CHAPTER 2

LESSON 1

The Nature of Matter

READING TOOL **Use Structure** As you read your textbook, outline the headings and subheadings throughout this lesson. Fill in the table below with the key points from each section. One has been filled in for you.

Heading	Sub-Heading	Key Points
Atoms	Protons and Neutrons	
	Electrons	Electrons are negatively charged and surround the nucleus.
Elements and Isotopes	Isotopes	
	Radioactive Isotopes	
Chemical Compounds		
Chemical Bonds	Ionic Bonds	
	Covalent Bonds	
	Weak Interactions	

Lesson Summary

As you read, circle the answers to each Key Question. Underline any words you do not understand.

BUILD Vocabulary

atom the basic unit of matter

nucleus the center of an atom, which contains the protons and neutrons

electron negatively charged particle; constantly moving around the nucleus

element pure substance that consists entirely of one type of atom

isotope one of several forms of a single element, which contains the same number of protons but different numbers of neutrons

compound substance formed by the chemical combination of two or more elements in definite proportions

Word Origins The word *compound* is from the Latin word *componere* which means "to put together." **In a chemical compound, what things are being put together?**

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Atoms

KEY QUESTION *What three subatomic particles make up atoms?*

All living things are made from chemical compounds. Chemical compounds are made up of the basic unit of matter, the **atom**. The particles that make up atoms are protons, neutrons, and electrons.

Protons and Neutrons Protons and neutrons are particles that are bound together by strong atomic forces. They form the center of the atom, called the **nucleus**. Protons have a positive charge, and neutrons carry no charge at all. Protons and neutrons have about the same mass.

Electrons The **electron** is the negatively charged particle in an atom. It is only 1/1840 of the mass of a proton. Electrons are in constant motion around the nucleus of the atom. They are arranged in a series of orbits called shells, that can only hold a certain number of electrons. The first shell can hold two, and the second can hold up to eight. Atoms have an equal number of protons and electrons. All atoms are electrically neutral because the positive charge of the protons and the negative charge of the electrons cancel out.

Elements and Isotopes

KEY QUESTION *How are all of the isotopes of an element similar?*

A chemical **element** is a pure substance made up entirely of one type of atom. Elements are represented by one- or two-letter symbols and organized by atomic number, which is how many protons they have. About 99 percent of the mass of living things is made up of six elements. They are calcium (Ca), carbon (C), hydrogen (H), oxygen (O), nitrogen (N), and phosphorous (P).

When two atoms interact, their electron shells overlap. The number of electrons in the outer electron shell determines some of the properties of an element. The electron shell affects how an atom may participate in chemical reactions.

Isotopes Atoms of the same element that contain different numbers of neutrons are called **isotopes**. The total number of protons and neutrons in the nucleus of an atom is called its mass number. Since isotopes have a different number of neutrons, their masses differ and they are identified by their mass numbers. Isotopes have different masses, but their chemical properties are the same.

Radioactive Isotopes Some isotopes have nuclei that are unstable and break down at a constant rate over time. These are radioactive isotopes. The radiation can be dangerous, but there are important uses for radioactive isotopes. They can be used to date rocks and fossils. They can be used to treat cancer and to kill bacteria. They can be used as "tracers" to follow the movements of substances within organisms.

Chemical Compounds

KEY QUESTION *In what ways does a compound differ from its component elements?*

A chemical **compound** is formed by the chemical combination of two or more elements in definite proportions. The composition of a compound is written in a chemical formula. Water is a compound with two atoms of hydrogen (H) for each element of oxygen (O). The formula for water is H_2O.

The physical and chemical properties of a compound are usually very different from those of the elements from which it is formed. Water is a liquid formed from two gases, hydrogen and oxygen. The element chlorine is a poisonous gas. However chlorine is part of the compound sodium chloride, or table salt. Sodium chloride is essential for living things.

READING TOOL

Make Connections

As you read, think about how each of vocabulary terms are related to each other.

☑ **Order the following components of matter from smallest to largest: *compounds, electrons, elements, protons, and neutrons.***

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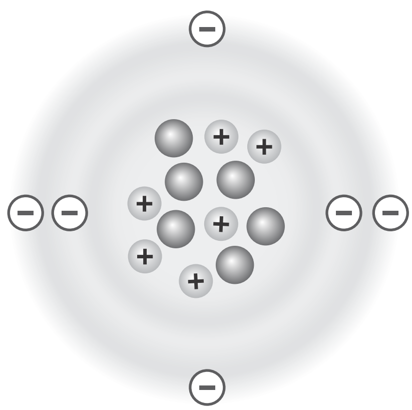
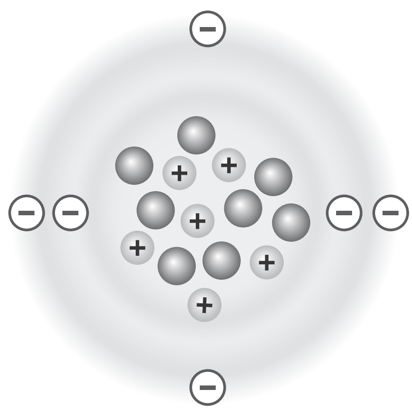
Visual Reading Tool: Isotopes

1. How many electrons does an atom of Carbon have? __________
2. Draw in the electrons that circle around Carbon's Nucleus on the images of Carbon-12 and Carbon-14 below.



Carbon-12



Carbon-14

3. Complete the Carbon Isotope chart below based upon what you know about the number of protons, neutrons, and electrons in an isotope.

Isotopes of Carbon			
Isotopes	Number of Protons	Number of Electrons	Number of Neutrons
Carbon-12 (nonradioactive)		6	6
Carbon-14 (radioactive)	6		

BUILD Vocabulary

ionic bond chemical bond formed when one or more electrons are transferred from one atom to another

ion atom that has a positive or negative charge

covalent bond type of bond between atoms in which the electrons are shared

molecule smallest unit of most compounds that displays all the properties of that compound

van der Waals forces weak attraction that develops between oppositely charged regions of nearby molecules

Prefixes The prefixes *com-* and *co-* mean "together." A compound is made up of elements joined together, and a covalent bond contains atoms that share electrons together. ☑ **How are covalent bonds different from ionic bonds?**

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Chemical Bonds

KEY QUESTION *What are the main types of chemical bonds?*

The atoms in compounds are held together by chemical bonds. Bonds are formed by the electrons in the outer shell, which are called valence electrons. The main types of chemical bonds are ionic bonds and covalent bonds.

Ionic Bonds **Ionic bonds** are formed when one or more electrons are transferred from one atom to another. This transfer causes the atom losing the electrons to become positively charged. The atom gaining the electrons becomes negatively charged. The positively and negatively charged atoms become **ions**. The oppositely charged ions are attracted to each other and form an ionic bond.

Covalent Bonds Sometimes atoms share electrons rather than transferring them. These shared electrons move around the nuclei of both atoms. The bond formed by sharing electrons is called a **covalent bond**. Atoms can share between two and six electrons. The structure that results is known as a **molecule**. A molecule is the smallest unit of most compounds.

Weak Interactions The strongest chemical bonds are ionic or covalent. Weak interactions between atoms are also important. Within living organisms, many molecules interact only briefly. **Van der Waals forces** are one type of weak interaction between molecules. They occur when molecules are very close together.

Hydrogen bonds are another type of weak interaction. They occur between a hydrogen atom of one molecule and an oxygen or nitrogen atom of a neighboring molecule.

Visual Reading Tool: Chemical Bonds

1. What kind of chemical bond holds the water molecule together? ______________________
2. What particles are shared between the atoms in the molecule? ______________________
3. What is the other main type of chemical bond? __________
4. What is the difference between covalent and ionic bonds?

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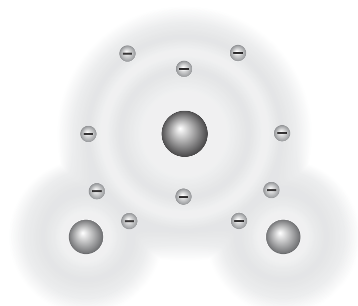

Water molecule (H_2O)

CHAPTER 2

LESSON 2

Properties of Water

READING TOOL **Cause and Effect** As you read the part of the lesson under "The Water Molecule," use the table below to list the causes and effects of the properties of water. Many of the causes may be the same, but each characteristic will have a different effect. Part of the table is completed for you.

Characteristic of Water	Cause	Effect
Hydrogen Bonding		The slightly negative end of a water molecule is attracted to the slightly positive end of another water molecule.
Expands Upon Freezing		
Dissolves Many Substances	Water forms hydrogen bonds.	
Cohesion		
Adhesion		
Heat Capacity		

Lesson Summary

The Water Molecule

As you read, circle the answers to each Key Question. Underline any words you do not understand.

BUILD Vocabulary

hydrogen bond weak attraction between a slightly positive hydrogen atom and another atom that is slightly negative

cohesion attraction between molecules of the same substance

adhesion force of attraction between different kinds of molecules

Prefixes *Cohesion* and *adhesion* share a root based on the Latin word *haerēre*, meaning "to cling." The prefix *co-* means "together," and the prefix *ad-* means "toward."

Some bugs can walk on the surface of water because the attraction between water molecules is strong enough to hold up the bug. What do we call this attraction? adhesion/cohesion.

KEY QUESTION *How does the structure of water contribute to its unique properties?*

Water covers nearly three-fourths of Earth's surface. Water is one of the few compounds found in a liquid state on Earth.

Polarity Water is made up of one oxygen atom and two hydrogen atoms. The oxygen atom has eight protons that pull the shared electrons slightly towards it, because it is stronger than the two protons that the hydrogens have. This causes a slight positive charge on the hydrogen end of the molecule and a slight negative charge on the oxygen end. Overall the charge remains neutral. A molecule in which the charge is unevenly distributed is said to be polar, because the molecule is like a magnet with two poles. Because of this polarity, water molecules are attracted to each other. The attraction between a hydrogen atom with a partial positive charge and an atom with a partial negative charge in another molecule creates a **hydrogen bond**.

Special Properties of Water Hydrogen bonds are not as strong as covalent or ionic bonds, but hydrogen bonds give water many of its unique characteristics. Because water is a polar molecule, it is able to form multiple hydrogen bonds that account for many of water's special properties. One of these properties is that water expands upon freezing, making ice less dense than water. Water can also dissolve many substances, which is why it is the basis for many living things. All of the properties of water listed below are caused by hydrogen bonds.

Cohesion The attraction of molecules of the same substance is called **cohesion**. This is why drops of water form beads on surfaces. Cohesion also causes surface tension, which explains why some bugs can walk on water.

Adhesion The attraction between molecules of different substances is called **adhesion**. The adhesion of water to the sides of a cylinder causes it to dip slightly in the center. Capillary action describes how water moves up a narrow tube. This phenomena is caused by both adhesion and cohesion.

Heat Capacity The amount of energy needed to raise the temperature of a substance is its heat capacity. Water has a high heat capacity, which means that bodies of water can absorb a lot of heat from sunlight with only a small change in temperature.

Water in Living Things Living things are mostly water. Water is 60 percent of the mass of the human body. Many chemical reactions in living things take place in water, which is why all living things need water.

Solutions and Suspensions

KEY QUESTION *How does water's polarity influence its properties as a solvent?*

Water is often part of a mixture. A **mixture** is two or more elements or compounds physically mixed together, but not chemically combined. There are two types of mixtures with water: solutions and suspensions.

Solutions A **solution** is a mixture with the components evenly distributed throughout the solution. In a solution of saltwater, table salt is the substance dissolved, called the **solute**, and water is the **solvent**, the substance in which the solute is dissolved. Water's polarity gives it the ability to dissolve both ionic compounds and other polar molecules. When a given amount of water has dissolved all of the solute that it can, the solution is said to be saturated.

Suspensions Some materials do not dissolve when placed in water. They separate into pieces so small that they are suspended in the water. Mixtures of water and nondissolved material are called **suspensions**.

Acids, Bases, and pH

KEY QUESTION *Why is it important for cells to buffer solutions against rapid changes in pH?*

A small number of water molecules will split apart to form ions. One water molecule can split apart to form one positive hydrogen ion, H^+, and one negative hydroxide ion, OH^-.

The pH Scale The **pH scale** indicates the concentration of H^+ ions in solution. The scale ranges from 0 to 14. Solutions below seven are considered acidic, and have more H^+ ions than OH^- ions. Solutions above seven are considered basic, and have more OH^- ions than H^+ ions. Pure water has a pH of 7, and the concentration of H^+ and OH^- ions is equal. Each step of the pH scale is a ten-fold difference in H^+ ion concentration. A liter of a solution with a pH of 4 has 10 times as many H^+ ions as a liter of solution with a pH of 5.

BUILD Vocabulary

mixture material composed of two or more elements or compounds that are physically mixed together but not chemically combined

solution type of mixture in which all the components are evenly distributed

solute substance that is dissolved in a solution

solvent dissolving substance in a solution

suspension mixture of water and nondissolved material

pH scale scale with values from 0 to 14, used to measure the concentration of H^+ ions in a solution

Multiple Meanings A solution can be a mixture within a solvent where the solute is evenly dissolved, or a solution can mean an answer to a problem. **What type of molecules will create a solution when mixed with water?**

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BUILD Vocabulary

acid a compound that forms hydrogen ions (H^+) in solution; a solution with a pH of less than 7

base a compound that produces hydroxide ions (OH^-) in solution; a solution with a pH of more than 7

buffer a compound that prevents sharp, sudden changes in pH

Apply Prior Knowledge You may have heard of buffers in other classes. A buffer is something that is used to lessen the impact of a shock, reduce the danger of an interaction between two incompatible substances, or protect against a loss of some kind.

☑ **How do buffers play a role in homeostasis in living things?**

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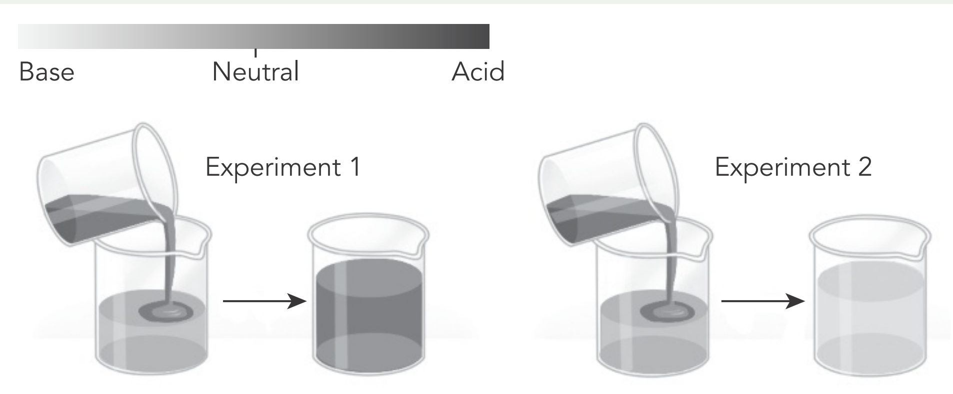
Acids An **acid** is any compound that releases H^+ ions when in a solution. Acidic solutions have higher concentrations of H^+ ions than pure water and have pH values below 7. Strong acids generally have pH values ranging from 1.5 to 3.0.

Bases A **base** is any compound that releases OH^- ions when in a solution. Basic, or alkaline, solutions have lower concentrations of H^+ ions than pure water and have pH values above 7. Strong bases generally have pH values ranging from 11 to 14.

Buffers The internal pH of most cells in the human body must generally be kept between 6.5 and 7.5. If the pH is lower or higher, it will affect the chemical reactions that take place within the cells. Thus, controlling pH is important for maintaining homeostasis. One of the ways that organisms control pH is through dissolved compounds called **buffers**. Buffers are weak acids or bases that can react with strong acids or bases to prevent sharp, sudden changes in pH. Blood, for example, has a normal pH of 7.4. Sudden changes in blood pH are usually prevented by a number of chemical buffers, such as bicarbonate and phosphate ions. Buffers in living things play an important role in maintaining homeostasis.

Visual Reading Tool: Buffers

The figure below shows what happens to the pH of two solutions when an acid is added. Use the key above the image to answer the questions about the image.



1. In Experiment 1, does adding an acid to a basic solution result in an acid or a base? __________
2. In Experiment 2, does adding an acid to a basic solution result in an acid or a base? __________
3. In which experiment is the acid added to a buffered base? How can you tell?

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CHAPTER 2

LESSON 3

Carbon Compounds

READING TOOL **Compare and Contrast** As you read, identify the similarities and differences between the different groups of macromolecules. Take notes in the table below. Circle elements that all of the compounds have in common. Some boxes have been filled in for you.

	Macromolecules			
	Carbohydrates	Lipids	Nucleic Acids	Proteins
Examples	glucose fructose galactose			
Single Units		fatty acids glycerol		
Elements			carbon hydrogen oxygen nitrogen phosphorus	
Functions				structure control reactions regulation fight disease receptors

Lesson Summary

The Chemistry of Carbon

KEY QUESTION *What elements does carbon bond with to make up life's molecules?*

Carbon is essential to life as we know it. Organic chemistry is the branch of chemistry that studies compounds that contain carbon. Carbon atoms have four valence electrons, allowing them to form covalent bonds with many elements such as hydrogen, oxygen, phosphorus, sulfur, and nitrogen. These carbon compounds have many different chemical properties that living things depend on. Carbon atoms can also bond to one another. This makes it possible for carbon to form long chains, or even rings. No other element can build molecules as large as carbon can build, which makes it the building block for life on our planet.

As you read, circle the answers to each Key Question. Underline any words you do not understand.

BUILD Vocabulary

monomer small chemical unit that makes up a polymer

polymer molecules composed of many monomers; makes up macromolecules

carbohydrate compound made up of carbon, hydrogen, and oxygen atoms; type of nutrient that is the major source of energy for the body

Prefixes *Mono-* means "one." *Poly-* means "many." Macromolecules built through polymerization use single units (monomers) to form a larger compound of many units (polymers). **What are three examples of carbohydrate polymers?**

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Macromolecules

KEY QUESTION *What are the functions of each of the four groups of macromolecules?*

Macromolecules are "giant molecules" because they are very large. Most macromolecules form through polymerization, a process in which larger and larger compounds are built by joining smaller compounds together. The smaller compounds are called **monomers**. They join together to form **polymers**. The monomers in a polymer can be identical. The monomers can also differ. The four major groups of macromolecules found in living things are carbohydrates, lipids, nucleic acids, and proteins.

Carbohydrates

Sugar, starch, and cellulose are different types of carbohydrates. **Carbohydrates** have carbon, hydrogen, and oxygen atoms, usually in a 1:2:1 ratio—that is, one carbon to two hydrogen and one oxygen atom. Organisms use carbohydrates to store and release energy as well as for structural support and protection. The breakdown of sugars such as glucose supplies energy to cells. Extra sugar is stored in complex carbohydrates.

Simple Sugars Single sugar molecules called monosaccharides (mahn oh SAK uh rydz) include glucose, galactose, and fructose. Galactose is found in milk; fructose is found in fruits.

Complex Carbohydrates Complex carbohydrates are polysaccharides formed by joining together many monosaccharides. Many animals store excess sugar as a polysaccharide called glycogen. Glycogen is broken down into glucose when glucose levels are low or when needed for muscle contraction.

Starches and Cellulose Plants store excess sugar in a polysaccharide called starch. They also make another polysaccharide called cellulose. Cellulose gives plants rigidity. Wood is mostly cellulose.

Lipids Lipids are macromolecules that are usually not soluble in water. **Lipids** are mostly carbon and hydrogen. Lipids include the compounds called fats, oils, and waxes. Lipids can be used to store energy, and they form important parts of biological membranes and waterproof coverings. Many lipids are formed by combining a glycerol molecule with fatty acids. If the carbon atoms in a fatty acid are all joined by single bonds, the fatty acid is said to be saturated. If there is at least one carbon-carbon double bond, the fatty acid is unsaturated. Lipids with fatty acids containing more than one double bond are polyunsaturated. The terms *saturated*, *unsaturated*, and *polyunsaturated*, appear on food labels.

Nucleic Acids **Nucleotides** are monomers that consist of three components: a 5-carbon sugar, a phosphate group, and a nitrogenous base. **Nucleic acids** are polymers made from nucleotide monomers. Nucleotides such as ATP are important for capturing and transferring energy. Two types of nucleic acids are ribonucleic acid, or RNA, and deoxyribonucleic acid, or DNA. Nucleic acids function to store and transmit heredity, or genetic information.

Proteins **Proteins** are macromolecules that have nitrogen, carbon, hydrogen, and oxygen atoms. Proteins are polymers of molecules known as amino acids. **Amino acids** are compounds with an amino group ($-NH_2$) and a carboxyl group ($-COOH$). In addition to forming proteins, amino acids have other functions.

Peptide Bonding Amino acids are linked by covalent peptide bonds to form polypeptides or proteins. The peptide bond is formed between the amino group of one amino acid and the carboxyl group of another amino acid.

Function Some proteins function to control the rate of reactions and regulate cell processes. Others form important cellular structures, while still others transport substances into or out of cells or help to fight disease.

Structure There are more than 20 different amino acids found in nature. All amino acids have the amino and carboxyl groups needed to join them together by covalent peptide bonds.

Amino acids differ from each other because they have different side chains called the R-group. These R-groups have different chemical properties.

BUILD Vocabulary

lipid macromolecule made mostly from carbon and hydrogen atoms; includes fats, oils, and waxes

nucleotide subunit of which nucleic acids are composed; made up of a 5-carbon sugar, a phosphate group, and a nitrogenous base

nucleic acid macromolecules containing hydrogen, oxygen, nitrogen, carbon, and phosphorus

protein macromolecule that contains carbon, hydrogen, oxygen, and nitrogen; needed by the body for growth and repair

amino acid compound with an amino group on one end and a carboxyl group on the other end

Related Words A polypeptide is a chain of amino acids joined by peptide bonds. A protein is made up of one or more polypeptides. Not all polypeptides are proteins.

☑ **How many levels of structure are there in a protein with only one polypeptide chain?**

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Levels of Organization Amino acids form polypeptide chains. They form them according to the instructions in the DNA. Polypeptides are not straight chains. They bend and twist to form three-dimensional shapes.
Scientists describe four levels of structure in proteins:

- Primary structure: the sequence of the amino acids
- Secondary structure: folding or coiling of the polypeptide chain
- Tertiary structure: the complete three-dimensional arrangement of the polypeptide chain
- Fourth level structure: If the protein has more than one polypeptide chain, the fourth level is the way the polypeptides are arranged in relation to each other.

Proteins retain their shape because of forces that include ionic and covalent bonds, van der Waals forces, and hydrogen bonds.

Visual Reading Tool: Macromolecules

The four major groups of macromolecules are carbohydrates, lipids, nucleic acids, and proteins. Identify each type of macromolecule from its monomer.

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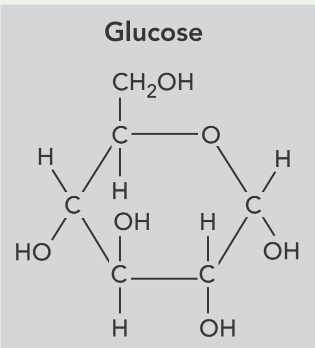

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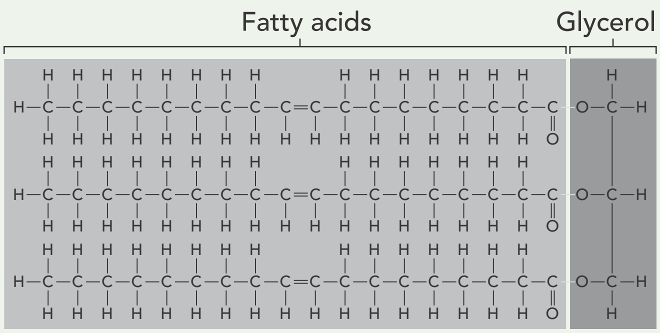

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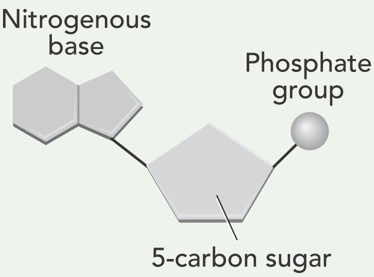

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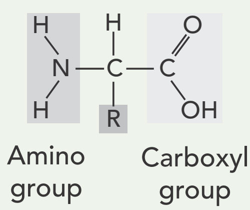

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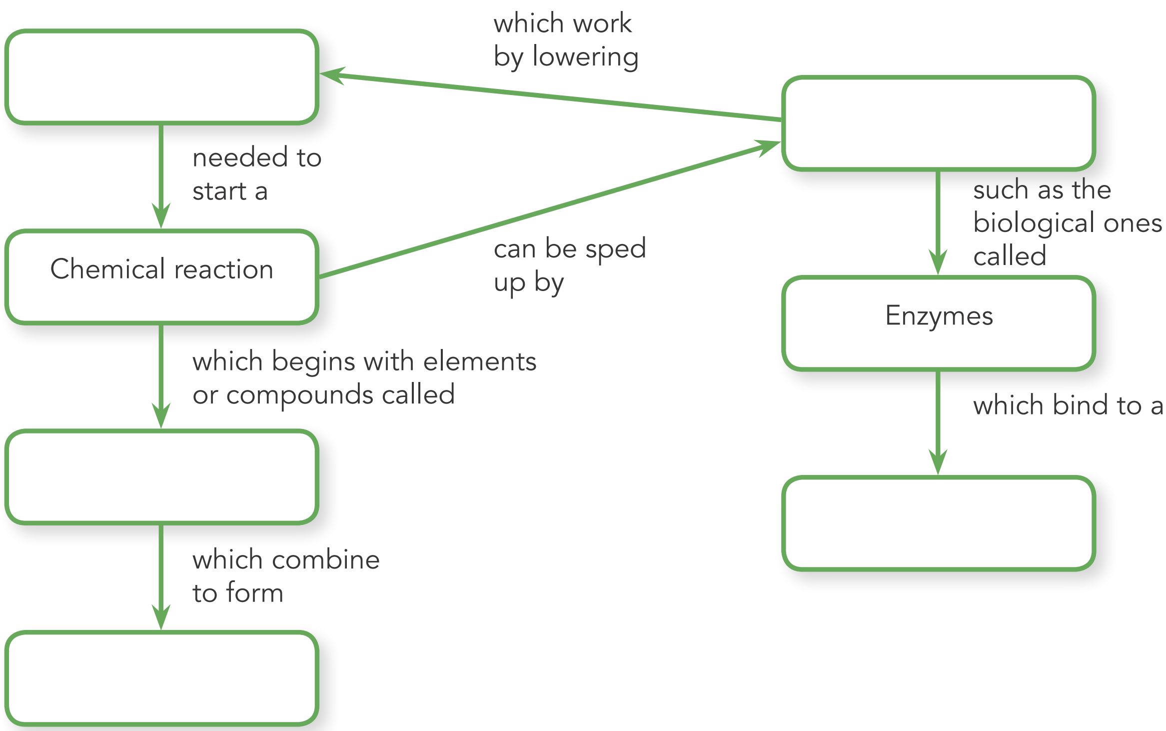
CHAPTER 2

LESSON 4

Chemical Reactions and Enzymes

READING TOOL **Make Connections** The concept map below shows the relationship between vocabulary terms in this lesson. As you read the lesson, complete the concept map below. Each word will only be used once and some words have already been entered for you.



Lesson Summary

Chemical Reactions

KEY QUESTION *What happens to chemical bonds during chemical reactions?*

A **chemical reaction** is a process that changes, or transforms, one set of compounds into another. An important scientific principle is that mass and energy are conserved during chemical transformations. This is also true for chemical reactions that occur in living organisms. Some chemical reactions occur slowly, such as the combination of iron and oxygen to form an iron oxide called rust. Other reactions occur quickly. The elements or compounds that engage in a chemical reaction are known as **reactants**. The elements or compounds produced by a chemical reaction are known as **products**. Chemical reactions involve changes in the chemical bonds that join atoms in compounds.

As you read, circle the answers to each Key Question. Underline any words you do not understand.

BUILD Vocabulary

chemical reaction process that changes, or transforms, one set of chemicals into another set of chemicals

reactant elements or compounds that enter into a chemical reaction

product elements or compounds produced by a chemical reaction

BUILD Vocabulary

activation energy energy that is needed to get a reaction started

catalyst substance that speeds up the rate of a chemical reaction

enzyme protein catalyst that speeds up the rate of specific biological reactions

substrate reactant of an enzyme-catalyzed reaction

Multiple Meanings When the word *catalyst* is used in everyday language, it usually means "something that causes a change." This definition is related to the scientific meaning of the word. In science, a catalyst speeds up the rate of a chemical reaction. Change happens when the chemical reaction occurs. ☑ **How does an enzyme speed up a chemical reaction?**

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Energy in Reactions

KEY QUESTION *How do energy changes affect whether a chemical reaction will occur?*

Whenever chemical bonds are formed or broken, energy is released or absorbed. Chemical reactions that release energy often occur on their own, or spontaneously. Chemical reactions that absorb energy require a source of energy. In the first case, the energy is released as heat, light or sound. When reactions require a source of energy, the reaction is unlikely to happen until energy is added. If a reaction releases energy, the reverse reaction requires energy.

Energy Sources Every form of life must have a source of energy so that it can carry out chemical reactions. Without this, it will die. Plants get their energy from sunlight. Animals get their energy by consuming other animals or plants.

Activation Energy Chemical reactions that release energy do not always occur spontaneously. Otherwise, the pages of a book might burst into flames without warning. The cellulose in paper burns only if you light it with a flame, which supplies enough energy to get the reaction started. The energy that is needed to get a reaction started is called its **activation energy**.

Enzymes

KEY QUESTION *What role do enzymes play in living things, and what affects their function?*

Some chemical reactions that are essential to life would happen so slowly or require such high activation energies that they could never take place on their own. These chemical reactions are made possible by **catalysts**. A catalyst is a substance that speeds up the rate of a chemical reaction by lowering the activation energy.

Nature's Catalysts **Enzymes** are biological catalysts, and most enzymes are proteins. The role of enzymes is to speed up chemical reactions that take place in cells. Enzymes lower the activation energy of the reaction. Lowering the activation energy has a dramatic effect on how quickly the reaction is completed. Enzymes are very specific and usually only catalyze one kind of chemical reaction. The name of an enzyme is usually related to the reaction it catalyzes.

The Enzyme-Substrate Complex For a chemical reaction to occur, the reactants must collide with sufficient energy to break existing bonds and form new bonds. If the reactants do not have enough energy, they will be unchanged after the collison. Enzymes reduce the energy needed by providing sites where reactants can be brought together. The reactants in an enzyme-catalyzed reaction are called **substrates**. The substrates bind to a part of the enzyme called the active site. They have complementary shapes, which fit together like a lock and key. The substrates and the active site may be kept together by weak interactions such as hydrogen bonds and van der Waals forces.

Regulation of Enzyme Activity Enzymes play an essential role in chemical reactions. Anything that changes the structure of the protein can change the shape of the active site. High temperature and very high or low pH can change the active site and cause the enzyme to not work well. Enzymes produced by human cells generally work best at temperartures close to 37°C, the normal temperature of the human body. Enzymes activity can be changed or turned on and off by molecules that carry chemical signals.

READING TOOL

Academic Words
The word *essential* refers to something that is of the utmost importance. It is essential that enzymes are kept within a certain temperature and pH range, or else they will change shape and no longer be able to catalyze their specific chemical reaction.

☑ **What temperature do most of the enzymes in the human body function at?**

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Visual Reading Tool: Effect of Enzymes

Use the chart to answer the following questions about the effect of enzymes on a chemical reaction.

1. Which curve shows the reaction pathway with the enzyme? ______________

2. Which reaction has the higher activation energy? ______________

3. Which arrow shows the activation energy with the enzyme? A or B? ______________

4. Does this reaction absorb or release energy? How do you know?

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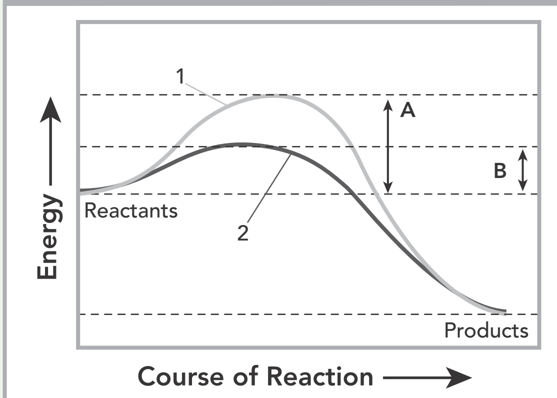
Effect of Enzymes



2 Chapter Review

Review Vocabulary

Choose the letter of the best answer.

1. Which is NOT one of the three subatomic particles that make up atoms?

☐ A. electron
☐ B. neutron
☐ C. boson
☐ D. proton

2. Which is a weak interaction between molecules?

☐ A. van der Waals
☐ B. bionic
☐ C. covalent
☐ D. ionic

Match each vocabulary word with its meaning.

3. ________	Element with 4 valence electrons that can covalently bond to many other elements.	a. cohesion
4. ________	Attraction between molecules of the same substance.	b. nucleic acid
5. ________	A macromolecule that contains phosphorus.	c. catalyst
6. ________	Increases speed of chemical reactions without itself changing.	d. carbon

Review Key Questions

Provide evidence and details to support your answers.

7. How does the structure of water contribute to its unique properties?

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8. Why is it important for cells to buffer solutions against rapid changes in pH? What does a buffer do?

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9. How do enzymes play a role in living things, and what affects their function?

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