

Advanced Biology

Study Guide – Unit 2: Chapters 3, 4, & 5

You should understand and be able to apply all concepts and vocabulary from chapters 3, 4, and 5. Additionally, you are responsible information given during lecture and lab.

Ch. 3: The Molecules of Cells

Introduction: Explain why lactose intolerance is considered normal in adult humans.

Explain why lactose tolerance might have evolved in people of European descent.

Introduction To Organic Compounds

3.1 Explain why carbon is unparalleled in its ability to form large, diverse molecules.

3.1 Define organic compounds, hydrocarbons, a carbon skeleton, and an isomer.

3.2 Describe the properties of and distinguish between the six chemical groups important in the chemistry of life.

3.3 List the four main classes of macromolecules, explain the relationship between monomers and polymers, and compare the processes of dehydration synthesis and hydrolysis.

Carbohydrates

3.4–3.7 Describe the structures, functions, properties, and types of carbohydrate molecules common in the human diet.

Lipids

3.8–3.10 Describe the structures, functions, properties, and types of lipid molecules.

3.10 Describe the health risks associated with the use of anabolic steroids.

Proteins

3.11–3.14 Describe the structures, functions, properties, and types of proteins.

3.15 Describe the major achievements of Linus Pauling.

Nucleic Acids

3.16 Compare the structures and functions of DNA and RNA.

3.17 Describe the adaptive advantage of lactose tolerance in people of East African descent.

Key Terms

alpha helix	denaturation	hydroxyl group	polymer
amine	deoxyribonucleic acid (DNA)	isomers	polypeptide
amino acid	(DNA)	lipid	polysaccharide
amino group	disaccharide	macromolecule	primary structure
anabolic steroid	double helix	methyl group	protein
carbohydrate	enzyme	monomer	quaternary structure
carbon skeleton	fat	monosaccharide	ribonucleic acid (RNA)
carbonyl group	functional group	nucleic acid	saturated
carboxyl group	gene	nucleotide	secondary structure
carboxylic acid	glycogen	organic compound	starch
cellulose	hydrocarbon	peptide bond	steroid
chitin	hydrolysis	phosphate group	tertiary structure
cholesterol	hydrophilic	phospholipid	unsaturated
dehydration reaction	hydrophobic	pleated sheet	

Word Roots

de- without or remove;

hydro- water (*dehydration reaction*: a chemical process in which two molecules become covalently bonded to each other with the removal of a water molecule)

di- two;

-sacchar sugar (*disaccharide*: a sugar molecule consisting of two monosaccharides linked by a dehydration reaction)

carb- coal (*carboxyl group*: a functional group in an organic molecule, consisting of an oxygen atom double-bonded to a carbon atom that is also bonded to a hydroxyl group)

glyco- sweet (*glycogen*: an extensively branched polysaccharide of many glucose monomers that serves as an energy-storage molecule in animal liver and muscle cells)

helic- a spiral (*alpha helix*: spiral shape created by the coiling of polypeptides in a protein's secondary structure); *double helix*: the form of native DNA, composed of two adjacent polynucleotide strands wound into a spiral shape)

hydro- water (*hydrocarbon*: a chemical compound composed only of the elements carbon and hydrogen)

- lyse break (*hydrolysis*: a chemical process in which polymers are broken down by the chemical addition of water molecules to the bonds linking their monomers);
- philos loving (*hydrophilic*: “water-loving”: refers to polar, or charged, molecules [or parts of molecules] that are soluble in water.)
- phobos fearing (*hydrophobic*: “water-fearing”: refers to nonpolar molecules [or parts of molecules] that do not dissolve in water)
- iso- equal (*isomer*: one of several organic compounds with the same molecular formula but different structures and, therefore, different properties)
- macro- large (*macromolecule*: a giant molecule in a living organism formed by the joining of smaller molecules)
- mono- single (*monosaccharide*: simplest type of sugar;
- meros- = part (*monomer*: a chemical subunit that serves as a building block of a polymer)
- poly- many (*polymer*: a large molecule consisting of many monomers covalently joined together in a chain; *polysaccharide*: many monosaccharides joined together)
- quatr- four (*quaternary structure*: the fourth level of protein structure; the shape resulting from the association of two or more polypeptide subunits)
- terti- three (*tertiary structure*: the third level of protein structure; the overall, three-dimensional shape of a polypeptide due to interactions of the R groups of the amino acids making up the chain)

Ch. 4: A Tour of the Cell

Introduction Describe the types of movement seen in cells.

Introduction to the Cell

- 4.1 Compare the designs of and images produced by a light microscope, a scanning electron microscope, and a transmission electron microscope. Distinguish between magnification and resolving power.
- 4.1 Define cell theory and briefly describe the discoveries that led to its development.
- 4.2 Explain why there are upper and lower limits to cell size.
- 4.3 Distinguish between the structures of prokaryotic and eukaryotic cells.
- 4.4 Explain why compartmentalization is important in eukaryotic cells.
- 4.4 Compare the structures of plant and animal cells. Note the function of each cell part.
- 4.4 Describe the structures and functions of the four compartments of eukaryotic cells.
- 4.5 Describe the hydrophobic and hydrophilic components of a plasma membrane.

Cell Structures Involved in Manufacturing and Breakdown

- 4.6–4.13 Describe the structure and functions of the nucleus, endomembrane system, smooth and rough endoplasmic reticulum, Golgi apparatus, lysosomes, and vacuoles.

Energy-Converting Organelles

- 4.14–4.15 Compare the structures and functions of chloroplasts and mitochondria.
- 4.16 Describe the evidence that suggests that mitochondria and chloroplasts evolved by endosymbiosis.

Internal and External Support: The Cytoskeleton and Cell Surfaces

- 4.17 Compare the structures and functions of microfilaments, intermediate filaments, and microtubules.
- 4.18 Relate the structure of cilia and flagella to their functions.
- 4.19 Describe examples of environmental and genetic causes of infertility in men.
- 4.20 Relate the structure of the extracellular matrix to its functions.
- 4.21 Compare the structures and functions of tight junctions, anchoring junctions, and gap junctions.
- 4.22 Relate the structure of plant cell walls to its functions.

Functional Categories of Cell Structures

- 4.23 Describe the four functional categories of organelles in eukaryotic cells.
- 4.23 Describe the three fundamental features of all organisms.

Key Terms

basal body	cytoplasm	granum (plural , grana)	mitochondria)
cell theory	cytoskeleton	integrins	nuclear envelope
cell wall	electron microscope (EM)	intermediate filament	nucleoid
cellular metabolism	endomembrane system	intermembrane space	nucleolus
central vacuole	endoplasmic reticulum (ER)	light microscope (LM)	nucleus (plural , nuclei)
centriole	endosymbiosis	lysosome	organelle
chloroplast	eukaryotic cell	microfilament	peroxisome
chromatin	extracellular matrix (ECM)	micrograph	plasma membrane
chromosome	flagellum (plural , flagella)	microtubule	plasmodesma (plural ,
cilia	glycoprotein	mitochondrial matrix	plasmodesmata)
crista (plural , cristae)	Golgi apparatus	mitochondrion (plural ,	prokaryotic cell

ribosome	microscope (SEM)	thylakoid	vacuole
rough endoplasmic reticulum	smooth endoplasmic reticulum	transmission electron microscope (TEM)	vesicle
scanning electron	stroma	transport vesicle	

Word Roots

centro-, center	(<i>centriole</i> : an animal cell structure composed of cylinders of microtubule triplets; within the cell's centrosome, a pair of centrioles function in cell division)
chloro-	green
-plast	molded (<i>chloroplast</i> : the site of photosynthesis in plants and algae)
cili-	hair (<i>cilium</i> : a short hair-like cellular appendage with a microtubule core, specialized for locomotion)
cyto-	cell
-plasm	fluid (<i>cytoplasm</i> : everything inside a cell between the plasma membrane and the nucleus, consisting of a semifluid medium and organelles)
-ell	small (<i>organelle</i> : a membrane-enclosed structure with a specialized function within a cell)
endo-	inner (<i>endomembrane system</i> : the system of membranes within a cell that includes the nuclear envelope, endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles, and the plasma membrane)
endo-	inner
sym-	together
bios-	living (<i>endosymbiosis</i> : when one organism lives inside another organism; the process by which the mitochondria and chloroplasts of eukaryotic cells probably evolved)
eu-	true
karyo-	nucleus (<i>eukaryotic cell</i> : a cell with a membrane-enclosed nucleus and other membrane-enclosed organelles)
extra-	outside (<i>extracellular matrix</i> : the substance in which animal tissue cells are embedded)
flagell-	whip (<i>flagellum</i> : a long whiplike cellular appendage specialized for locomotion)
glyco-	sweet (<i>glycoprotein</i> : a macromolecule consisting of one or more polypeptides linked to short chains of sugars)
lyso-	loosen (<i>lysosome</i> : a digestive organelle containing hydrolytic enzymes used by eukaryotic cells to digest food and wastes)
micro-	small
-tubul	a little pipe (<i>microtubule</i> : a straight, hollow tube of globular proteins in the cytoskeleton of eukaryotic cells that support the structure and movement of cilia and flagella)
-graphy	a picture (<i>micrograph</i> : a photograph taken through a microscope)
nucle-	nucleus
-oid	like (<i>nucleoid</i> : a dense region of DNA in a prokaryotic cell) _ a band or bond (<i>plasmodesmata</i> : an open channel in a plant cell wall)
pro-	before; (<i>prokaryotic cell</i> : a cell that has no nucleus)
-soma	a body (<i>chromosome</i> : the structure carrying the genetic material found in the nucleus of a eukaryotic cell; also, the main gene-carrying structure of a prokaryotic cell; <i>ribosome</i> : a cell structure consisting of RNA and protein organized into two subunits and functioning as the site of protein synthesis in the cytoplasm; <i>peroxisome</i> : an organelle containing enzymes that transfer hydrogen from various substrates to oxygen, producing and then degrading hydrogen peroxide)
thylaco-	sac or pouch (<i>thylakoid</i> : a flattened membranous sac inside the chloroplast that serves as the site of the light reactions of photosynthesis)
trans-	across
-port	a harbor;
vesic-	sac or bladder (<i>transport vesicle</i> : a membranous compartment used to enclose and transport materials from one part of a cell to another)

Ch. 5: The Working Cell

Introduction: Explain how organisms use bioluminescence to attract mates or prey, repulse predators, or communicate.

Membrane Structure and Function

- 5.1 Describe the fluid mosaic structure of cell membranes.
- 5.1 Describe the diverse functions of membrane proteins.
- 5.1 Relate the structure of phospholipid molecules to the structure and properties of cell membranes.
- 5.2 Explain how the properties of phospholipids spontaneously form membranes.
- 5.3 Define diffusion and describe the process of passive transport.
- 5.4 Explain how osmosis can be defined as the diffusion of water across a membrane.
- 5.5 Distinguish between hypertonic, hypotonic, and isotonic solutions.
- 5.5 Explain how animal and plants cells change when placed into hypertonic or hypotonic solutions.

- 5.6 Explain how transport proteins facilitate diffusion.
 5.6–5.8 Compare the processes of facilitated diffusion and active transport.
 5.7 Describe the function of aquaporins in cell membranes.
 5.9 Distinguish between exocytosis, endocytosis, phagocytosis, pinocytosis, and receptor-mediated endocytosis.

Energy and the Cell

- 5.10 Define and compare kinetic energy, potential energy, chemical energy, and heat.
 5.11 Define the first and second laws of thermodynamics. Explain how these laws of thermodynamics relate to energy use in a cell.
 5.12 Define and compare endergonic and exergonic reactions. Explain how cells use cellular respiration and energy coupling to survive.
 5.13 Describe the three main types of cellular work.
 5.13 Explain how ATP functions as an energy shuttle.

How Enzymes Function

- 5.14 Explain how enzymes speed up chemical reactions.
 5.15 Describe the structure of an enzyme-substrate interaction.
 5.15 Explain how the cellular environment affects enzyme activity.
 5.16 Explain how competitive and noncompetitive inhibitors alter an enzyme's activity.
 5.16 Explain how certain poisons, pesticides, and drugs inhibit enzymes.
 5.16 Describe the process of feedback inhibition.

Key Words:

active site	endocytosis	fluid mosaic	passive transport
active transport	energy coupling	heat	phagocytosis
adenosine triphosphate (ATP)	energy of activation (EA)	hypertonic solution	phosphorylation
aquaporin	energy	hypotonic solution	pinocytosis
cellular respiration	entropy	induced fit	potential energy
chemical energy	enzyme	isotonic solution	receptor-mediated endocytosis
coenzyme	exergonic reaction	kinetic energy	second law of thermodynamics
cofactor	exocytosis	metabolic pathway	selective permeability
competitive inhibitor	facilitated diffusion	metabolism	substrate
concentration gradient	feedback inhibition	noncompetitive inhibitor	thermodynamics
diffusion	first law of thermodynamics	osmoregulation	tonicity
endergonic reaction		osmosis	

Word Roots

aqua-	water
-pori	a small opening (<i>aquaporin</i> : a transport protein in the plasma membrane of a plant or animal cell that facilitates the diffusion of water across the membrane)
co-	together (<i>cofactor</i> : a nonprotein molecule or ion that is required for the proper functioning of an enzyme)
endo-	inner, within (<i>endergonic reaction</i> : an energy-requiring chemical reaction that yields products with more potential energy than the reactants); cyto- _ cell (<i>endocytosis</i> : cellular uptake of molecules or particles via formation of new vesicles from the plasma membrane)
exo-	outer (<i>exergonic reaction</i> : an energy-releasing chemical reaction in which the reactants contain more potential energy than the products; <i>exocytosis</i> : the movement of materials out of the cytoplasm of a cell by the fusion of vesicles with the plasma membrane)
hyper-	exceeding
-tonus	tension (<i>hypertonic</i> : a solution with a higher concentration of solutes)
hypo-	lower (<i>hypotonic</i> : a solution with a lower concentration of solutes)
iso-	same (<i>isotonic</i> : solutions with equal concentrations of solutes)
kinet-	movement (<i>kinetic energy</i> : the energy of motion)
osmo-	pushing (<i>osmosis</i> : the diffusion of water across a selectively permeable membrane)
phago-	eat (<i>phagocytosis</i> : cellular “eating,” a type of endocytosis in which a cell engulfs macromolecules, other cells, or particles into its cytoplasm)
pino-	drink (<i>pinocytosis</i> : cellular “drinking,” a type of endocytosis in which the cell takes fluid and dissolved solutes into small membranous vesicles)
therm-	heat (<i>thermodynamics</i> : the study of the energy transformations that occur in a collection of matter)