Interactive Classroom

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Glencoe Science

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Section 1: Atoms, Elements, and Compounds

Section 2: Chemical Reactions

- Section 3: Water and Solutions
- Section 4: The Building Blocks of Life

EXIT

Atoms

- Chemistry is the study of matter.
- Atoms are the building blocks of matter.
- Neutrons and protons are located at the center of the atom.
- Protons are positively charged particles.
- Neutrons are particles that have no charge.



6.1 Atoms, Elements, and Compounds

 Electrons are negatively charged particles that are located outside the nucleus.



Elements

- An element is a pure substance that cannot be broken down into other substances by physical or chemical means.
- There are over 100 known elements, 92 of which occur naturally.
- Each element has a unique name and symbol.



Chapter 6 Chemistr

Chemistry in Biology

6.1 Atoms, Elements, and Compounds

The Periodic Table of Elements

- Horizontal rows are called periods.
- Vertical columns are called groups.



Isotopes 🕥

Atoms of the same element that have the same number of protons and electrons but have a different number of neutrons



Radioactive Isotopes

 When a nucleus breaks apart, it gives off radiation that can be detected and used for many applications.





Compounds

- A pure substance formed when two or more different elements combine
- Compounds are always formed from a specific combination of elements in a fixed ratio.
- Compounds cannot be broken down into simpler compounds or elements by physical means.



Chapter 6

Chemistry in Biology

6.1 Atoms, Elements, and Compounds

Chemical Bonds

- Covalent bonds
 - Chemical bond that forms when electrons are shared



• A molecule is a molecule compound in which the atoms are held together by covalent bonds.



Ionic Bonds 🕥

 Electrical attraction between two oppositely charged atoms or groups of atoms









Ionic Bonds



- Some atoms tend to donate or accept electrons more easily than other atoms.
- The elements identified as metals tend to donate electrons.
- The elements identified as nonmetals tend to accept electrons.



 Most ionic compounds are crystalline at room temperature and have higher melting points than molecular compounds formed by covalent bonds.



van der Waals Forces 🕥

- When molecules come close together, the attractive forces between slightly positive and negative regions pull on the molecules and hold them together.
- The strength of the attraction depends on the size of the molecule, its shape, and its ability to attract electrons.



Reactants and Products

- A chemical reaction is the process by which atoms or groups of atoms in substances are reorganized into different substances.
- Clues that a chemical reaction has taken place include the production of heat or light, and formation of a gas, liquid, or solid.



Chemical reaction



Physical reaction



6.2 Chemical Reactions

Chemical Equations

- Chemical formulas describe the substances in the reaction and arrows indicate the process of change.
- Reactants are the starting substances, on the left side of the arrow.
- Products are the substances formed during the reaction, on the right side of the arrow.

Reactants --- Products



Glucose and oxygen react to form carbon dioxide and water.

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$



6.2 Chemical Reactions

Balanced Equations

- The law of conservation of mass states matter cannot be created or destroyed.
- The number of atoms of each element on the reactant side must equal the number of atoms of the same element on the product side.

$$C_{6}H_{12}O_{6} + 6O_{2} \rightarrow 6CO_{2} + 6H_{2}O_{2}$$





Energy of Reactions

The activation energy is the minimum amount of energy needed for reactants to form products in a chemical reaction.





- This reaction is exothermic and released heat energy.
- The energy of the product is lower than the energy of the reactants.



- This reaction is endothermic and absorbed heat energy.
- The energy of the products is higher than the energy of the reactants.





Chapter 6

Chemistry in Biology

6.2 Chemical Reactions

Enzymes

 A catalyst is a substance that lowers the activation energy needed to start a chemical reaction.



It does not increase how Reaction progress much product is made and it does not get used up in the reaction.

Enzymes are biological catalysts.



Chapter 6

6.2 Chemical Reactions

- The reactants that bind to the enzyme are called substrates.
- The specific location where a substrate binds on an enzyme is called the active site.



- The active site changes shape and forms the enzyme-substrate complex, which helps chemical bonds in the reactants to be broken and new bonds to form.
- Factors such as pH, temperature, and other substances affect enzyme activity.





6.3 Water and Solutions

Water's Polarity

- Molecules that have an unequal distribution of charges are called polar molecules.
- Polarity is the property of having two opposite poles.
- A hydrogen bond is a weak interaction involving a hydrogen atom and a fluorine, oxygen, or nitrogen atom.







- 6.3 Water and Solutions
- **Homogenous Mixtures**
- A mixture that has a uniform composition throughout
- A solvent is a substance in which another substance is dissolved.
- A solute is the substance that is dissolved in the solvent.



Food coloring dissolved in water forms a homogenous mixture.



6.3 Water and Solutions

Heterogeneous Mixtures

 In a heterogeneous mixture, the components remain distinct.



A salad is a heterogeneous mixture.



6.3 Water and Solutions

Acids and Bases

- Substances that release hydrogen ions (H⁺) when dissolved in water are called acids.
- Substances that release hydroxide ions (OH⁻) when dissolved in water are called bases.



6.3 Water and Solutions

pH and Buffers

The measure of concentration of H⁺ in a solution is called pH.



Resources

- Acidic solutions have pH values lower than 7.
- Basic solutions have pH values higher than 7.

Home

6.3 Water and Solutions

 Buffers are mixtures that can react with acids or bases to keep the pH within a particular range.



6.4 The Building Blocks of Life

Organic Chemistry

 The element carbon is a component of almost all biological molecules.





6.4 The Building Blocks of Life

- Carbon has four electrons in its outermost energy level.
- One carbon atom can form four covalent bonds with other atoms.
- Carbon compounds can be in the shape of straight chains, branched chains, and rings.



6.4 The Building Blocks of Life

Macromolecules

- Carbon atoms can be joined to form carbon molecules.
- Macromolecules are large molecules formed by joining smaller organic molecules together.
- Polymers are molecules made from repeating units of identical or nearly identical compounds linked together by a series of covalent bonds.


COncepts In MOtion

Table 6.1 Biological Macromolecules	
Group	Function
	Stores energyProvides structural support
	Stores energyProvides steroidsWaterproofs coatings
	 Transports substances Speeds reactions Provides structural support Provides hormones
	 Stores and communicates genetic information
Carlashadustas	
Carbonydrates	Lipias
Nucleic acids	Proteins
rag each group to its corresponding function C	
Home Resources 🗲 🔿	

Carbohydrates 🕥

 Compounds composed of carbon, hydrogen, and oxygen in a ratio of one oxygen and two hydrogen atoms for each carbon atom—(CH₂O)_n



- Values of *n* ranging from three to seven are called simple sugars, or monosaccharides.
- Two monosaccharides joined together form a disaccharide.
- Longer carbohydrate molecules are called polysaccharides.



Lipids 🕚

- Molecules made mostly of carbon and hydrogen
- A triglyceride is a fat if it is solid at room temperature and an oil if it is liquid at room temperature.



- Lipids that have tail chains with only single bonds between the carbon atoms are called saturated fats.
- Lipids that have at least one double bond between carbon atoms in the tail chain are called unsaturated fats.
- Fats with more than one double bond in the tail are called polyunsaturated fats.



Proteins

- A compound made of small carbon compounds called amino acids
- Amino acids are small compounds that are made of carbon, nitrogen, oxygen, hydrogen, and sometimes sulfur.





- Amino acids have a central carbon atom.
- One of the four carbon bonds is with hydrogen.
- The other three bonds are with an amino group (-NH₂), a carboxyl group (-COOH), and a variable group (-R).





- The number and the order in which the amino acids are joined define the protein's primary structure.
- After an amino acid chain is formed, it folds into a unique three-dimensional shape, which is the protein's secondary structure, such as a helix or a pleat.



- Nucleic acids are complex macromolecules that store and transmit genetic information.
- Nucleic acids are made of smaller repeating subunits called nucleotides, composed of carbon, nitrogen, oxygen, phosphorus, and hydrogen atoms.



Chemistry in Biology

Chapter Resource Menu



Chapter Diagnostic Questions

Formative Test Questions

CheckPoint

CheckPoint

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CheckPoint

Biolog

Standardized Test Practice

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nline



Vocabulary

Image Bank

COncepts In MOtion

<u>Animation</u>

Click on a hyperlink to view the corresponding lesson.



Chapter Diagnostic Questions



Which of the following particles is negatively charged?

A. electronB. isotopeC. neutronD. proton



Chapter Diagnostic Questions



Isotopes are created by a change in the number of what particle of an atom?

A. electrons B. neutrons C. protons D. ions



Chapter Diagnostic Questions



Identify the proteins that speed up the rate of chemical reactions.

A. substrates B. enzymes C. ions D. reactants





What particles are in an atom's nucleus?

A. neutrons and electrons
B. protons and electrons
C. protons and neutrons







What causes the overall charge of an atom to be zero?

A. an equal number of protons and neutrons
 B. an equal number of protons and electrons
 C. an equal number of neutrons and electrons





What type of substance is water?

- A.a compound B. an element C. an isotope
 - D. a mixture





What provides the energy for all living processes?

A. chemical bonds
B. ionic compounds
C. radioactive isotopes
D. van der Waals forces





Which is a chemical reaction?

A. a match burning
B. salt dissolving
C. water boiling
D. gasoline evaporating





Which chemical reaction is endothermic?







How does an enzyme increase the rate of a chemical reaction?

A. It acts as a reactant.
B. It reduces the amount of heat produced.
C. It increases the amount of product.
D. It lowers the activation energy.





What occurs at the active site in the enzyme substrate complex?







enzyme.





Why is water able to dissolve a wide variety of solutes?

A. It acts as a catalyst.
B. Its pH is neutral.
C. It is a polar molecule.
D. It is an ionic compound.





What type of bonds attracts water molecules to each other and to other substances?

A. covalent bonds
B. double bonds
C. hydrogen bonds
D. ionic bonds





Which ion, when released in water, causes a solution to be basic?

A. CI⁻ B.OH⁻ C. H⁺ D. Na⁺





What is the name for a substance that keeps the pH in cells within the 6.5 to 7.5 pH range?

A. alkali B. antacid C. buffer D. neutralizer





Which element do almost all biological molecules contain?

A. carbon
B. nitrogen
C. phosphorus
D. sodium





How many covalent bonds can carbon form with other atoms?

A. 1 B. 2 C.4 D. 8







What type of biological molecule is an enzyme?

A. hormone B. nucleic acid C. protein D. steroid





What are fats, oils, and waxes composed of?

A. lipids
B. nucleotides
C. polypeptides
D. sugars





What are the monomers that make up proteins?

A. amino acids
B. fatty acids
C. glycerols
D. nucleotides





Which biological molecule transports substances between cells?

A. carbohydrate
B. lipid
C. nucleic acid
D. protein



Chapter Assessment Questions



Look at the following figure. Determine what the upward curve represents.

A. activation energy
B. reactants
C. products
D. enzymes





Chapter Assessment Questions



Look at the energy levels in the atom. What is the maximum number of electrons energy level two can hold?

A. 2 B. 4 C. 6 D.8





Chapter Assessment Questions



Explain why chemical equations must be balanced.

Answer: Chemical reactions require balance of mass. Therefore, the number of atoms of each element on the reactant side must equal the number of atoms of the same element on the product side.


Standardized Test Practice



Which is a result of van der Waals forces?

A. atoms sharing electrons
B. table salt dissolving in water
C. ionic compounds forming crystals
D. water molecules forming droplets



Chemistry in Biology Chapter 6



Standardized Test Practice



A. Energy is not needed to start the chemical reaction.
B. Heat and/or light energy are released in this reaction.
C. The activation energy is greater than the energy released.
D. The energy of the products and the

reactants is the same.



Standardized Test Practice



Which fruit contains a higher concentration of hydrogen ions?



A. tomatoes B. bananas

Home Resources

Standardized Test Practice



What do cellulose and chitin have in common?

A. They are energy-storing polymers.
B. They are found in the cells of animals.
C. They are structural polysaccharides.
D. They are composed of repeating sucrose units.



Standardized Test Practice



Which polysaccharide stores energy in muscle and liver tissue?

A. gluten B.glycogen C. starch D. sucrolose



Standardized Test Practice



What is the function of this biological macromolecule?



Home Resources 🗲

Standardized Test Practice



A. communicate signals between cells
B. produce vitamins and hormones
C. provide support and protection
D. store and transmit genetic information



Standardized Test Practice



Which is a characteristic of all lipids?

A. They are saturated triglycerides.
B. They do not dissolve in water.
C. They are liquid at room temperature.
D. They store less energy than carbohydrates.











Section 1

- 🚯 atom
- Inucleus
- e) proton
- eutron
- electron
- element
-) isotope

- compound
- covalent bond
- molecule
- 🚯 ion
- 🕑 ionic bond
- van der Waals

force



Section 2

- Chemical reaction
- reactant
- epiperina product
- activation energy
- catalyst
- 🕑 enzyme





Section 3

- e polar molecule
- And the second secon
- mixture
- solution
- solvent
- solute
 -) acid

basepHbuffer



Section 4

- macromolecule
- e polymer
- carbohydrate
- 🚯 lipid
- e) protein
- amino acid





Animation



- Ionic Bonds
- Enzymes
- Visualizing Properties of Water
- Polypeptides

