A. P. BIOLOGY SUMMER ASSIGNMENT

Read in Campbell Biology in Focus, A.P. 1st edition, copyright 2014 :

Chapter 1 -- Introduction

Chapter 2 -- Chemical Context of Life, p. 24-36

Chapter 3 -- Carbon and the Molecular Diversity of Life

Chapter 4 – A Tour of the Cell

There will be a test on the 3rd day of class. Come prepared with any questions the 1st day of class. Test questions will be similar to the "self-quiz" questions at the end of the chapters.

A. P. BIOLOGY CHAPTER 1 -- EVOLUTION AND THE FOUNDATIONS OF BIOLOGY

Core theme: Evolution accounts for the unity and diversity of life

Emergent Properties arise at successive levels of organization – cells, molecules, organelles, tissues, organs, organ systems, organisms, populations, communities, ecosystems, the biosphere.

Structure (Form) correlates with Function in organisms

Eukaryotic and Prokaryotic cells – the differences between

DNA contains genes. Gene expression determines the structure and functioning of the organism

Core theme: life requires an input and processing of energy

Core theme: organisms interact with other organisms and with the physical environment.

Classification: Life is classified into three domains: Bacteria, Archaea and Eukarya

A. P. BIOLOGY CHAPTER 2 – THE CHEMICAL CONTEXT OF LIFE

Ch. 2.3 -- Bonding – covalent, ionic, hydrogen, Van der Waals

Ch. 2.5 – Properties of water

1. **cohesion** – due to hydrogen bonds. → surface tension and adhesion

2. **moderation of temperature** – water has a high specific heat = amount of heat that must be absorbed or lost for 1 gram of a substance to change temp by 1 degree C. Why high spec heat? many hydrogen bonds must form or break for water to change T
   water → ice
   makes more bonds→heat is released and warms the environment. water mcs get colder
   water → vapor
   bonds break→heat is absorbed by the mcs. →evaporative cooling = the surface gets colder
   oceans and lakes
   water modifies the air temperature around it:
   →water mcs absorb heat from the warm air→cools the air (daytime)
   →water releases the stored heat to the cool air→warms the air (nighttime)

3. **expansion upon freezing**
   water is densest at 4 degrees C, then gets less dense as it freezes because the hydrogen bonds are held "at arm's length" apart, so there are not as many of them. -→ice floats. Floating ice insulates and allows for life under water.

4. **solvent** – solutes dissolve in it.

A. P. BIOLOGY CHAPTER 3 OUTLINE – CARBON AND THE MOLECULAR DIVERSITY OF LIFE

I **Emergent Properties**

II Polymers

- A. Formation of a bigger mc: condensation rxn; dehydration rxn
- B. Break up of a bigger mc. to a smaller mc: hydrolysis
- C. These processes require energy (=nrg) and enzymes
- D. Have important chemical groups (p. 43)

III **Carbohydrates** (p. 45-49)

- A. Monosaccharides, disaccharides, polysaccharides, -ose
- B. Structure – CH_2O, glycosidic linkages formed by dehydration synthesis
- C. Functions
  1. fuel (e.g glucose)
  2. storage (e.g. starch, glycogen)
  3. structure (e.g. cellulose)

IV **Lipids** (p. 49-51)

- A. Hydrophobic
- B. Examples: fats, phospholipids, steroids, waxes, and some pigments
- C. Fat: structure: glycerol, fatty acid, ester linkage
- D. Function — store energy, insulation, cushion organs, waterproof coverings, hormones, structure
- E. Saturated (no double bonds) vs. unsaturated (1 or more double bond) .
- F. Phospholipids

1. part of cell membrane
2. ambivalent toward water; amphipathic
3. arrange themselves into micelles; form a double layer in membranes

G. Steroids
1. 4 fused rings, different functional groups attached
2. examples: cholesterol, estrogen, testosterone

V **Protein** (p. 51-59) (do not need to know fig. 3.17)

A. Diverse structure and function
B. Structure: polypeptide of amino acids joined by a peptide bond
C. 20 different kinds of amino acids—all have an amino group, a central C, a carboxyl group, a H, and an "R" group which is unique to each a.a.
D. Functions:
1. structure, e.g. collagen, keratin
2. storage, e.g. ovalbumin in egg white
3. transport, e.g. hemoglobin
4. hormone, e.g. insulin
5. receptor, e.g. on nerve cell membrane
6. contractile, e.g. actin and myosin in muscles
7. defensive, e.g. antibodies
8. enzyme, e.g. digestive enzymes

E. Function depends on unique 3-D shape (conformation); there are 4 levels of protein structure:
1. primary—amino acids
2. secondary—alpha (α) helix, beta (β) pleated sheet
3. tertiary—hydrophobic interactions, disulfide bridges, van der Waals, H bonds, ionic bonds
4. quaternary—subunits

F. Denaturation
G. Protein folding problem

VI **Nucleic acids** (p. 60-62)

A. Examples: DNA, RNA
B. Structure: nucleotides (purines: A,G; pyrimidines: T, C), sugar (ribose or deoxyribose), phosphate; hydrogen bonds; double helix
C. Function: carry hereditary info.

A. P. BIOLOGY CHAPTER 4 OUTLINE -- A TOUR OF THE CELL

I Introductory Remarks:

A. All Cells Have
1. Plasma membrane = cell membrane
2. Cytoplasm (= the contents of the cell, exclusive of the nucleus and bounded by the plasma membrane) and Cytosol (= the semi-liquid portion of the cytoplasm)
3. Ribosomes
4. Chromosomes that carry genes

B. Surface:Volume Ratio
   1. Affects exchange and diffusion rates: higher S:V → more diffusion and exchange
   2. Smaller have a bigger S:V ratio
   3. So, cells have to be small to be able to get everything they need into and out of the cell

II Microscopes, cell fractionation –don't need to know details

III **Prokaryotic cells**
   A. Domains Bacteria and Archaea
   B. No nucleus; DNA in nucleoid region
   C. No membrane-bound organelles
   D. tiny

IV **Eukaryotic cells** ----–pix p.72-73.

   A. have membrane bound organelles
   B. bigger than prokaryotes
   C. all organisms except bacteria
   D. differences between plant and animal cells
      1. animals – centrioles, centrosomes, lysosomes, flagella, no cell wall
      2. plants – chloroplasts, central vacuole, plasmodesmata, cell wall

V Parts of a Eukaryotic Cell

   A. **Nucleus**
      1. contains most of the DNA in cell. Chromosome = DNA & proteins = chromatin
      2. nuclear envelope = nuclear membrane: double memb. has pores lined by proteins. things (e.g. ribosome parts) can leave thru pores
      3. nuclear matrix = framework of fibers – extends thru nuc interior; helps with organizing interior of nuc.
      4. nucleolus – fibers and granules; rRNA made here; ribosomal subunits formed here (are made of rRNA and proteins)

   B. **Ribosomes**
      1. no membrane around
      2. made of rRNA and protein
      3. proteins made here
      4. cells that have to make lots of protein have lots of these (e.g.pancreas)
      5. two types:
         a. free (floating in cytosol). NOTE: cytosol more specifically refers to the liquid inside the cell, cytoplasm refers to the liquid and the organelles outside the nucleus); synthesize proteins that function within the cytosol
         b. bound (bound to the rough endoplasmic reticulum) ; synthesize proteins that will be excreted from the cell, or are part of some membrane in the cell. e.g. pancreas, lysosomes
         c. ribos can switch back and forth from free to bound, and vice versa

C. **Endomembrane system** – consists of various membrane bound organelles in the cell that all work together. things (proteins, lipids) move from one to the next (see p. 81, Fig 4.15)); includes 1 – 4 below, plus nuc memb.

1. **Endoplasmic reticulum** – a series of fluid-filled membranous sacs called cisternae; is attached to nuc. memb. 2 types differ in structure and function; gee whiz: 1⁄2 of membrane in cell is ER

   a. **smooth** – no ribosomes here
      1) synthesizes lipids and steroids (lots in ovaries and testes)
      2) helps detoxify toxins –poisons and drugs ; lots in liver; alcohol— the more you drink, the more smooth ER you have to detox it, so your tolerance increases. same effect with drugs
      3) stores Calcium (more in muscle chapter)
      4) metabolism of carbs

   b. **rough** - ribos are bound to this
      1) polypeptide (protein) made in bound ribosome, threaded into inside of rough ER.
      2) gets folded into 3D shape (secondary and tertiary structure)
      3) carbs added to make glycoprotein
      4) membranes made here

2. **Golgi apparatus (AKA Golgi body)** –flattened membranous sacs – called cisternae;
   a. one way transport
   b. sorts and packages materials into transport vesicles
   c. receives vesicles from ER; put tags on to direct mcs to specific areas of cell (e.g. membrane, other organelles)
   d. makes some carbs itself
   e. lots in cells that secrete mcs.

3. **Lysosomes** – digestive compartments; memb. bound sac of hydrolytic enzymes; used to digest macromolecules for food or for recycling old organelles;
   a. pH 5 (acidic); keeps the digestive enzymes away from the cytosol and other organelles
   b. maintains an acidic environment in the lysosome so the digestive enzymes can work
   c. Amoebas digest their food using these - phagocytosis
   d. involved in programmed cell death (more later!)
   e. helps cells renew themselves, e.g. liver cells
   f. the hydrolytic enzymes and lysosome membranes are made by rough E.R. and Golgi

4. **Vacuoles** – large versions of vesicles ; membrane bound storage organelle;
   a. several kinds
      1) food
      2) contractile (e.g. *Paramecium* to get rid of excess
      3) central in plants (keeps plant turgid, not wilted), etc.
   b. In plants, they can store waste products, contain pigment, contain chemical compounds that are poisonous to animals

D. **Mitochondria** – energy producer. cell respiration occurs here. – break down sugar to produce energy in the form of ATP.
   1. smooth outer membrane, folded inner membrane (more surface area for cell resp→structure and function) called cristae;
   2. intermembrane space between 2 membs.
   3. matrix = liquidy area inside inner membrane
   4. mito has own DNA and ribosomes
   5. in cells with lots of metabolic activity there are lots (1000s) of mitos.
   6. reproduce by splitting in two.

E. **Chloroplast** – energy producer; in plants; photosynthesis occurs here

   1. 2 membranes and a series of membranous sacs called thylakoids. Stack of thylakoids = granum (grana = plural)
   2. liquid in interior is called stRoma
   3. there are other types of plastids that store starch, have pigments to give flowers colors, etc.
   4. has own DNA and ribos.
   5. reproduce by splitting in two
   6. Endosymbiont theory

F. **Peroxisomes** – membrane bound compartment that break down and/or detoxify certain chemicals. Produce hydrogen peroxide (H_2O_2) as a byproduct. Hydrogen peroxide is toxic, but they can also break it down. Some in the liver help to detoxify alcohol and poisons

G. **Cytoskeleton** – a network of fibers extending throughout the cytoplasm. See p. 86 chart; know the 3 types – size (big, med. small), subunits, and main functions of each. we will go into more detail later. In animals, the centrosome is the area in the cell where the centrioles occur. Centrosome is sometimes called "microtubule organizing center"

H. **Cilia and Flagella** -- movement; cilia: small and numerous, flags: bigger and fewer. flags undulate, cilia beat back and forth like rowboat oars; both have core of microtubules (cytoskeleton) with a "9 + 2" pattern = 9 pairs (doublets)in a ring around a central pair; anchored to cell by basal body (more details later)

I. **Cell walls of plants** - protects cell, maintains shape; supports plant against gravity
   1. made of cellulose
   2. don't need to know details re. primary, secondary cell wall.

J. **Extracellular Matrix (ECM)** helps support, move, regulate cell behavior, and adhere cells to other cells; mostly made of glycoproteins , especially collagen; more details later

K. **Intercellular Junctions**
   1. **plasmodesmata** – in plants; channels between adjacent cells that allow cytosol to pass through
   2. **tight junctions** – membranes of adjacent cells are fused, forming continuous belts around cells; prevent fluids from leaking in or out, e.g. urinary bladders, intestines

3. **desmosomes** – anchoring junctions; fasten cells together into strong sheets (like rivets); e.g. intestines, stomach, urinary bladder, skin
4. **gap junctions** –communicating junctions - allows cytoplasm to move between adjacent animal cells; e.g. most gland cells, brain cells

VI **Emergent Properties** – a cell is a living unit greater than the sum of its parts!