

STUDY CARD for CAMPBELL BIOLOGY, Ninth Edition

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Themes in the Study of Life (Ch. 1)

1. The theme accounts for life's unity and diversity.
2. New perspectives emerge at each level of the biological hierarchy, from atoms to the biosphere.
3. Organisms interact with their environments.
4. Life requires energy transfer.
5. Structure and function are correlated.
6. The cell is the basic unit of an organism.
7. DNA encodes heritable information.
8. Feedback mechanisms regulate biological systems.

The Chemical Context of Life (Ch. 2)

1. Matter consists of chemical elements in pure form and in chemically combined compounds.
2. An element's properties depend upon the structure of its atoms.
 - a. The number of protons (Z) defines the element.
 - b. Electrons (Z) occupy electron shells.
3. Chemical bonds form when atoms interact and complete their outer electron shells.
 - a. Single or double covalent bonds form when pairs of electrons are shared between atoms.
 - b. Electrons transfer between atoms. An ionic bond is the attraction between oppositely charged ions.
 - c. Weak bonds include hydrogen bonds and van der Waals forces.
4. Chemical reactions occur and bond chemical bonds or reactants are converted to products.

Water and Life (Ch. 3)

1. Water molecules are polar. Hydrogen bonding between water molecules gives water unique properties that allow life to exist on Earth.
 - a. Cohesion due to hydrogen bonding contributes to the transport of water against gravity in plants.
 - b. Water's high specific heat and high heat of vaporization moderate temperatures on Earth.
 - c. Ice floats because hydrogen bonds lock water into a crystalline lattice that reduces its density.



- a. Water is a versatile solvent.
 - b. Hydrophilic substances have an affinity for water whereas hydrophobic substances repel water.
2. Acids and bases contribute to pH regulation.
 - a. Acids ionize to form a pH < 7 .
 - b. Basic substances form a pH > 7 .
 - c. Buffers maintain changes in pH.

Carbon and Molecular Diversity (Ch. 4)

1. Organic chemistry is the study of carbon compounds. Carbon atoms use four diverse molecules for bonding with up to four other atoms.
 - a. Carbon chains form the skeletons of most organic molecules.
 - b. Proteins have a core of only C and H.
 - c. Sugars have the same molecular formula but different structures and properties.
2. Functional groups are the parts of molecules involved in chemical reactions.

3. ATP is an important source of energy for cellular processes: $ATP \rightarrow ADP + P_i + \text{Energy}$.

Large Biological Molecules (Ch. 5)

1. Macromolecules are polymers synthesized from monomers by dehydration reactions.
 - a. Polymers are distinguished by monomers, by the addition of a water molecule (hydrolysis).
 - b. Variation in the linear sequence of monomers results in the diversity of polymers.
 - c. Four major classes of large biological molecules are found in cells.
2. Carbohydrates include sugars (monosaccharides) and polymers of sugars (polysaccharides).
 - a. Most monosaccharides are multiples of CH_2O .
 - b. Starch (in plants) and glycogen (in animals) are polysaccharides that store energy.
 - c. Cellulose (in plants) and chitin (in animals) are polysaccharides that provide structural support.
3. Lipids are hydrophobic.
 - a. Fatty acids are linked to three fatty acid chains to be saturated or unsaturated; they store energy.
 - b. Phospholipids (glycerol, two fatty acids, and phosphate) form hydrophobic and hydrophilic regions; they form a bilayer in water.
 - c. Steroids (a carbon skeleton with four fused rings) include cholesterol and sex hormones.
4. Proteins form diverse structures and functions.
 - a. A protein consists of one or more polypeptides, each a polymer of amino acids (from a set of 20).
 - b. A peptide bond joins the carboxyl group of one amino acid with the amino group of the next.

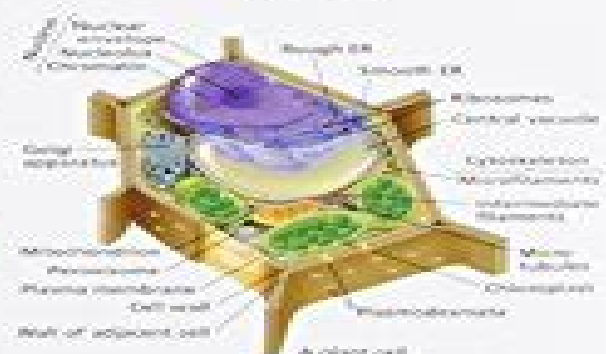
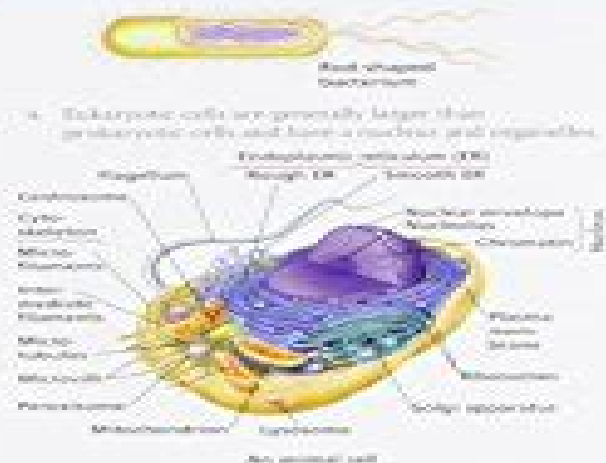
Linkage from H₂O group



- a. Four levels of protein structure lead to the unique shape and function of each protein.
2. Nucleic acids store, transmit, and help express hereditary information.
 - a. DNA and RNA are polymers of nucleotides.
 - b. A nucleotide has a nitrogenous base, a five-carbon sugar, and one or more phosphate groups.
 - c. DNA has deoxyribose as its sugar; RNA has ribose.
 - d. DNA has A, G, C, and T as bases; RNA has A, G, C, and U.
 - e. DNA is a double helix; RNA varies in shape.
 - f. A gene (hereditary unit) is a stretch of DNA that dictates the synthesis of RNA, which then directs the amino acid sequence of a polypeptide.

A Tour of the Cell (Ch. 6)

1. All organisms are composed of one or more cells.
2. All cells are bounded by a plasma membrane and contain cytosol, one or more chromosomes, and ribosomes.
3. Prokaryotic cells usually have a cell wall but lack a nucleus and membrane-bounded organelles.



1. Within the nucleus, chromosomes made up of a histone (DNA and proteins) carry the genetic instructions for making polypeptides.
2. Ribosomes are the cellular organelles that carry out protein synthesis.
3. The endomembrane system is a network of membranes, including the endoplasmic reticulum (ER).
 - a. Smooth ER has enzymes to lipid synthesis, carbohydrate metabolism, and detoxification.
 - b. Rough ER has ribosomes that synthesize secretory proteins, which enter the ER lumen. Rough ER also synthesizes membrane proteins and glycoproteins.
 - c. The Golgi apparatus refines ER products and packages them in vesicles.
 - d. Cytosomes, such as lysosomes, hydrolytic enzymes, digest macromolecules and recycle organelles.
 - e. Vacuoles function in digestion, storage, waste disposal, water balance, and cell growth.
4. Microtubules and chloroplasts change energy from one form to another.
 - a. Mitochondria, the sites of cellular respiration, extract energy from food and make ATP.

Biology Study Card

G Psacharopoulos



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Table of Contents Biology Study Card

1. Understanding the eBook Biology Study Card
 - The Rise of Digital Reading Biology Study Card
 - Advantages of eBooks Over Traditional Books
2. Identifying Biology Study Card
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Biology Study Card
 - User-Friendly Interface
4. Exploring eBook Recommendations from Biology Study Card
 - Personalized Recommendations
 - Biology Study Card User Reviews and Ratings
 - Biology Study Card and Bestseller Lists
5. Accessing Biology Study Card Free and Paid eBooks
 - Biology Study Card Public Domain eBooks
 - Biology Study Card eBook Subscription Services
 - Biology Study Card Budget-Friendly Options

6. Navigating Biology Study Card eBook Formats
 - ePub, PDF, MOBI, and More
 - Biology Study Card Compatibility with Devices
 - Biology Study Card Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Biology Study Card
 - Highlighting and Note-Taking Biology Study Card
 - Interactive Elements Biology Study Card
8. Staying Engaged with Biology Study Card
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Biology Study Card
9. Balancing eBooks and Physical Books Biology Study Card
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Biology Study Card
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Biology Study Card
 - Setting Reading Goals Biology Study Card
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Biology Study Card
 - Fact-Checking eBook Content of Biology Study Card
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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