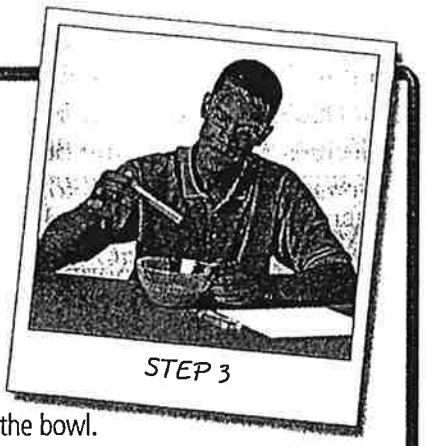
**Thinking Critically** Robert Boyle believed that the basic elements of matter were corpuscles. What would a modern scientist call these basic elements of matter?

# 4-3 What is a mixture?

## INVESTIGATE

### *Separating a Mixture*

**HANDS-ON ACTIVITY**




1. Place one-half cup of iron-fortified cereal into a plastic sandwich bag. Squeeze as much air out of the bag as you can. Seal the plastic bag.
2. Use your hands to crush the cereal into a fine powder. Then, pour the cereal into a bowl. Add enough water to the bowl to completely cover the cereal.
3. Cover one end of a magnet with plastic wrap and use it to stir the mixture for at least 10 minutes. Remove the magnet and let the liquid on the magnet drain back into the bowl.
4. Hold the magnet over a sheet of white paper. Use a hand lens to observe the particles on the end of the magnet.

**THINK ABOUT IT:** What did you observe on the end of the magnet? Where did the matter come from?

### *Objective*

Describe the physical properties of a mixture.

**Mixtures** Cut up some tomatoes, lettuce, onions, and green peppers. Put the pieces in a bowl and stir them together. What do you have? Some people would say that you have a salad. A scientist might say that you have a mixture. You have learned that a mixture is made up of two or more substances that are physically combined. Each part of a mixture keeps its own properties.

Not all mixtures are as easy to identify. If you put some salt in a glass of water and stir, you would have a mixture of salt and water. But this mixture is different from the salad mixture. You cannot see the individual parts of salt or water.

1 **CONTRAST:** What is the difference between a salad mixture and a salt-water mixture?

**Kinds of Mixtures** The kinds of matter in a mixture can be present in varying amounts. The discussion above describes the two basic types of mixtures—evenly mixed and unevenly mixed. The mixture of salt and water is evenly mixed. You cannot see the individual particles of salt or water. The salt is still salt, and the water is still water. However, they are so evenly mixed that every part of this mixture is exactly the same as every other part. A drop taken from the top of the mixture will be identical to a drop taken from the bottom.

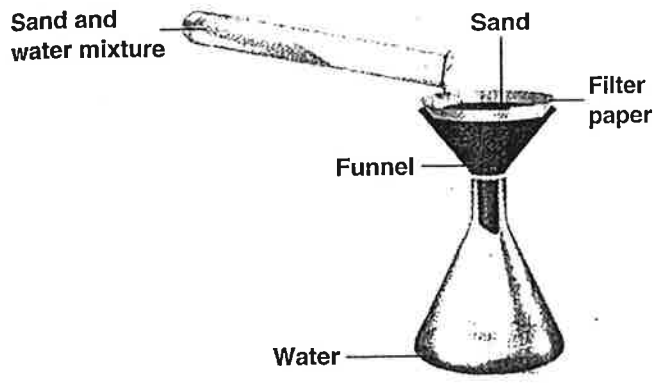
The salad is unevenly mixed. One part of the salad may have more tomato while another part has more green pepper. Each part of the mixture keeps its own properties. A tomato is still red and tastes like a tomato.

▲ **Figure 4-8** A salad is a mixture. Each part of the mixture keeps its own properties.

2 **INFER:** Why do the different kinds of matter in a mixture keep their own properties?

**Separating a Mixture** The properties of the different kinds of matter in a mixture can be used to separate the mixture. Because the parts of a mixture are not chemically combined, they can be separated by physical means. For example, each of the different vegetables could be picked out of the salad by hand.

A physical property of water is that it evaporates when it is heated. So, if you heat a mixture of salt and water, the water will evaporate and the salt will be left behind. The mixture will be separated. Some mixtures can be separated by filtering. If a mixture of sand and water is poured into a filter, the water will pass through. The sand will be trapped by the filter.




▲ **Figure 4-9** Separating a mixture of sand and water

3 **EXPLAIN:** How can you separate a mixture of sand and water?

## CHECKING CONCEPTS

1. Salt water is an example of a _____.
2. The substances in a mixture are _____ combined.
3. The substances in a mixture can be present in _____ amount.
4. The substances in a mixture always keep their own _____.
5. The substances in a mixture can be _____ by using the physical properties of the substances.
6. A mixture of _____ and water can be separated by filtering the mixture.

## THINKING CRITICALLY

7. **HYPOTHESIZE:** Will freezing a mixture of salt and water separate the two substances? Explain your answer.
8. **CLASSIFY:** A teaspoon of instant coffee is placed in a cup of boiling water. Is this a mixture or a compound? Explain your answer.

## DESIGNING AN EXPERIMENT

*Design an experiment to solve the following problem. Include a hypothesis, variables, a procedure, and a type of data to study.*

PROBLEM: You have a mixture of sand, water, and gravel. How can you separate this mixture into its different parts?

## *Real-Life Science*

### MIXTURES THAT YOU CAN EAT

Have you ever gone camping or hiking and taken some trail mix with you? As the name of this snack tells you, trail mix is a mixture. You can see the individual bits of dried fruits and nuts. You could pick out the individual parts with your fingers if you wanted to.

Think about some of the other foods that you eat every day. Many of these foods are mixtures. Rice and beans, vegetable soup, ice cream—all are mixtures.

**Thinking Critically** If you were to make trail mix, do you have to follow the recipe exactly?

| ENERGY TRAIL MIX |
|---|
| 1 c. dried apricots |
| 2 c. raisins |
| ½ c. dry roasted peanuts |
| ½ c. almonds |
| ½ c. pineapple chunks |
| ½ c. banana chips or coconut chips |
| Combine ingredients; mix well. Store in an airtight container. Makes 1¾ quarts. |

▲ **Figure 4-10** Recipe for trail mix

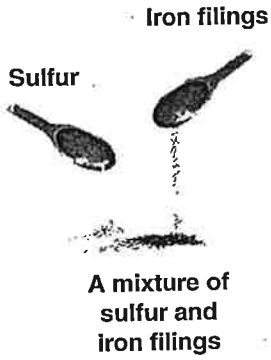
# 4-4 How are mixtures and compounds different?

*Objective*

Contrast the properties of mixtures with the properties of compounds.

**Making a Mixture** The different kinds of matter in a mixture are physically combined. A fruit salad is a mixture of different kinds of fruit. You can make a mixture of iron filings and sulfur by mixing the two substances together.

Iron filings are magnetic slivers of gray metal. Sulfur is a nonmetallic yellow powder. Just like each piece of fruit in a salad keeps its properties, each substance in the iron-sulfur mixture will keep its own properties. You would be able to see the grains of yellow powder and slivers of gray metal in a mixture of these two substances.

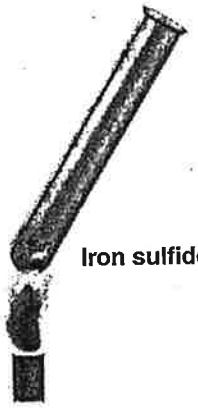



◀ **Figure 4-11** Making a mixture of sulfur and iron

1 **INFER:** How can you make a mixture of iron filings and sulfur?

**Making a Compound** A compound is made up of two or more elements. It is formed as a result of a chemical change. The elements in a compound combine by forming chemical bonds between the atoms of the elements. For example, molecules of sugar are formed as a result of a chemical change. Atoms of hydrogen form chemical bonds with atoms of oxygen and atoms of carbon to produce molecules of sugar.

Not only can iron and sulfur be physically combined to make a mixture, they can also be chemically combined to form a compound. This compound is called iron sulfide. Iron sulfide forms when a mixture of iron filings and sulfur is heated. The atoms of the two elements will combine to form chemical bonds with each other. The compound iron sulfide will be produced. Like all compounds, the properties of iron sulfide are different from the properties of the elements that make it up.




◀ **Figure 4-12** Making the compound iron sulfide

2 **EXPLAIN:** What happens when a mixture of iron filings and sulfur is heated?

**Comparing Mixtures and Compounds** Mixtures and compounds are different in several ways. A mixture of iron and sulfur does not have a definite chemical composition. The mixture might contain equal parts of each element. Or, it might have twice as much of one element as the other. Each substance in a mixture of iron and sulfur keeps its own properties. A mixture of iron and sulfur can be separated by physical means. For example, a magnet can be used to attract the iron.

The compound iron sulfide always has a definite chemical composition. Every molecule of iron sulfide contains one atom of iron and one atom of sulfur.

When elements combine chemically, each element loses its properties. The iron and sulfur in iron sulfide cannot be separated by physical means. Figure 4-13 lists some differences between mixtures and compounds.

**COMPARING MIXTURES AND COMPOUNDS**

| Mixtures | Compounds |
|---|---|
| Made of two or more substances physically combined | Made of two or more substances chemically combined |
| Substances keep their own properties | Substances lose their own properties |
| Can be separated by physical means | Can be separated only by chemical means |
| Have no definite chemical composition | Have a definite chemical composition |

▲ **Figure 4-13** Differences between mixtures and compounds

3 **CONTRAST:** How are mixtures and compounds different?

## CHECKING CONCEPTS

1. The elements in a _____ are chemically combined.
2. Each kind of matter in a _____ keeps its own properties.
3. A _____ does not have a definite chemical composition.
4. A _____ cannot be separated by physical means.

## THINKING CRITICALLY

5. **INFER:** When a certain poisonous gas is combined with a chemically active metal, a fine white powdery substance results. The new substance is neither poisonous nor chemically active. Is the powder a mixture or a compound? How do you know?
6. **COMPARE:** Water is a compound. Salt water is a mixture. List the differences between water and salt water.

## Integrating Earth Science

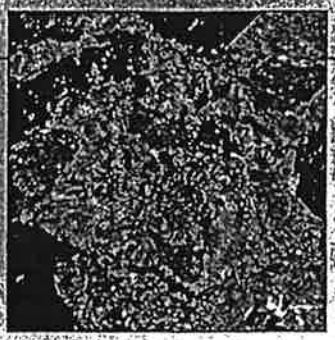
**TOPICS: rocks, minerals**

### CLASSIFYING ROCKS

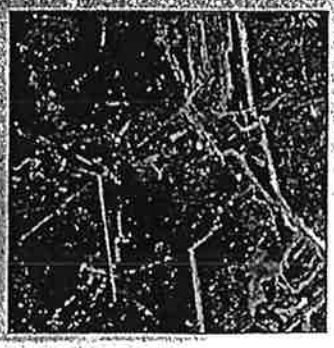
Like other types of matter, rocks can be classified as elements, compounds, or mixtures. Some rocks are actually made of pure elements. For example, copper and gold are elements that can be found in nearly pure form. However, rocks that are mixtures of different compounds are more common than are rocks made of pure elements.

Some compounds that can be found in certain rocks include quartz, mica, and feldspar. Quartz is a hard, cloudy-looking mineral that is actually a compound made up of silicon and oxygen. One form of mica is a black compound made up of the elements potassium, aluminum, silicon, oxygen, and hydrogen. Feldspar is a milky-white or pink compound that can be made up of aluminum, silicon, sodium, potassium or calcium and oxygen. A mixture of these three compounds can be found in a type of rock called granite. Granite is a hard rock with big grains of quartz, mica, and feldspar.

**Thinking Critically** How would you classify granite?



▲ **Figure 4-14** Granite is a mixture.



▲ **Figure 4-15** Mica can be found in granite.

# 4-5 What is an ionic bond?

## *Objective*

Describe how atoms form ionic bonds.

## *Key Terms*

**valence electron:** electron in the outermost energy level of an atom

**ion:** atom with an electrical charge

**ionic bond:** bond formed between atoms that have gained or lost electrons

**Valence Electrons** The formation of chemical bonds is a process involving valence electrons. A **valence electron** is an electron in the outermost energy level of an atom. Except for the elements hydrogen and helium, the outermost energy level of an atom can hold a maximum of eight electrons. An atom with eight electrons in its outermost energy level is very stable.

Atoms of all elements have valence electrons. Atoms with fewer than eight valence electrons tend to form bonds with other atoms. Atoms can give electrons, receive electrons, or share electrons with other atoms to reach the stable number of eight valence electrons.

1 DEFINE: What are valence electrons?

**Neutral Atoms** All matter is made up of atoms. Every atom is made up of smaller particles called protons, neutrons, and electrons. A proton has a positive charge. An electron has a negative charge. A neutron has no charge.

In an atom, the number of protons and the number of electrons are the same. Because the charges are balanced, all atoms are neutral.

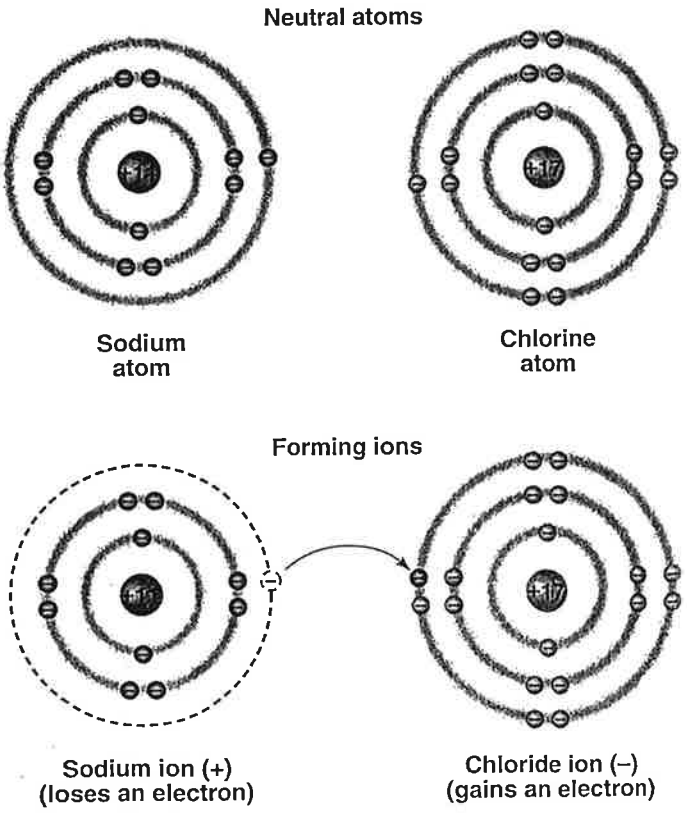
2 EXPLAIN: Why are atoms neutral?

**Charged Atoms** When forming chemical bonds, the atoms of nonmetals tend to gain electrons while the atoms of metals tend to lose electrons. When the number of electrons in an atom is different from the number of protons, the atom becomes electrically charged. An atom with an electrical charge is called an **ion.**

If a neutral atom gains electrons, it becomes a negative ion. It is a negative ion because there are now more electrons than there are protons. Electrons have a negative charge. If a neutral atom loses electrons, it becomes a positive ion. There are more protons than there are electrons.

3 COMPARE: Does a negative ion have more protons or more electrons?

**Ionic Bonds** In compounds, particles of matter are held together by chemical bonds. A bond that forms when one atom gains one or more electrons from another atom is called an **ionic bond.** The atom that gains electrons becomes a negative ion. The atom that loses electrons becomes a positive ion. The two ions have opposite electrical charges. As a result, they are attracted to each other. This force of attraction holds atoms together in an ionic bond.




▲ **Figure 4-18** Atoms of sodium and chlorine form ionic bonds.

4 EXPLAIN: How does an ionic bond form?

**Ionic Compounds** Compounds whose atoms are held together by ionic bonds are called ionic compounds. Ionic compounds are not made up of molecules. Instead, they are made up of one or more positive ions and one or more negative ions. Because the atoms are held together by ionic bonds, ionic compounds have similar properties. One of these properties is crystal shape. A crystal is a solid that contains atoms arranged in a regular pattern. Many ionic compounds, such as sodium chloride, form crystals. Ionic compounds also have high melting points and they are conductors of electricity when they are melted.

5 **IDENTIFY:** What is a crystal?

## CHECKING CONCEPTS

1. Electrons have a _____ electrical charge.
2. When an atom loses electrons, it becomes a _____ ion.
3. An _____ forms when one atom takes an electron from another atom.
4. Particles with opposite electrical charges _____ each other.
5. An ionic compound is not made up of _____.
6. A _____ is a solid that contains atoms arranged in a regular pattern.

## THINKING CRITICALLY

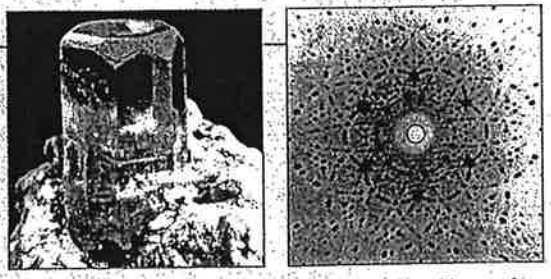
7. **INFER:** Could an atom ever lose an electron without another atom gaining the electron? Explain.
8. **ANALYZE:** Why are ionic compounds not made of molecules?

## BUILDING SCIENCE SKILLS

***Modeling Crystal*** A crystal is a solid that contains atoms arranged in a regular pattern. The pattern of atoms forms a crystal lattice. The shape of a crystal is determined by its crystal lattice. Table salt, or sodium chloride, is an example of a crystal. Research the type of crystal lattice found in table salt. Draw a diagram of the crystal lattice of sodium chloride and display it to the class. Label the sodium ions and chloride ions in the lattice.

## *How Do They Know That?*

### CRYSTALLOGRAPHY



▲ Figure 4-19 A beryl crystal (left) and an X-ray of beryl (right)

Crystals have been the object of scientific study for hundreds of years. Early mineralogists classified crystals according to observable properties such as shape and color. Around 1800, mineralogists began measuring the angles found on a crystal's surface. The mineralogists thought that the size of a crystal's angles was related to the type of substances that make up the crystal. However, they had no way of looking at the internal structure of a crystal.

In 1895, X-rays were discovered. Using X-rays, scientists could examine the structure of crystals. They discovered that crystal angles are caused by common structural patterns inside the crystal. As a result of X-ray crystallography, scientists were able to identify six basic crystal systems. The names of these crystal systems are cubic, tetragonal, orthorhombic, monoclinic, hexagonal/trigonal, and triclinic.

**Thinking Critically** How do you think the names of the crystal systems are related to their shapes? Use a reference to find out.

# 4-6 What is a covalent bond?

## *Objective*

Describe how atoms combine in covalent bonds.

## *Key Term*

**covalent bond:** bond formed when atoms share electrons

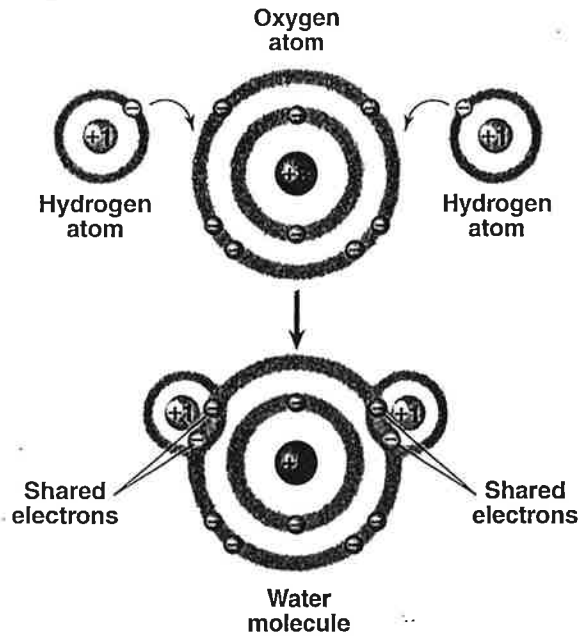
**Outermost Energy Levels** In most atoms, the outermost energy level is not completely filled. The outermost energy level does not contain the maximum number of valence electrons that it can hold. In order to complete their outermost energy levels, atoms gain, lose, or share electrons. These electrons come from other atoms that also have incomplete outermost energy levels.

Ionic bonds form when one atom gains one or more electrons from another atom. The result is an ionic compound. Elements can also form compounds when their atoms share electrons to form a molecule. This type of bonding is called a **covalent bond.**

1 **IDENTIFY:** How can atoms complete their outermost energy levels?

**Covalent Compounds** Compounds whose atoms share electrons in covalent bonds are called covalent compounds. The shared electrons are in the outermost energy levels of all the atoms in a molecule of the covalent compound.

Water is an example of a covalent compound. A water molecule has covalent bonds between an atom of oxygen and two atoms of hydrogen. The oxygen atom has six electrons in its outermost energy level. It needs two more electrons to completely fill this energy level. A hydrogen atom has one electron in its one and only energy level. This energy level is complete when it has two electrons. So, a hydrogen atom needs only one more electron to fill its outermost energy level. Figure 4-20 shows the covalent bonds in a molecule of water. Notice how two atoms of hydrogen form covalent bonds with one atom of oxygen to form the water molecule.




▲ **Figure 4-20** A molecule of water has covalent bonds between the atoms of hydrogen and the atom of oxygen.

2 **CLASSIFY:** Is water an ionic compound or a covalent compound?

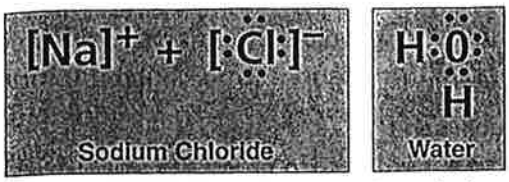
**Comparing Ionic and Covalent Compounds** Covalent compounds are formed differently from ionic compounds. Atoms joined by a covalent bond do not lose or gain electrons. So, they do not become positively or negatively charged. They do not become ions. The atoms remain neutral. Figure 4-21 lists the main points to know about ionic compounds and covalent compounds.

| COMPARING IONIC AND COVALENT COMPOUNDS | |
|---|---|
| Ionic Compounds | Covalent Compounds |
| Atoms complete their outermost energy levels. | Atoms complete their outermost energy levels. |
| Electrons are lost and gained. | Electrons are shared. |
| Atoms form ions. | Atoms remain neutral. |

▲ **Figure 4-21** Ionic compounds and covalent compounds act differently.

3 **COMPARE:** How are covalent compounds different from ionic compounds?

**Electron Dot Diagrams** Electron dot diagrams include the symbols of the elements in a compound and the arrangement of the valence electrons for each element. These diagrams can be used to show the positive and negative ions in an ionic compound. They can also be used to show a molecule of a covalent compound. Figure 4-22 shows the electron dot diagrams for sodium chloride and water.




▲ **Figure 4-22** Electron dot diagrams for an ionic compound (left) and a covalent compound (right)

4 **INFER:** What do electron dot diagrams show?

## CHECKING CONCEPTS

1. In most atoms, the _____ energy level is not completely filled.
2. In a covalent bond, electrons are _____.
3. Water is an example of a _____ compound.
4. In a covalent compound, the atoms join together to form a _____.
5. In a covalent compound, the atoms remain _____.
6. Diagrams that show the symbol of the elements in a compound and the arrangement of the electrons for each element are called _____.

## THINKING CRITICALLY

7. **HYPOTHESIZE:** A carbon atom has four valence electrons in its outermost energy level. An oxygen atom has six valence electrons. Hypothesize about the type of bonding that will take place between carbon and oxygen.

## Hands-On Activity

### MAKING A MOLECULAR MODEL

*You will need white and red modeling clay, and toothpicks.*

1. Using the red clay, make four round balls that are the same size.
2. Make one round ball of white clay that is the same size as the red balls.
3. Use toothpicks to connect each of the four red balls to the white ball. Space the red balls equally around the white ball. You have just made a model of a methane molecule. A molecule of methane contains four hydrogen atoms joined to one carbon atom.

▲ STEP 3 Make a model of a methane molecule.

**Practicing Your Skills**

4. OBSERVE: What element is represented by the red balls?
5. OBSERVE: What element is represented by the white ball?
6. ANALYZE: What type of bond joins the atoms?
7. ANALYZE: Do the atoms in a methane molecule have an electrical charge? Why or why not?

# 4-7 What is an organic compound?

## *Objective*

Identify some organic compounds.

## *Key Terms*

**organic compound:** compound containing carbon

**organic chemistry:** study of organic compounds

**structural formula:** molecular model that uses straight lines to indicate bonds

**polymers:** large molecules that are formed by many smaller molecules

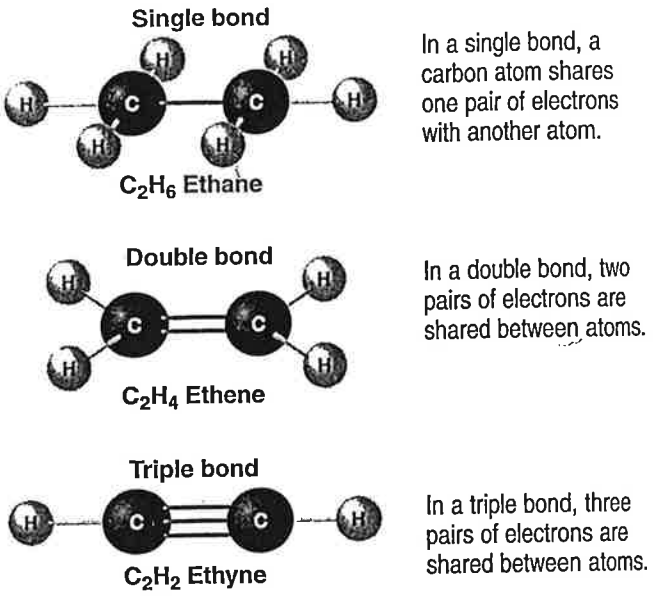
**Classifying Compounds** Scientists classify compounds based on which ones contain the element carbon and which ones do not. The compounds that contain carbon are called **organic compounds.** The compounds that do not usually contain carbon are called inorganic compounds. An example of an organic compound is sugar, which is made up of carbon, hydrogen, and oxygen. An example of an inorganic compound is water. Water is made up of oxygen and hydrogen.

At one time, scientists thought that only living things contained organic compounds. Today, scientists know that some nonliving substances, such as plastics, contain organic compounds. Also, the compounds carbon dioxide and carbon monoxide are classified as inorganic compounds even though they do contain carbon.

**1** **DEFINE:** What is an organic compound?

**Organic Chemistry** About 95% of all known substances are organic compounds. Because so many of the compounds around us are organic compounds, the study of these substances has been given its own special branch of science called **organic chemistry.**

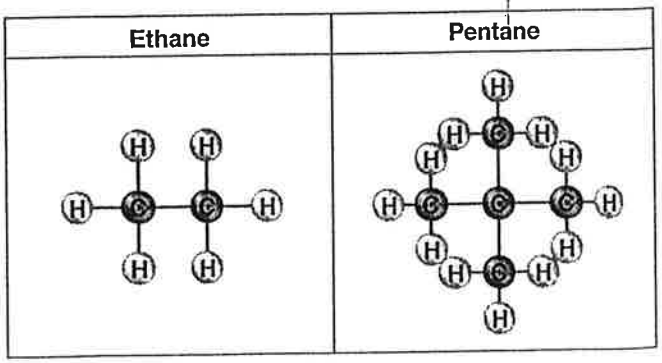
Scientists studying organic chemistry have learned that a molecule of an organic compound can contain large numbers of atoms. This can happen because a carbon atom has four electrons in its outermost energy level. As a result, a carbon atom can form covalent bonds with up to four other atoms. A carbon atom can form three different kinds of covalent bonds—a single bond, a double bond, and a triple bond.




▲ **Figure 4-23** Three types of covalent bonds allow many different organic compounds to be formed.

**2** **IDENTIFY:** What is organic chemistry?

**Structural Formulas** When carbon atoms join together, they can form many different atomic structures. The atoms can join in a straight chain or a branched chain, or curve around in a ring. These arrangements of atoms can be shown in a structural formula. A **structural formula** is a molecular model that uses straight lines to show bonds. Structural formulas are frequently used to represent organic compounds. Figure 4-24 shows the structural formulas of some organic compounds.




▲ **Figure 4-24** Structural formulas

**3** **IDENTIFY:** What is a structural formula?

**Polymers** Organic compounds can join together to form very large molecules. These molecules can contain thousands or even millions of atoms. Very large molecules that are formed by many smaller molecules are called **polymers**. The smaller molecules that make up polymers are called monomers.

You may be familiar with some polymers, such as silk, nylon and wool. Many kinds of polymers are used to make materials that we use every day. Some products made from polymers include foam drinking cups, garden hoses, milk containers, and automobile parts.

4 **LIST:** Name some products made from polymers.

## CHECKING CONCEPTS

1. All organic compounds contain the element _____.
2. A carbon atom can form covalent bonds with up to _____ other atoms.
3. In a _____ bond, two pairs of electrons are shared between atoms.
4. The study of organic compounds is called _____.
5. A _____ shows the arrangement of atoms in a molecule of an organic compound.
6. Very large molecules made up of many smaller molecules are called _____.

## THINKING CRITICALLY

7. **INFER:** An atom of hydrogen contains one electron in its one energy level. Could a hydrogen atom form a triple bond with another atom? Explain your answer.
8. **EXPLAIN:** Why are there more organic compounds than inorganic compounds?

## INTERPRETING VISUALS

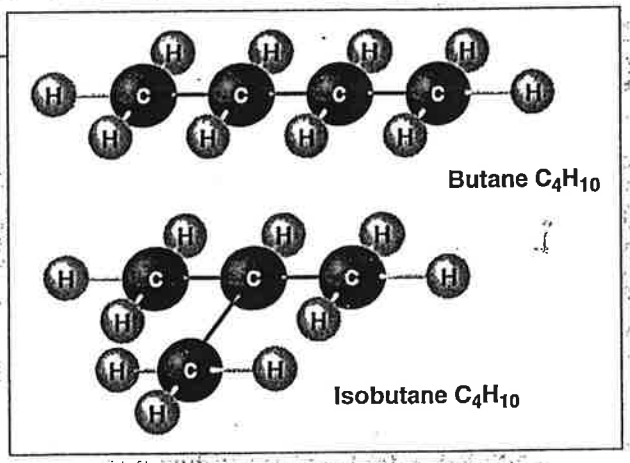
*Use Figure 4-24 to help you answer the following questions.*

9. What is the chemical formula of ethane?
10. What is the chemical formula of pentane?

## *Science and Technology*

### ISOMERS

A structural formula can show you that a certain kind of organic compound can have different arrangements. Two or more compounds that have the same chemical makeup but different structures are called isomers. For example, Figure 4-25 shows the two structural formulas for the compound butane. Each isomer has four carbon atoms and ten hydrogen atoms in each of its molecules. However, the atoms of each isomer are arranged differently. One isomer is a straight chain and the other isomer is a branched chain. Because each molecule has a different arrangement, each compound has different physical and chemical properties.




▲ **Figure 4-25** Butane (top) and isobutane (bottom) are isomers.

Organic compounds that have a large number of carbon atoms may have many isomers. In general, as the number of carbon atoms increases, the number of isomers will also increase.

**Thinking Critically** Why do you think the number of isomers increases when the number of carbon atoms increases?

# 4-8 What organic compounds are needed by living things?

## *Objective*

Identify organic compounds needed by living things.

## *Key Terms*

**carbohydrates** (kahr-boh-HY-drayts)**:** sugars and starches

**lipids:** fats and oils

**proteins:** compounds used to build and repair body tissues

**amino acids:** building blocks of proteins

**nucleic acids:** compounds made up of carbon, oxygen, hydrogen, nitrogen, and phosphorus

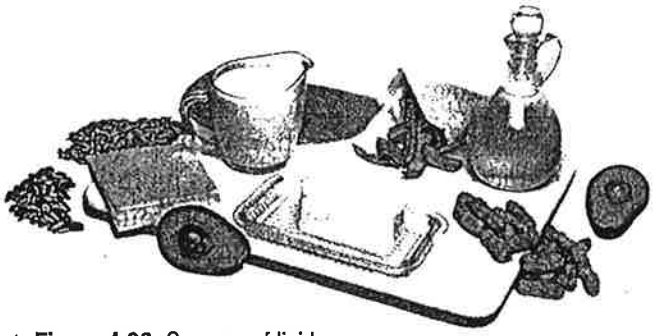
**Needs of Living Things** All living things need certain organic compounds to stay alive. An organism gets the organic compounds it needs from its food. Most foods are made up of carbohydrates, lipids, and proteins.

1 **IDENTIFY:** How do organisms obtain the organic compounds they need?

**Carbohydrates** The organic compounds that are made up of carbon, hydrogen, and oxygen are called carbohydrates. Sugars and starches are **carbohydrates**. These organic compounds are the body's main source of energy. Foods such as cereals, grains, pasta, vegetables, and fruits are good sources of carbohydrates.

2 **EXPLAIN:** Why do all living things need carbohydrates?

**Lipids** The organic compounds that are made up mostly of carbon and hydrogen are called lipids. Fats and oils are **lipids**. These compounds are another energy source for the body. Lipids can be stored in the body for use at a later time. For this reason, lipids are often called the body's stored energy supply. Foods such as butter, meat, cheese, and nuts are good sources of lipids.



▲ **Figure 4-26** Sources of lipids

Cholesterol is a kind of lipid. Animal fat contains cholesterol. Eating too many foods high in certain kinds of cholesterol can be harmful to the body. Excess amounts of cholesterol may form fatty deposits on the walls of blood vessels. These fatty deposits can interfere with the flow of blood through the body.

3 **DESCRIBE:** Why do living things need lipids?

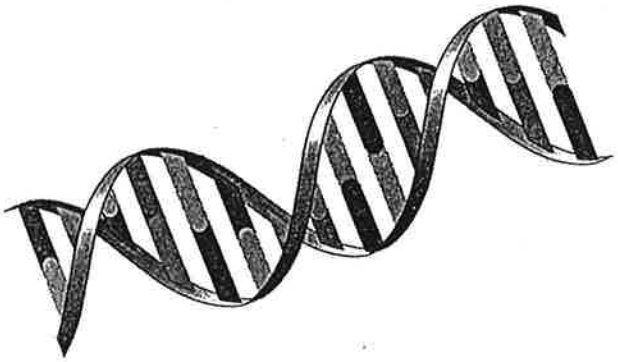
**Proteins** Organic compounds that are used to build and repair the body are called **proteins**. Proteins are made up of substances called **amino acids**. Amino acids contain carbon, hydrogen, oxygen, and nitrogen. Amino acids join together in long chains to form proteins. For this reason, amino acids are called the building blocks of proteins. Meat, milk, fish, eggs, and beans are good sources of protein. Foods such as fish and soybeans provide the body with most of the amino acids it needs.

▲ **Figure 4-27** Sources of amino acids and proteins

4 **RELATE:** What is the relationship between amino acids and proteins?

**Nucleic Acids** Other organic compounds that your body needs are called nucleic acids. **Nucleic acids** are made up of carbon, oxygen, hydrogen,

nitrogen, and phosphorus. There are two types of nucleic acids, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). These organic compounds are made up of very large molecules. Each molecule is a type of polymer made up of chains of smaller molecules joined together. You have probably heard of DNA. It contains the information about the characteristics that you have inherited and it also controls the activities of the cells in your body.



▲ **Figure 4-28** Section of a DNA molecule

5 **DESCRIBE:** What elements are nucleic acids made up of?

## CHECKING CONCEPTS

1. An organism gets the organic compounds it needs from its _____.
2. Organic compounds made up of carbon, hydrogen, and oxygen are called _____.
3. Sugars and starches are _____.
4. Fats and oils are _____.
5. Organic compounds used to build and repair body parts are called _____.
6. The organic compounds that control the activities in body cells are called _____.

## THINKING CRITICALLY

7. **INFER:** Why do many long-distance runners eat a meal of pasta before running a race?

## BUILDING SCIENCE SKILLS

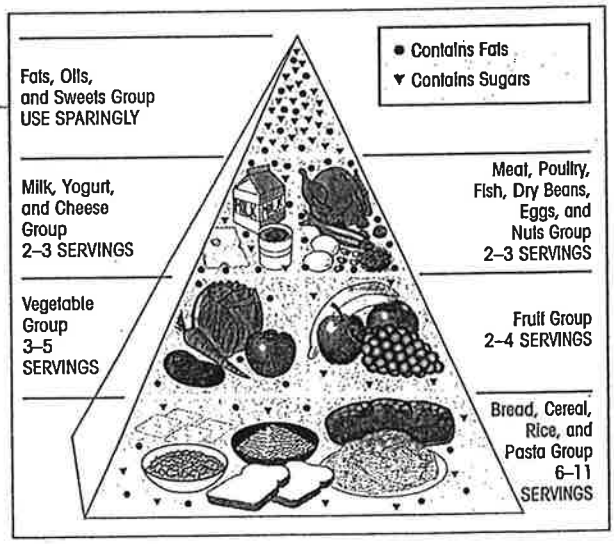
***Organizing Information*** Make a table with the following headings: *Carbohydrates*, *Lipids*, and *Proteins*. Under each heading, identify five types of foods that you enjoy eating which contain that type of organic compound.

## *Real-Life Science*

### FOOD PYRAMID

To keep your body healthy you should eat a balanced diet. One way to get a balanced diet is to follow the Food Guide Pyramid.

The pyramid shows the six food groups that provide important organic compounds. It also tells how much food you should eat from each group every day. The bottom row of the pyramid is the bread, cereal, rice, and pasta group. These foods contain carbohydrates. The second row of the pyramid contains the vegetable group and the fruit group. The foods in these groups contain carbohydrates and other substances your body needs. The third level contains the milk, yogurt, and cheese group and the meat, poultry, fish, dry beans, eggs, and nuts group. These two groups contain proteins. The group at the top of the pyramid is the fats, oils, and sweets group. Foods from this group should be eaten in small amounts.




▲ **Figure 4-29** The Food Guide Pyramid

**Thinking Critically** How does the food pyramid tell you how much food you should eat from each group?

Name _____ Date _____

Mr. Smith - Chemistry Homework 4-1

## GUIDED QUESTIONS

1. What are some of the ways to organize a collection?

_____

_____

_____

2. What are the three main types of matter?

_____

_____

3. What is a substance?

_____

_____

## CHECKING CONCEPTS

1. Matter is classified into three groups based on the _____ of the matter.
2. An _____ is made up of only one kind of atom.
3. A _____ is made up of atoms of different elements that are chemically combined
4. The elements in a given compound are always combined in a _____ ratio.
5. A _____ is made up of two or more different kinds of matter that are physically combined.
6. The amounts of the different kinds of matter in a _____ can vary.
7. A _____ is any element or compound.

Name _____ Class _____ Date _____

# 4-1 What are three types of matter?

## Lesson Review

Decide which type or types of matter—element, compound, or mixture—are being described. Write the correct terms in the spaces provided.

_____ 1. A substance made up of one type of atom

_____ 2. A chemical combination of two or more substances

_____ 3. Each sample has the same properties as every other sample.

_____ 4. Elements are chemically combined in a fixed ratio.

_____ 5. A physical combination of two or more substances

_____ 6. Kinds of matter are present in any amounts.

_____ 7. Is classified as a substance

_____ 8. Cannot be chemically broken down into a simpler substance

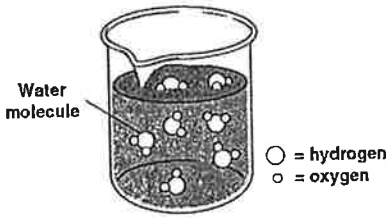
_____ 9. Each sample does not necessarily have the same properties as every other sample.

## Skill Challenge

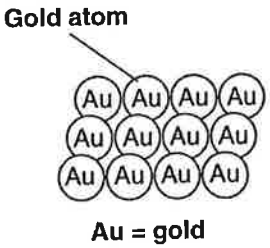
***Skills:*** *classifying, applying*

Study the diagrams below. Circle the letter of the diagram that is described by each phrase. Some phrases may describe more than one diagram.

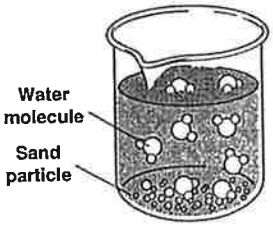
A




B




C




| | | | |
|---|---|---|---|
| 1. an element | A | B | C |
| 2. a compound | A | B | C |
| 3. a mixture | A | B | C |
| 4. a substance | A | B | C |

Name _____ Date _____

Mr. Smith - Chemistry Homework 4-3

## GUIDED QUESTIONS

1. What is the difference between a salad mixture and a salt-water mixture?

_____

_____

_____

2. Why do the different kinds of matter in a mixture keep their own properties?

_____

_____

_____

3. How can you separate a mixture of sand and water?

_____

_____

## CHECKING CONCEPTS

1. Salt water is an example of a _____.
2. The substances in a mixture are _____ combined.
3. The substances in a mixture can be present in _____ amounts.
4. The substances in a mixture always keep their own _____.
5. The substances in a mixture can be _____ by using the physical properties of the substances.
6. A mixture of _____ and water can be separated by filtering the mixture.

Name _____ Class _____ Date _____

# 4-3 What is a mixture?

## Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.

_____ 1. The substances in a mixture can be separated by physical means.

_____ 2. Salt water can be separated by evaporation.

_____ 3. A salad is an example of a mixture that is evenly mixed.

_____ 4. The substances in a mixture keep their own properties.

_____ 5. A mixture of sand and water can be separated by filtering.

_____ 6. Salt water is an example of a compound.

_____ 7. The substances in a mixture can be present in any amount.

_____ 8. Two or more substances that have been physically combined make up a mixture.

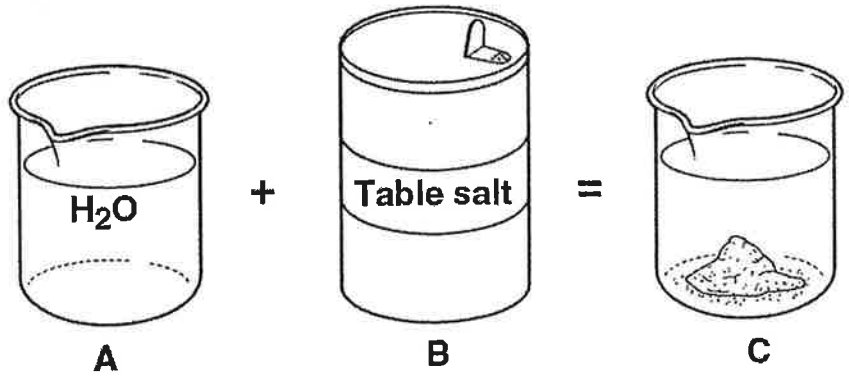
_____ 9. A drop taken from the top of a mixture of salt and water will not be identical to a drop taken from the bottom of the mixture.

_____ 10. The parts of a mixture are chemically combined.

## Skill Challenge

***Skills:*** *interpreting a diagram, synthesizing*

Study the diagram below. Use the information in the diagram to complete the statements that follow.




1. Part _____ of the diagram shows a mixture.
2. A compound is shown in Parts _____ of the diagram.
3. Molecules of the substance shown in Part A of the diagram _____ exactly alike.
4. Molecules of the substance shown in Part B _____ exactly alike.
5. All of the molecules shown in Part C _____ exactly alike.
6. The different molecules in Part _____ of the diagram can be separated by physical means.

Name _____ Date _____

Mr. Smith - Chemistry Homework 4-4

## GUIDED QUESTIONS

1. How can you make a mixture of iron fillings and sulfur?

_____

_____

_____

2. What happens when a mixture of iron fillings and sulfur is heated?

_____

_____

_____

3. How are mixtures and compounds different?

_____

_____

_____

## CHECKING CONCEPTS

1. The elements in a _____ are chemically combined.
2. Each kind of matter in a _____ keeps its own properties.
3. A _____ does not have a definite chemical composition.
4. A _____ cannot be separated by physical means.
5. When a certain poisonous gas is combined with a chemically active metal, a fine white powdery substance results. The new substance is neither poisonous nor chemically active. Is the powder a mixture or a compound? How do you know?

Choose your answer by circling the term: Mixture Compound

How do you know?

_____

_____

_____

_____

_____

Name _____ Class _____ Date _____

# 4-4 How are mixtures and compounds different?

## Lesson Review

Complete the following.

1. Substances that make up a _____ lose their original properties.
2. A _____ can be separated by physical means.
3. Iron sulfide contains the elements _____ .
4. The elements that make up a _____ are chemically combined.
5. Each substance in a mixture of iron and sulfur keeps its own _____ .
6. A _____ has a definite chemical composition.
7. Iron sulfide is an example of a _____ .
8. A _____ has no definite chemical composition.
9. A _____ can be separated only by chemical means.
10. _____ a mixture of iron filings and sulfur will make the iron and sulfur atoms combine chemically.

## Skill Challenge

***Skills:*** *comparing, analyzing*

Decide whether each statement is true for compounds and mixtures by writing either *yes* or *no* in the spaces provided.

| Statement | Compound | Mixture |
|---|---|---|
| Has a definite chemical composition | 1. | 2. |
| Can be separated by physical means | 3. | 4. |
| Made up of two or more substances | 5. | 6. |
| Elements that form it keep their own properties. | 7. | 8. |
| Elements are joined chemically. | 9. | 10. |

Name _____ Date _____

Mr. Smith - Chemistry Homework 4-5

## GUIDED QUESTIONS

1. What are valence electrons?

_____

_____

_____

2. Why are atoms neutral?

_____

_____

_____

3. Does a negative atom have more protons or more electrons?

_____

_____

4. How does an ionic bond form?

_____

_____

_____

5. What is a crystal?

_____

_____

_____

## CHECKING CONCEPTS

1. Electrons have a _____ electrical charge.
2. When an atom loses electrons, it becomes a _____ ion.
3. An _____ forms when one atom takes an electron from another atom.
4. Particles with opposite ~~electoral~~ ELECTRICAL charges _____ each other.
5. A _____ is a solid that contains atoms arranged in a regular pattern.

Name _____ Class _____ Date _____

# 4-5 What is an ionic bond?

## Lesson Review

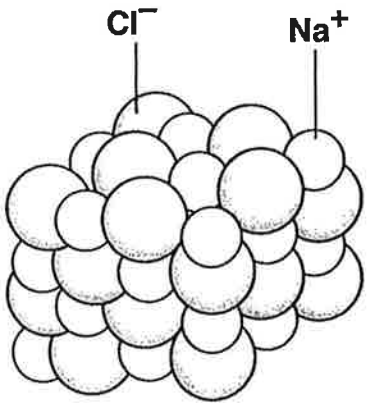
Complete the following.

1. The two ions in an ionic bond have _____ electrical charges.
2. A solid that contains atoms arranged in a regular pattern is called a _____ .
3. A proton has a _____ electrical charge.
4. In a neutral atom, the number of protons _____ the number of electrons.
5. The bond that is formed when one atom gains electrons from another atom is an _____ bond.
6. Ionic compounds have similar properties, including _____ melting points.
7. An atom with an electrical charge is called an _____ .
8. If a neutral atom gains electrons, it becomes a _____ ion.
9. When an atom's electrical charges are balanced, the atom is electrically _____ .
10. If a neutral atom loses electrons, it becomes a _____ ion.

## Skill Challenge

***Skills:*** *interpreting a diagram, analyzing*

Use the diagram below to answer the questions that follow.




1. What kind of structure do the positive and negative ions in the diagram form? _____
2. What type of bonds join the atoms in the substance? _____
3. What kind of ion is $Na^+$? _____
4. What kind of ion is $Cl^-$? _____
5. What holds the $Na^+$ and $Cl^-$ atoms together? _____

Name _____ Date _____

Mr. Smith - Chemistry Homework 4-6

## GUIDED QUESTIONS

1. How can elements complete their outermost energy levels?

_____

_____

_____

2. Is water an ionic compound or a covalent compound?

_____

_____

3. How are covalent compounds different from ionic compounds?

_____

_____

4. What do electron dot diagrams show?

_____

_____

_____

## CHECKING CONCEPTS

1. In most atoms, the _____ energy levels is not completely filled.
2. In a covalent bond, electrons are _____.
3. Water is an example of a _____ compound.
4. In a covalent compound, the atoms join together to form a _____.
5. In a covalent compound, the atoms remain _____.
6. Diagrams that show the symbol of the elements in a compound and the arrangement of the electrons for each elements are called _____.

Name _____ Class _____ Date _____

# 4-6 What is a covalent bond?

## Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.

_____ 1. Most atoms have complete outer energy levels.

_____ 2. Atoms joined by a covalent bond do not gain or lose electrons.

_____ 3. Water is an example of an ionic compound.

_____ 4. In an ionic compound, atoms remain neutral.

_____ 5. An oxygen atom in a molecule of water has a complete outer energy level.

_____ 6. In a covalent compound, atoms form ions.

_____ 7. In a molecule of water, each hydrogen atom trades electrons with the oxygen atom.

_____ 8. Covalent bonds form when one atom gains electrons from another atom.

_____ 9. Ionic compounds and covalent compounds are similar in that the atoms in both have complete outer energy levels.

_____ 10. Two atoms share electrons in an ionic bond.

## Skill Challenge

***Skills:*** *comparing, identifying*

Decide whether each statement is true for ionic compounds and covalent compounds by writing *yes* or *no* in the spaces provided.

| Statement | Ionic Compound | Covalent Compound |
|---|---|---|
| Water is an example of this kind of compound. | 1. | 2. |
| Atoms remain neutral. | 3. | 4. |
| Electrons are lost or gained. | 5. | 6. |
| Atoms are joined together. | 7. | 8. |
| Atoms are electrically charged. | 9. | 10. |

Name _____ Date _____

Mr. Smith - Chemistry Homework 4-7

## GUIDED QUESTIONS

1. What are organic compounds?

_____

_____

2. What is organic chemistry?

_____

_____

3. What is a structural formula?

_____

_____

4. Name some products made from polymers?

_____

_____

## CHECKING CONCEPTS

1. All organic compounds contain the element _____.
2. A carbon atom can form covalent bonds with up to _____ other atoms.
3. In a _____ bond, two pairs of electrons are shared between atoms.
4. The study of organic compounds is called _____.
5. A _____ _____ shows the arrangement of atoms in a molecule of an organic compound.
6. Very large molecules made up of many smaller molecules are called _____.
7. What is the chemical formula for ethane? _____
8. What is the chemical formula for pentane? _____

Name _____ Class _____ Date _____

# 4-7 What is an organic compound?

## Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.

_____ 1. About 95 percent of all known substances are inorganic compounds.

_____ 2. A molecule of an organic compound can contain large numbers of atoms.

_____ 3. Water is an example of an organic compound.

_____ 4. A structural formula uses straight lines to represent protons.

_____ 5. The study of organic compounds is called organic chemistry.

_____ 6. Carbon dioxide is an example of an organic compound.

_____ 7. In a double bond, three pairs of electrons are shared between atoms.

_____ 8. Organic compounds contain the element hydrogen.

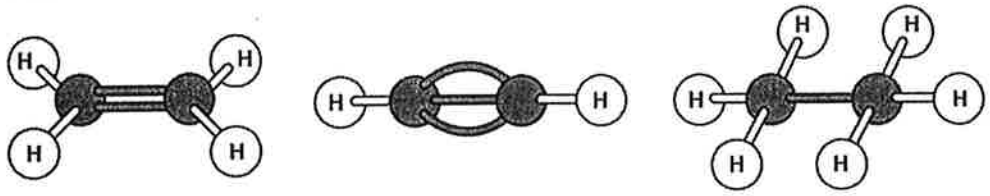
_____ 9. A carbon atom can form three different kinds of covalent bonds.

_____ 10. Silk, nylon, and wool are examples of monomers.

## Skill Challenge

***Skills:*** *relating, comparing*

Match the parts of the diagram below with the following descriptions. The black circles show carbon atoms. The white circles show hydrogen atoms.




1. Three pairs of electrons are shared between atoms. _____
2. covalent bond _____
3. single bond _____
4. joins carbon atoms to other atoms _____
5. Two pairs of electrons are shared between atoms. _____

Name _____ Class _____ Date _____

# Polymers

## Enrichment Activity for Lesson 4-7

***Skills:*** *inferring, relating*

The following passage describes a special type of molecule called a *polymer*. Read the passage. Then, answer the questions that follow.

A polymer is a huge molecule made up of many simple units that form a repeating structure. For example, the polymer polyethylene is made up of about 2,000 ethene molecules joined together by covalent bonds. Polyethylene is a common plastic that is used to make plastic bags, toys, and bottles. Many of the plastic items you use in your home are probably made of polyethylene.

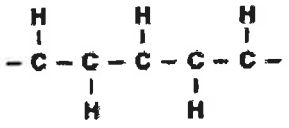
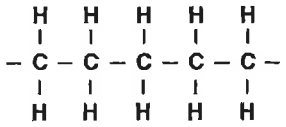
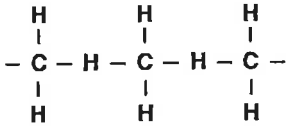
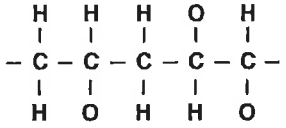
Polymers can be made from the products of crude oil. Many common substances use these polymers. You probably have clothing made of polyester fabric. Polyester is a polymer. Some of the pots and pans in your kitchen may be coated with the polymer tetrafluoroethylene, or TFE. TFE is a material that forms a nonstick surface.

Although many synthetic products are made from polymers, some polymers also occur in nature. For example, rubber is a natural polymer, as is cellulose. Cellulose is the material that makes up part of the cell walls of plants.

1. How is a polymer like a string of beads? _____

_____

2. A single ethene molecule has the formula $C_2H_4$. Which of the drawings below do you think shows the most likely structure for a segment of a polyethylene molecule? Circle the correct letter.

| | |
|---|---|
| A.  | B.  |
| C.  | D.  |

3. Why do you think some plastics have properties that are similar to those of rubber? _____

_____

4. What are some things you use daily that are probably made from polymers? _____

_____

5. Experts who are concerned about the conservation of nonrenewable resources feel that people should buy and use fewer products made of plastic and other synthetic materials. Explain their point of view.

_____

_____

Name _____ Class _____ Date _____

# Plastic Containers

## Enrichment Activity for Lesson 4-7

***Skills:*** *interpreting a table, making a graph*

Open your refrigerator at home and see how many food containers are made of plastic. You will probably find quite a few—soft-drink bottles, containers for take-out food, plastic bags, and plastic wrap sealed over leftovers. If you continue to look around your home, you will find many other items that are packaged in plastic. Shampoo, detergents, and medicines are a few examples.

Most plastic containers are made from one of about five different types of plastic. The table below lists the different types of plastics that are used in packaging. Study the table. Then, answer the questions that follow.

**PLASTIC CONTAINERS**

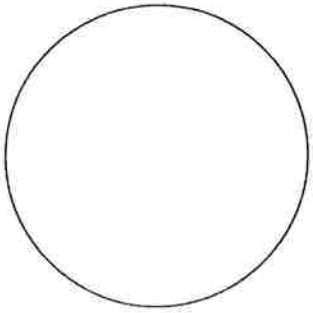
| Type of Plastic | % Usage | Type of Containers |
|---|---|---|
| High-density polyethylene (HDPE) | 66 | milk, liquid detergents, juices, bottled water, shampoos |
| Polyethylene terephthalate (PET) | 18 | soft drinks, cosmetics, meats, boil-in-bag foods |
| Polyvinyl chloride (PVC) | 6 | cooking oils, mouthwashes, shampoos, floor polishes |
| Low-density polyethylene (LDPE) | 5 | toiletries, cosmetics |
| Polypropylene (PP) | 3 | materials such as syrups that are hot when they are bottled |
| Other | 2 | tablets, salves, ointments |

1. What type of plastic is used to make nearly two-thirds of all plastic containers? _____

2. Which type of plastic is particularly well-suited to contain hot liquids? _____

3. Containers made from PET plastic are recyclable. What percent of all plastic containers are made from PET recyclable plastic? Which of the plastic containers in your refrigerator should be set aside for recycling? _____

4. Make a circle graph to show the percentages of various types of plastics used for containers.



Name _____ Date _____

Mr. Smith - Chemistry Homework 4-8

## GUIDED QUESTIONS

1. How do organisms obtain the organic compounds they need?

_____

_____

2. Why do all living things need carbohydrates?

_____

_____

3. Why do living things need lipids?

_____

_____

4. What is the relationship between amino acids and proteins?

_____

_____

5. What elements are nucleic acids made up of?

_____

_____

## CHECKING CONCEPTS

1. An organism gets the organic compounds it needs from its _____.
2. Organic compound made up of carbon, hydrogen, and oxygen are called _____.
3. Sugars and starches are _____.
4. Fats and oils are _____.
5. Organic compounds used to build and repair body parts are called _____.
6. The organic compounds that control the activities in the body cells are called _____.
7. Why do you think its important for a runner to eat a meal of pasta before running a race?

Name _____ Class _____ Date _____

# 4-8 What organic compounds are needed by living things?

## Lesson Review

Write the letter of the term that best completes each statement in the space provided.

_____ 1. Organic compounds made up of carbon, hydrogen, and oxygen are
**a.** amino acids. **b.** carbohydrates. **c.** lipids. **d.** proteins.

_____ 2. The body's main source of energy comes from
**a.** carbohydrates. **b.** amino acids. **c.** proteins. **d.** lipids.

_____ 3. The building blocks of proteins are
**a.** cholesterol. **b.** lipids. **c.** carbohydrates. **d.** amino acids.

_____ 4. Lipids are organic compounds made up mostly of carbon and
**a.** oxygen. **b.** nitrogen. **c.** hydrogen. **d.** helium.

_____ 5. Organic compounds that are used to build and repair body parts are
**a.** carbohydrates. **b.** lipids. **c.** proteins. **d.** fats.

_____ 6. The body's stored energy supply comes from
**a.** lipids. **b.** amino acids. **c.** carbohydrates. **d.** proteins.

_____ 7. Nucleic acid that contains information about inherited characteristics is
**a.** lipids. **b.** DNA. **c.** protein. **d.** starch.

_____ 8. Cholesterol is contained in
**a.** cereals. **b.** animal fat. **c.** sugars. **d.** starches.

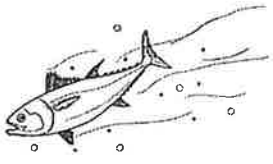
_____ 9. All the following are good sources of lipids *except*
**a.** cheese. **b.** meat. **c.** fruits. **d.** nuts.

_____ 10. Fish and soybeans provide the body with most of the needed
**a.** amino acids. **b.** cholesterol. **c.** carbohydrates. **d.** fats.

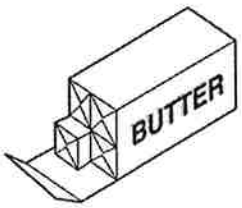
## Skill Challenge

***Skills:*** *classifying, relating*

Classify each of the following foods as a source of carbohydrates, lipids, or proteins.



1

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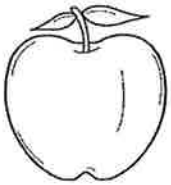

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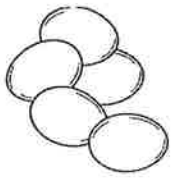


4

1. _____ 3. _____

2. _____ 4. _____

Name _____ Class _____ Date _____

# Chapter 4 Key Term Review

Choose the term or phrase from the box that best completes each statement.

| | | |
|---|---|---|
| amino acids | ionic bond | organic compound |
| carbohydrates | lipids | polymers |
| chemical bond | mixture | proteins |
| compound | molecule | structural formula |
| covalent bond | nucleic acids | substances |
| ion | organic chemistry | valence electrons |

1. The smallest part of a compound that has all the properties of the compound is a _____ .
2. Sugars and starches are examples of _____ .
3. The bond formed when atoms gain or lose electrons is an _____ .
4. Two or more substances that have been combined but not chemically changed form a _____ .
5. The study of organic compounds is called _____ .
6. The building blocks of proteins are called _____ .
7. The organic compounds DNA and RNA are examples of _____ .
8. An _____ is a compound that contains carbon.
9. The bond formed when atoms share electrons is a _____ .
10. An _____ is a charged atom.
11. A molecular model of an organic compound is a _____ .
12. Organic compounds made up mostly of carbon and hydrogen are _____ .
13. _____ are compounds needed to build and repair the body.
14. A _____ is a substance made up of two or more elements chemically combined.
15. Elements and compounds are _____ .
16. A _____ is a force of attraction that holds atoms together.
17. Silk, nylon, and wool are examples of _____ .
18. The negatively charged particles in the outer energy level of an atom are _____ .

Name _____ Class _____ Date _____

# Chapter 3 Key Term Review

Match each term in **Column B** with its definition in **Column A**. Write the correct letter in the spaces provided.

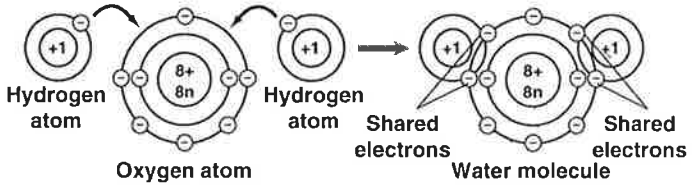
| | Column A | Column B |
|---|---|---|
| _____ | 1. positively charged particle | a. ductile |
| _____ | 2. able to be hammered into different shapes | b. nucleus |
| _____ | 3. negatively charged particle | c. mass number |
| _____ | 4. shine | d. electron |
| _____ | 5. smallest part of an element that can be identified as that element | e. atomic number |
| _____ | 6. having a repeating pattern | f. nonmetals |
| _____ | 7. number of protons in the nucleus of an atom | g. neutron |
| _____ | 8. able to be drawn into thin wires | h. isotope |
| _____ | 9. place where an electron is most likely to be found in an atom | i. periodic |
| _____ | 10. core of an atom | j. luster |
| _____ | 11. neutral particle | k. energy level |
| _____ | 12. elements that have none of the properties of metals | l. proton |
| _____ | 13. total number of the protons and neutrons in an atom | m. atom |
| _____ | 14. atom of an element with the same number of protons but a different number of neutrons | n. malleable |

Name _____ Class _____ Date _____

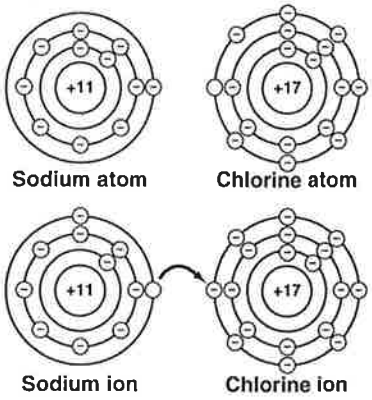
# Chapter 4 Test

**Interpreting Diagrams** Study the diagram below. Then, answer the questions that follow.

A




B




1. What kind of bond is shown in Part A of the diagram? _____

   What clues in the diagram did you use to identify the bond? _____

2. What kind of bond is shown in Part B of the diagram? _____

   What clues in the diagram did you use to identify the bond? _____

3. Do the atoms shown in the diagram combine to form mixtures or compounds? _____

   How do you know? _____

4. How many protons does a neutral atom of chlorine contain? _____

   How do you know? _____

5. Identify the elements shown in the diagram that form ions. What kinds of ions are formed, and what are their charges? _____

**Multiple Choice** Write the letter of the term or phrase that best completes each statement.

_____ 1. In a mixture, substances
   **a.** keep their own properties. **b.** have a definite chemical composition.
   **c.** lose their original properties. **d.** combine chemically.

_____ 2. Water is an example of
   **a.** an element. **b.** a compound. **c.** a mixture. **d.** an ion.

_____ 3. A molecule of sugar contains carbon and
   **a.** hydrogen. **b.** oxygen. **c.** sodium. **d.** hydrogen and oxygen.

_____ 4. A solid that contains atoms arranged in a regular pattern is a
   **a.** structural formula. **b.** compound. **c.** crystal. **d.** mixture.

Name _____ Class _____ Date _____

# Chapter 4 Test *(continued)*

_____ 5. Organic compounds used to build and repair the body are
**a.** proteins. **b.** cholesterol. **c.** carbohydrates. **d.** lipids.

_____ 6. Organic compounds contain the element
**a.** hydrogen. **b.** carbon. **c.** oxygen. **d.** nitrogen.

_____ 7. In a covalent compound, electrons are
**a.** gained. **b.** lost. **c.** shared. **d.** transferred.

_____ 8. Two or more substances that have been combined but not chemically changed make up
**a.** a mixture. **b.** an element. **c.** a compound. **d.** an ion.

_____ 9. An ion is formed when an atom gains or loses
**a.** a neutron. **b.** a proton. **c.** an electron. **d.** a neutron or proton.

_____ 10. A molecule of water contains two hydrogen atoms joined to one
**a.** nitrogen atom. **b.** carbon atom. **c.** sodium atom. **d.** oxygen atom.

_____ 11. Cholesterol can be a harmful
**a.** carbohydrate. **b.** lipid. **c.** amino acid. **d.** protein.

_____ 12. Carbon atoms can join other atoms in a
**a.** double bond. **b.** triple bond. **c.** single bond. **d.** single, double, or triple bond.

_____ 13. An example of a type of carbohydrate is
**a.** sugar. **b.** cheese. **c.** eggs. **d.** milk.

_____ 14. A substance made up of two or more elements that have chemically combined is
**a.** a mixture. **b.** a molecule. **c.** a compound. **d.** an ion.

_____ 15. A compound
**a.** can be separated by physical means. **b.** can be separated by chemical means.
**c.** has no definite chemical composition. **d.** cannot be separated by chemical means.

_____ 16. A neutral atom becomes a positive ion when it
**a.** gains an electron. **b.** gains a proton. **c.** loses an electron. **d.** loses a proton.

_____ 17. The substances that make up salt water
**a.** can be present in any amounts. **b.** are always present in equal amounts.
**c.** are always present in definite amounts. **d.** are represented by a chemical formula.

_____ 18. An organism's main source of energy comes from
**a.** amino acids. **b.** carbohydrates. **c.** proteins. **d.** lipids.

_____ 19. Atoms can complete their outer energy levels by
**a.** gaining electrons. **b.** sharing electrons.
**c.** losing electrons. **d.** gaining, losing, or sharing electrons.

_____ 20. The body's stored energy supply comes from
**a.** amino acids. **b.** proteins. **c.** lipids. **d.** carbohydrates.