

Biology AP Exam



Preparation Packet

May 10, 2011

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The 2011 AP Biology exam will be on Monday, May 9th in the morning. The entire exam is three hours long and divided into two sections:

Section I is Multiple Choice. 100 questions are given with a time limit of 80 minutes. That means about 48 seconds per question. These multiple choice questions are drawn from topics from the entire course. Section I is worth 60% of your grade.

Section II is the Free Response). There are four questions. The time begins with a 10 minute reading period where you will have time to read the questions and consider your answers. You'll be able to jot down some notes on the question pamphlet. Then you will have 90 minutes to write your essays in the exam booklet. That means about 22 minutes per question. Section II is worth 40% of your grade.

WEEK 1: Chemistry of Life (7%)**Week 1 Concepts:**

- How do the unique chemical and physical properties of water make life on earth possible?
- What is the role of carbon in the molecular diversity of life?
- How do cells synthesize and break down macromolecules
- How do structures of biologically important molecules (carbohydrates, lipids, proteins, nucleic acids) account for their functions?
- How do the laws of thermodynamics relate to the biochemical processes that provide energy to living systems?
- How do enzymes regulate the rate of chemical reactions?
- How does the specificity of an enzyme depend on its structure?
- How is the activity of an enzyme regulated?

Week 1 Vocabulary:

-Atoms (Protons, Neutrons, Electrons)	-Nucleic Acids (nucleotide)	-Phospholipid
-Bonds (Covalent, Ionic, Hydrogen)	-Proteins (Amino Acids, dipeptide, polypeptide)	-Cholesterol
-Compound	-Primary, Secondary, Tertiary, Quaternary Structures	-Monosaccharide (glucose, fructose)
-Kinetic Energy	-Condensation Reaction	-Disaccharide (sucrose, lactose, maltose)
-Water (Cohesion, adhesion, capillary action, specific heat)	-Hydrolysis Reaction	-Polysaccharide (glycogen, starch, cellulose, chitin)
-pH	-Fatty Acid	-Enzymes (active site, catalysis, substrate)
-Alkaline/Base, Acidic/Acid	-Triglyceride	-Negative Feedback
-Functional Groups	-Glycerol	-Metabolism
-Lipids	-Hydrophilic	-Catabolism
-Carbohydrates	-Hydrophobic	-Organic
	-Steroid	

Week 1 Multiple Choice Questions:

1. A substrate molecule may be bound to the active site of an enzyme by all of the following EXCEPT

(A) Hydrogen bonds	(D) Peptide bonds
(B) Ionic bonds	(E) Van der Waals interactions
(C) Hydrophobic interactions	

2. The bonding of two amino acid molecules to form a larger molecules requires

(A) The release of a water molecule	(D) The release of a carbon dioxide molecule
(B) The addition of a nitrogen atom	(E) The addition of a water molecule
(C) An increase in activation energy	

3. A common feature of starch and glycogen is that molecules of both

(A) Form microtubules that give support to connective tissue fibers
(B) Contain repeated monomers of glucose and galactose
(C) Are important structural components of plant cell walls
(D) Are polymers of glucose
(E) Are water-soluble disaccharides

4. A solution with a pH of 11 is how many times more basic than a solution with a pH of 9?

(A) 2	(B) 4	(C) 10	(D) 100	(E) 1000
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5. The hydrolysis of maltose results in which of the following?

(A) Two glucose molecules	(D) Two fructose molecules
(B) One glucose and one fructose molecule	(E) Two amino acids
(C) One glycerol and one fatty acid	

6. Which of the following is a major storage carbohydrate in animals?

(A) Cellulose	(B) Maltose	(C) Fructose	(D) Starch	(E) Glycogen
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7. Which of the following organic compounds is a polymer?

(A) glucose	(B) fructose	(C) glycogen	(D) amino acid	(E) nucleotide
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8. A particular polypeptide contains 80 amino acids. When the polypeptide is completely hydrolyzed, how many water molecules are used during this process?

(A) 2	(B) 30	(C) 40	(D) 79	(E) 80
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9. All of the following qualities contribute to capillary action EXCEPT:

- (A) cohesion (B) adhesion (C) polarity (D) hydrogen bonding (E) glycosidic bonding

Directions: Each group of questions consists of five lettered headings following by a list of numbered phrases or sentences. For each numbered phrase or sentence, select the one heading that is most closely related to it. Each heading may be used once, more than once, or not at all in each group.

Questions 10-13

- (A) Hydrogen bond (B) Peptide bond (C) Glycosidic bond (D) Polarity (E) Ester bond

10. Weak bonds formed between water molecules
 11. Bond formed between two monosaccharides
 12. A bond that links two amino acids
 13. A bond that links a fatty acid to a glycerol molecule

Week 1 Free Response Questions:

1. Proteins functioning as enzymes exhibit precise specifications. Discuss the levels of structural organization within proteins which are responsible for specific molecular interaction.
 2. A class of biology students performed an experiment on the digestion of starch by salivary amylase. Each student determined the length of time required for different dilutions of his saliva to digest completely a standard concentration of starch. Iodine was used to test for the presence of starch. The results obtained by some of the class are summarized in the table below.

TIME REQUIRED FOR THE DISAPPEARANCE OF STARCH WITH VARIOUS SALIVA DILUTIONS

Dilutions (saliva: H₂O)

Student	1:9 (10%)	1:19 (5%)	1:49 (2%)	1:99 (1%)
A	45 seconds	50 seconds	100 seconds	135 seconds
B	(no end point)	----	----	----
C	90 seconds	100 seconds	200 seconds	270 seconds
D	260 seconds	300 seconds	600 seconds	800 seconds

- a. Present the data for Student A in graphic form.
 b. Carefully examine the data collected by the four students above and state as many conclusions as you can that are supported by these data.
 c. Assuming there have been no errors in techniques, form as many hypotheses as you can to explain the differences observed.
 d. Design one experiment to test the validity of one hypothesis. Clearly state what data you would want to collect in this experiment to test your hypothesis.
3. Discuss the biological importance of each of the following organic compounds in relation to cellular structure and function in plants and animals. a. Carbohydrates b. Proteins c. Lipids d. Nucleic acids
4. Describe the chemical compositions and configuration of enzymes and discuss the factors that modify enzyme structure and/or function.
5. Enzymes are biological catalysts.
 a. Relate the chemical structure of an enzyme to its specificity and catalytic activity.
 b. Design a quantitative experiment to investigate the influence of pH or temperature on the activity of an enzyme.
 c. Describe what information concerning the structure of an enzyme could be inferred from your experiment.
6. The unique properties (characteristics) of water make life possible on Earth. Select three properties of water and:
 a) for each property, identify and define the property and explain it in terms of the physical/chemical nature of water.
 b) for each property, describe one example of how the property affects the functioning of living organisms.
7. After an enzyme is mixed with its substrate, the amount of product formed is determined at 10-second intervals for 1 minute. Data from this experiment are shown below.

Time (sec)	0	10	20	30	40	50	60
Product formed (mg)	0.0	0.25	0.50	0.70	0.80	0.85	0.85

Draw a graph of these data and answer the following questions.

- a. What is the initial rate of this enzymatic reaction?
 b. What is the rate after 50 seconds? Why is it different from the initial rate?
 c. What would be the effect on product formation if the enzyme were heated to a temperature of 100C for 10 minutes before repeating the experiment? Why?
 d. How might altering the substrate concentration affect the rate of the reaction? Why?
 e. How might altering the pH affect the rate of reaction? Why?

WEEK 2: Cells (10%)

Week 2 Concepts:

- ❑ What are the similarities and differences between prokaryotic and eukaryotic cells?
- ❑ What are the evolutionary relationships between prokaryotic and eukaryotic cells?
- ❑ What is the current model of the molecular architecture of membranes?
- ❑ How do variations in this structure account for functional differences among membranes?
- ❑ How does the structural organization of membranes provide for transport and recognition?
- ❑ What are various mechanisms by which substances cross membranes?
- ❑ How does compartmentalization organize a cell's functions?
- ❑ How are the structures of the various subcellular organelles related to their functions?
- ❑ How do organelles function together in cellular processes?
- ❑ What factors limit cell size?
- ❑ How does the cell cycle assure genetic continuity?
- ❑ How does mitosis allow for the even distribution of genetic information to new cells?
- ❑ What are the mechanisms of cytokinesis?
- ❑ How is the cell cycle regulated?
- ❑ How can aberrations in the cell cycle lead to tumor formation?

Week 2 Vocabulary:

- | | |
|--|--|
| -Phospholipid Bilayer | -Chloroplasts |
| -Fluid Mosaic Model | -Chromoplasts |
| -Diffusion (concentration gradient) | -Amyloplasts |
| -Osmosis | -Cell Wall |
| -Impermeable | -Vacuole |
| -Cell Transport Methods (passive transport, active transport, facilitated diffusion, endocytosis, exocytosis, pinocytosis) | -Microtubules |
| -Tight junctions | -Centrioles |
| -Desmosomes | -Microfilaments |
| -Gap junctions | -Mitosis versus Meiosis |
| -Plasmodesmata | -Sister Chromatids |
| -Prokaryotes | -Homologous Chromosomes |
| -Eukaryotes | -Autosomal Chromosomes |
| -Flagella | -Sex Chromosomes (X & Y) |
| -Cilia | -Diploid |
| -Cytoskeleton | -Haploid |
| -Nucleus | -Somatic Cells |
| -Nucleolus | -Germ Cells |
| -Chromatin | -Prophase, Metaphase, Anaphase, Telophase |
| -Ribosomes | -Centromere |
| -Endoplasmic Reticulum (rough and smooth) | -Kinetochores |
| -Golgi Complex | -Cytokinesis (cleavage furrow, cell plate) |
| -Lysosomes | -Synapsis |
| -Mitochondria | -Tetrad |
| | -Crossing Over |
| | -Recombination |

Week 2 Multiple Choice Questions:

1. One of the most pronounced differences between animal and plant cells is that

- (A) animal cells alone have one or more large vacuoles
(B) animal cells alone have a nucleolus
(C) animal cells alone have their nuclear chromatin attached to the spindle fibers during mitosis
(D) plant cells alone have rough endoplasmic reticulum
(E) plant cells alone have relatively thick rigid cell walls
2. Which of the following macromolecules is primarily responsible for the insolubility of cell membranes in water?
(A) Starch (B) Cellulose (C) Protein (D) Phospholipid (E) Glycogen
3. In cells, which of the following can function to give shape, enable movement, and anchor organelles?
(A) Vacuoles filled with water and surrounded by a single membranes
(B) Ribosomes, peroxisomes, and lysosomes
(C) Microtubules, microfilaments, and intermediate fibers
(D) The interconnected networks of the E.R.
(E) Golgi apparatus and associated vesicles in the cytoplasm
4. Mitosis in flowering plants is similar to mitosis in animals in that in both
(A) A cell plate forms
(B) Synapsis of homologous chromosomes occurs
(C) Large centrioles attach to the spindle fibers
(D) Each daughter cell has half the number of chromosomes found in each parent cell
(E) Centromeres uncouple and chromosomes move apart
5. All of the following statements about a chloroplast and a mitochondrion are true EXCEPT:
(A) Both use proton gradients for energy production (D) Both capture light energy
(B) Both contain DNA (E) Both are bounded by two unit membranes
(C) Both synthesize ATP
6. Prokaryotes differ from eukaryotes in that only the prokaryotes contain
(A) Mitochondria in which glucose is oxidized (D) DNA that is not bound to histone protein
(B) Chromosomes enclosed within a nuclear envelope (E) Photosynthetic pigments in plastids
(C) Plasma membranes surrounding the cytoplasm
7. All of the following are functions of the smooth endoplasmic reticulum of animals EXCEPT
(A) Detoxification of poisons in the liver (D) Storage of Ca^{2+} in the sarcomere of muscles
(B) Synthesis of proteins (E) Synthesis of lipids
(C) Synthesis of steroid hormones
8. Regarding mitosis and cytokinesis, one difference between higher plants and animals is that in plants
(A) The spindles contain cellulose microfibrils in addition to microtubules, whereas animal spindles do not contain microfibrils
(B) Sister chromatids are identical, whereas in animals they differ from one another
(C) A cell plate begins to form at telophase, whereas in animals a cleavage furrow is initiated at that stage
(D) Chromosomes become attached to the spindle at prophase, whereas in animals chromosomes

do not become attached until anaphase

(E) Spindle poles contain centrioles, whereas spindle poles in animals do not

9. The organelle that is a major producer of ATP and is found in both heterotrophs and autotrophs is the
(A) chloroplast (B) nucleus (C) ribosome (D) Golgi apparatus (E) Mitochondrion

10. Structures found in the cells of both angiosperms and mammals are

(A) cell walls and cell membranes

(D) centrioles and lysosomes

(B) chloroplasts and ribosomes

(E) cell membranes and

chromosomes

(C) contractile vacuoles and leukoplasts

11. All of the following cell components are found in prokaryotic cells EXCEPT

(A) DNA

(B) Ribosomes

(C) Cell membrane

(D) Nuclear envelope

(E) Enzymes

12. Cytokinesis is the portion of the cell cycle during which

(A) the growth of cells is momentarily arrested in G₂ stage

(B) centromeres uncouple and chromatids separate

(C) the amount of DNA per chromosome doubles

(D) a cell plate is formed in plant cells

(E) the nuclear membrane breaks down

13. If plant cells are immersed in distilled water, the resulting movement of water into the cells is called

(A) conduction

(B) active transport

(C) transpiration

(D) osmosis

(E) facilitated

diffusion

14. Which of the following is the primary role of the lysosome?

(A) ATP synthesis

(D) Intracellular digestion

(B) Lipid transport

(E) Carbohydrate storage

(C) Protein synthesis

15. The cytoplasmic channels between plant cells which are most similar to gap junctions between animal cells are called

(A) middle lamellas

(B) tonoplasts

(C) plasmodesmata

(D) tight junctions

(E) desmosomes

Week 2 Short Answer Questions:

1. Death is a natural and necessary part of life cycles at all levels of organization.

a. Discuss TWO examples of how cell death affects the development and functioning of a multicellular organism

b. Discuss ONE example of how substances are degraded and reused in cells.

c. Discuss the evolutionary significance of death.

2. Electron microscope studies have revealed the probable structure of plasma membranes and the membranes of various cell components.

a. Describe the kinds of observations and experiments that are used to study the basic structure and molecular components of these membranes.

b. Discuss mechanisms by which materials are thought to move across membranes.

c. Discuss the significance of membranes in the biochemical events which occur in mitochondria and chloroplasts.

3. All living cells exploit their environment for energy and for molecular components in order to maintain their internal environments. Describe the roles of several different membrane systems in these activities.
4. Describe a model of the cell membrane of a eukaryotic cell and discuss different ways in which substances move across the membrane.
5. Describe the structural arrangement and function of the membranes associated with each of the following eukaryotic organelles:
- a. Mitochondrion b. Endoplasmic Reticulum c. Chloroplast d. Golgi Apparatus
6. Describe the fluid-mosaic model of a plasma membrane. Discuss the role of the membrane in the movement of materials through by each of the following processes.
- a. Active Transport b. Passive Transport
7. Describe the structure of a generalized eukaryotic plant cell. Indicate the ways in which a non-photosynthetic prokaryotic cell would differ in structure from this generalized eukaryotic plant cell.
8. Discuss the process of cell division in animals. Include a description of mitosis and cytokinesis, and of the other phases of the cell cycle. Do not include meiosis.
9. A laboratory assistant prepared solutions of 0.8 M, 0.6 M, 0.4 M, and 0.2 M sucrose, but forgot to label them. After realizing the error, the assistant randomly labeled the flasks containing these four unknown solutions as flask A, flask B, flask C, and flask D.
Design an experiment, based on the principles of diffusion and osmosis, that the assistant could use to determine which of the flasks contains each of the four unknown solutions. Include in your answer (a) a description of how you would set up and perform the experiment; (b) the results you would expect from your experiment; and (c) an explanation of those results based on the principles involved. (Be sure to clearly state the principles addressed in your discussion.)
10. Membranes are important structural features of cells.
- a. Describe how membrane structure is related to the transport of materials across a membrane.
- b. Describe the role of membranes in the synthesis of ATP in either cellular respiration or photosynthesis.

WEEK 3: Cellular Energetics (8%)

Week 3 Concepts:

- What is the role of ATP in coupling the cell's anabolic and catabolic processes?
- How does chemiosmosis function in bioenergetics?
- How are organic molecules broken down by catabolic pathways?
- What is the role of oxygen in energy-yielding pathways?
- How do cells generate ATP in the absence of oxygen?
- How does photosynthesis convert light energy into chemical energy?
- How are the chemical products of the light-trapping reactions coupled to the synthesis of carbohydrates?
- What kinds of photosynthetic adaptations have evolved in response to different environmental conditions?
- What interactions exist between photosynthesis and cellular respiration?

Week 3 Vocabulary:

- | | |
|------------------------------------|--|
| -Kinetic energy | -ATP Synthetase |
| -Potential energy | -Fermentation (lactate and alcoholic) |
| -Entropy | -Pigment |
| -Exergonic Reaction (exothermic) | -Chlorophyll |
| -Endergonic Reaction (endothermic) | -Carotenoids |
| -Activation Energy | -Palisade Mesophyll |
| -Autotroph | -Thylakoid Discs |
| -Heterotroph | -Grana |
| -Oxidation | -Stroma |
| -Reduction | -Photosystem I (P700) |
| -ATP | -Photosystem II (P680) |
| -Aerobic | -Photolysis |
| -Anaerobic | -Calvin Cycle (Calvin-Benson Cycle) |
| -Chemiosmotic ATP synthesis | -Light Dependent Reactions |
| -Glycolysis | -Light Independent Reactions (Dark Reactions) |
| -Pyruvate | -RuBP |
| -NADH | -Rubisco |
| -Citric Acid Cycle (Krebs Cycle) | -C3 Photosynthesis |
| -Acetyl CoA | -C4 Photosynthesis |
| -Electron Transport Chain | -CAM Photosynthesis (Crassulacean Acid Metabolism) |
| -Matrix | |

Week 3 Multiple Choice Questions:

1. Carbon dioxide is passed into a solution of bromothymol blue indicator until the acid solution turns yellow. A spring of elodea is then placed into this yellow solution. After a few hours in the sunlight, the yellow solution turns blue. The purpose of this experiment is to show that
 - (A) Oxygen is given off during photosynthesis
 - (B) Carbon dioxide is used during photosynthesis
 - (C) Carbon dioxide is given off as a by-product of photosynthesis
 - (D) Bromothymol blue changes to bromothymol yellow under acid conditions
 - (E) Chlorophyll acting as a photocatalyst is necessary for photosynthesis

2. Which of the following statements concerning respiration is correct?
 - (A) Aerobic respiration is probably more ancient in an evolutionary sense than is anaerobic respiration
 - (B) When oxygen is absent, fermentation proceeds without the participation of enzymes
 - (C) Each NADH + H⁺ generated in the Krebs cycle contains sufficient energy for the production of 3 ATP molecules.
 - (D) Unlike pyruvic acid, fatty acids break up into 3-carbon units during respiration
 - (E) In one turn of the citric acid cycle, 8 molecules of CO₂ are formed

3. All of the following statements about a chloroplast and a mitochondrion are true EXCEPT:
- (A) Both use proton gradients for energy production
 - (B) Both contain DNA
 - (C) Both synthesize ATP
 - (D) Both capture light energy
 - (E) Both are bounded by two unit membranes
4. When a person exercises strenuously, all of the following occur EXCEPT
- (A) Glucose decreases
 - (B) Lactic acid increases
 - (C) CO₂ increases
 - (D) ADP increases
 - (E) Glycogen increases
5. All of the following statements are correct regarding the light-independent (dark) reactions of photosynthesis except:
- (A) The energy source utilized is the ATP and NADPH obtained through the light reaction
 - (B) This reaction begins soon after sundown and ends before sunrise
 - (C) The 5-carbon sugar is constantly being regenerated
 - (D) One of the end products is PGAL
 - (E) The pathway used is usually a 3-carbon pathway, although a 4-carbon pathway does exist in some species
6. The function of water in photosynthesis is to
- (A) Supply electrons in the light-dependent reactions
 - (B) Provide O₂ for the light-independent (dark) reactions
 - (C) Transport H⁺ ions in the light-independent (dark) reactions
 - (D) Combine with CO₂
 - (E) Absorb light energy
7. The end products of the light-dependent reactions of photosynthesis are
- (A) ADP, H₂O, NADPH₂
 - (B) ATP, CO₂, H₂O
 - (C) CO₂, H⁺, PGAL
 - (D) ADP, PGAL, RuBP (RuDP)
 - (E) ATP, NADPH₂, O₂
8. Dichlorophenolindeophenol (DPIP) is a blue dye that is decolorized when it is reduced. After being mixed with DPIP, which of the following would show the greatest change in color?
- (A) Isolated chloroplasts in the light
 - (B) Chlorophyll extract in the dark
 - (C) Boiled chloroplasts in the dark
 - (D) Isolated chloroplasts in the dark
 - (E) Boiled chloroplasts in the light
9. All of the following statements concerning cellular respiration are true EXCEPT:
- (A) In the citric acid cycle, two molecules of CO₂ and one molecule of FADH₂ are produced for each acetyl-CoA that enters the cycle.
 - (B) ATP is converted to ADP during two of the reactions of glycolysis
 - (C) When aerobes respire anaerobically, they may build up an oxygen debt that may be paid eventually by intake of oxygen
 - (D) The metabolic breakdown of glucose yields more energy during fermentation than during aerobic respiration
 - (E) The conversion of glucose to pyruvic acid can occur in the absence of oxygen

Week 3 Essay Questions:

1. Explain how the molecular reactions of cellular respiration transform the chemical bond energy of Krebs cycle substrates into the more readily available bond energy of ATP. Include in your discussion the structure of the mitochondrion and show how it is important to the reactions of the Krebs cycle and the electron transport chain.

2. Describe the similarities and differences between the biochemical pathways of aerobic respiration and photosynthesis in eukaryotic cells. Include in your discussion the major reactions, the end products, and energy transfers.

3. Explain what occurs during the Krebs (citric acid) cycle and electron transport by describing the following:

- The location of the Krebs cycle and electron transport chain in the mitochondria.
- The cyclic nature of the reactions in the Krebs cycle.
- The production of ATP and reduced coenzymes during the cycle.
- The chemiosmotic production of ATP during electron transport.

4. The results below are measurements of cumulative oxygen consumption by germinating and dry seeds. Gas volume measurements were corrected for changes in temperature and pressure.

Cumulative Oxygen Consumed (mL)					
Time (minutes)	0	10	20	30	40
22 °C Germinating Seeds	0.0	8.8	16.0	23.7	32.0
22 °C Dry Seeds	0.0	0.2	0.1	0.0	0.1
10 °C Germinating Seeds	0.0	2.9	6.2	9.4	12.5
10 °C Dry Seeds	0.0	0.0	0.2	0.1	0.2

- Using the graph paper provided, plot the results for the germinating seeds at 22 °C and 0 °C.
- Calculate the rate of oxygen consumption for the germinating seeds at 22 °C, using the time interval between 10 and 20 minutes.
- Account for the differences in oxygen consumption observed between:
 - germinating seeds at 22 °C and at 10°C;
 - germinating seeds and dry seeds.
- Describe the essential features of an experimental apparatus that could be used to measure oxygen consumption by a small organism. Explain why each of these features is necessary.

5. Membranes are important structural features of cells.

- Describe how membrane structure is related to the transport of materials across a membrane.
- Describe the role of membranes in the synthesis of ATP in either cellular respiration or photosynthesis.

6. Energy transfer occurs in all cellular activities. For 3 of the following 5 processes involving energy transfer, explain how each functions in the cell and give an example. Explain how ATP is involved in each example you choose.

Cellular movement
Chemiosmosis

Active transport
Fermentation

Synthesis of molecules

WEEK 4: Heredity (8%)**Week 4 Concepts:**

- What features of meiosis are important in sexual reproduction?
- Why is meiosis important in heredity?
- How is meiosis related to gametogenesis?
- What are the similarities and differences between gametogenesis in animals and gametogenesis in plants?
- How is genetic information organized in the eukaryotic chromosome?
- How does this organization contribute to both continuity of and variability in the genetic information?
- How did Mendel's work lay the foundation of modern genetics?
- What are the principal patterns of inheritance?

Week 4 Vocabulary:

-Meiosis	-Oogenesis	-Law of Independent Assortment
-Centromere	-Ovum	-Incomplete Dominance
-Sister Chromatid	-Polar Bodies	-Codominance
-Homologous Chromosomes	-Chromatin	-Gene Linkage
-Autosomal Chromosomes	-Histones	-Lethal allele
-Sex Chromosomes (X and Y chromosome)	-Nucleosomes	-Sickle Cell Anemia
-Diploid and Haploid	-Parental, F1 and F2 generations	-Carrier
-Synapsis	-Homozygous	-Tay Sachs Disease
-Tetrad	-Heterozygous	-Cystic Fibrosis
-Crossing Over	-Alleles	-Huntington's Disease
-Chiasma	-Dominant	-PKU (Phenylketonuria)
-Genetic Recombination	-Recessive	-Albinism
-Spermatogenesis	-Genotype	-Hemophilia
-Spermatogonia	-Phenotype	-Nondisjunction
	-Law of Segregation	

Week 4 Multiple Choice Questions:

1. Mitosis in flowering plants is similar to mitosis in animals in that in both
 - (A) A cell plate forms
 - (B) Synapsis of homologous chromosomes occurs
 - (C) Large centrioles attach to the spindle fibers
 - (D) Each daughter cell has half the number of chromosomes found in each parent cell
 - (E) Centromeres uncouple and chromosomes move apart

2. Regarding mitosis and cytokinesis, one difference between higher plants and animals is that in plants
 - (A) The spindles contain cellulose microfibrils in addition to microtubules, whereas animal spindles do not contain microfibrils
 - (B) Sister chromatids are identical, whereas in animals they differ from one another
 - (C) A cell plate begins to form at telophase, whereas in animals a cleavage furrow is initiated at that stage
 - (D) Chromosomes become attached to the spindle at prophase, whereas in animals chromosomes do not become attached until anaphase
 - (E) Spindle poles contain centrioles, whereas spindle poles in animals do not

3. Cytokinesis is the portion of the cell cycle during which
 - (A) the growth of cells is momentarily arrested in G₂ stage
 - (B) the amount of DNA per chromosome doubles
 - (C) centromeres uncouple and chromatids separate
 - (D) a cell plate is formed in plant cells
 - (E) the nuclear membrane breaks down

4. If the diploid number for an organism is 24 chromosomes, the haploid number is
 - (A) 6
 - (B) 12
 - (C) 18
 - (D) 24
 - (E) 48

5. Crossing-over occurs during which of the following phases in sexual reproduction?
 - (A) Prophase I
 - (B) Metaphase I
 - (C) Anaphase I
 - (D) Prophase II
 - (E) Metaphase II

6. If red hair, blue eyes, and freckles were consistently inherited together, the best explanation would be that
 (A) These traits are recessive characteristics
 (B) Both parents have red hair, blue eyes, and freckles
 (C) The genes for these traits are linked on the same chromosome
 (D) Gene duplications have occurred
 (E) These traits are dominant to others
7. The replacement of glutamic acid by valine at a specific position in the beta chains of hemoglobin leads to sickle cell anemia. This change represents which of the following mutual events?
 (A) DNA base pair substitution (D) DNA base pair deletion
 (B) DNA base pair addition (E) Chromosomal deletion
 (C) Frame-shift mutation

Week 4 Essay Questions:

1. Describe in detail the process of meiosis as it occurs in an organism with a diploid chromosome number of 4 ($2n = 4$). Include labeled diagrams in your discussion. Indicate when and how each of the following occurs in meiosis:
 a. Crossing over b. Nondisjunction
2. Discuss Mendel's laws of segregation and independent assortment. Explain how the events of meiosis I account for the observations that led Mendel to formulate these laws.
3. Assume that a particular genetic condition in a mammalian species causes an inability to digest starch. this disorder occurs with equal frequency in males and females. In most cases, neither parent of affected offspring has the condition.
 (a) Describe the most probable pattern of inheritance for this condition. Explain your reasoning. Include in your discussion a sample cross(es) sufficient to verify your proposed pattern.
 (b) Explain how mutation could cause this inability to digest starch.
 (c) Describe how modern techniques of molecular biology could be used to determine whether the mutant allele is present in a given individual.
4. In fruit flies, the phenotype for eye color is determined by a certain locus. *E* indicates the dominant allele and *e* indicates the recessive allele. The cross between a male wild-type fruit fly and a female white-eyed fruit fly produced the following offspring.

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F1	0	45	55	0	1

The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring.

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F2	23	31	22	24	0

- a) Determine the genotypes of the original parents (P generation) and explain your reasoning. You may use Punnett squares to enhance your description, but the results from the Punnett squares must be discussed in your answer.
 b) The brown-eyed female in the F1 generation resulted from a mutational change. Explain what a mutation is, and discuss two types of mutations that might have produced the brown-eyed female in the F1 generation.
 c) Use a Chi-squared test on the F2 generation data to analyze your prediction of the parental genotypes. Show all your work and explain the importance of your final answer.

Critical Values of the Chi-Squared Distribution

Probability (p)	Degrees of Freedom (df)				
	1	2	3	4	5
0.05	3.84	5.99	7.82	9.49	11.1

The formula for Chi-squared is:

$$X^2 = \sum \left[\frac{(o-e)^2}{e} \right]$$

where o = **observed** number of individuals

e = **expected** number of individuals

Σ = the **sum of the values** (in this case, the differences, squared, divided by the number expected)

WEEK 5: Molecular Genetics (9%)**Week 5 Concepts:**

- ❑ How do the structures of nucleic acids relate to their functions of information storage and protein synthesis?
- ❑ What are the similarities and differences between prokaryotic and eukaryotic genomes?
- ❑ What are some mechanisms by which gene expression is regulated in prokaryotes and eukaryotes?
- ❑ In what ways can genetic information be altered?
- ❑ What are some effects of these alterations?
- ❑ What is the structure of viruses?
- ❑ What are the major steps in viral reproduction?
- ❑ How do viruses transfer genetic material between cells?
- ❑ What are some current recombinant technologies?
- ❑ What are some practical applications of nucleic acid technology?
- ❑ What legal and ethical problems may arise from these applications?

Week 5 Vocabulary:

-DNA	-Promoter
-RNA	-Termination Signal
-Bacteriophage	-RNA Polymerase
-Virus	-Polypeptide
-Double Helix	-Transcription
-Complementary Base Pairs	-Translation
-Adenine, Cytosine, Thymine, Guanine	-Codon
-Template Strand	-Degenerate
-DNA Polymerase I and III	-Introns
-DNA Helicase	-Exons
-Topoisomerase (Gyrase)	-Nucleolus
-Single Stranded Binding Proteins	-Aminoacyl attachment site
-DNA Ligase	-Anticodon
-Mutagens	-P site and A site (on a ribosome)
-Genome	-Release Factor
-Chromatin	-Operon
-Histones	-Regulatory Proteins
-Nucleosomes	-Enhancers
-Plasmid	-Clone
-Recombinant DNA	-Retrovirus
-Restriction Enzymes	-Lytic Cycle
-mRNA, tRNA, rRNA	-Lysogenic cycle
-Ribosome	-Transduction

Week 5 Multiple Choice Questions:

1. According to the Jacob-Monod model of the lac operon, the regulator gene does which of the following?

(A) Specifies the amino acid sequence of the enzyme	(D) Controls the activity of histones
(B) Determines whether promoter genes will be translated	(E) Produces corepressor substances
(C) Directs the synthesis of a repressor protein	

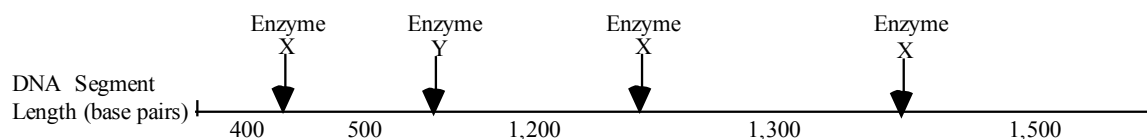
2. Once transcribed, eukaryotic mRNA typically undergoes substantial alteration that results primarily from

(A) excision of introns	(D) fusion into circular forms known as plasmids
(B) linkage into histone molecules	(E) union with ribosomes
(C) fusion with other newly transcribed mRNA to form larger translatable units	

3. Transfer RNA is a molecule that serves to bring together specific
- (A) Anticodons and rRNA molecules
 - (B) Amino acids and mRNA codons
 - (C) Proteins and anticodons
 - (D) Amino acids and rRNA molecules
 - (E) Proteins and mRNA codons
4. The nitrogenous base, adenine, is found in which of three of the following?
- (A) Proteins, chlorophyll, and vitamin A
 - (B) ATP, DNA, and RNA
 - (C) Proteins, carbohydrates, and ATP
 - (D) Proteins, ATP, and DNA
 - (E) Chlorophyll, ATP, and DNA
5. Which of the following are found in viruses?
- (A) Chloroplasts
 - (B) Ribosomes
 - (C) Mitochondria
 - (D) Nucleic acid
 - (E) Golgi bodies
6. The enzyme that is found in retroviruses and that is required for the synthesis of DNA from RNA is
- (A) DNA polymerase III
 - (B) Restriction endonuclease
 - (C) Dehydrogenase
 - (D) RNA polymerase
 - (E) Reverse transcriptase
7. In DNA replication, DNA polymerase catalyzes the reaction in which
- (A) the double helix unwinds
 - (B) the sugar-phosphate bonds of each strand are broken
 - (C) a phosphate group is added to the 3'-carbon or 5'-carbon of ribose
 - (D) a nucleotide with a base complementary to the base on the template strand is added to the new DNA
 - (E) the two nucleotide strands come together and intertwine to form a double helix
8. In order for a bacterium to produce a eukaryotic protein, which of the following must first be isolated from a eukaryotic cell prior to cloning?
- (A) The protein's primary RNA transcript from the nucleus
 - (B) The protein's mRNA from the cytoplasm
 - (C) The protein from the rough endoplasmic reticulum
 - (D) The introns from the segment of DNA that codes for the protein
 - (E) The segments of DNA that control transcription for this protein
9. Which of the following substances is found in RNA molecules but not in DNA molecules?
- (A) Adenine
 - (B) Phosphorus
 - (C) Thymine
 - (D) Deoxyribose
 - (E) Uracil
10. All of the following enzymes are involved in the replicative process of DNA EXCEPT
- (A) DNA helicase
 - (B) RNA polymerase
 - (C) DNA polymerase
 - (D) RNA primer
 - (E) DNA ligase
11. Eukaryotic gene expression can be regulated at all of the following stages EXCEPT
- (A) RNA processing
 - (B) transcription
 - (C) mRNA degradation
 - (D) operon induction
 - (E) chromatin modification
12. All of the following are examples of chromosomal aberrations or mutations EXCEPT
- (A) frame shift
 - (B) deletion
 - (C) sex linkage
 - (D) translocation
 - (E) inversion
13. The length of DNA molecules is measured in base pairs. The base composition of DNA varies from one species to another. Which of the following ratios would you expect to remain constant in the DNA?
- (A) cytosine/adenine
 - (B) adenine/thymine
 - (C) thymine/guanine
 - (D) pyrimidine/purine
 - (E) guanine/deoxyribose

Week 5 Essay Questions:

- Describe the production and processing of a protein that will be exported from a eukaryotic cell. Begin with the separation of the messenger RNA from the DNA template and end with the release of the protein at the plasma membrane.
- Describe the operon hypothesis and discuss how it explains the control of messenger RNA production and the regulation of protein synthesis in bacterial cells.
- Describe the biochemical composition, structure, and replication of DNA. Discuss how recombinant DNA techniques may be used to correct a point mutation.
- Describe the steps of protein synthesis, beginning with the attachments of a messenger RNA molecule to the small subunit of a ribosome and ending with the release of the polypeptide from the ribosome. Include in your answer a discussion of how the different types of RNA function in this process.
- The diagram below shows a segment of DNA with a total length of 4,900 base pairs. The arrows indicate reaction sites for restriction enzymes (enzyme X and enzyme Y).



- Explain how the principles of gel electrophoresis allow for the separation of DNA fragments.
 - Describe the results you would expect from the electrophoretic separation of fragments from the following treatments of the DNA segment above. Assume that the digestions occurred under appropriate conditions and went to completion.
 - DNA digested with only enzyme X
 - DNA digested with only enzyme Y
 - DNA digested with enzyme X and enzyme Y combined
 - Undigested DNA
 - Explain both of the following.
 - The mechanism of action of restriction enzymes.
 - The different results you would expect if a mutation occurred at the recognition site for enzyme Y.
- The human genome illustrates both continuity and change.
 - Describe the essential features of two of the procedures/techniques below. For each of the procedures/techniques you describe, explain how its application contributes to understanding genetics.
 - The use of a bacterial plasmid to clone and sequence a human gene.
 - Polymerase Chain Reaction (PCR)
 - Restriction fragment length polymorphism (RFLP) analysis
 - All humans are nearly identical genetically in coding sequences and have many proteins that are identical in structure and function. Nevertheless, each human has a unique DNA fingerprint. Explain this apparent contradiction.

WEEK 6: Evolutionary Biology (8%)**Week 6 Concepts:**

- What are the current biological models for the origins of biological macromolecules?
- What are the current models for the origins of prokaryotic and eukaryotic cells?
- What types of evidence support an evolutionary view of life?
- What is the role of natural selection in the process of evolution?
- How are heredity and natural selection involved in the process of evolution?
- What mechanisms account for speciation and macroevolution?
- What different patterns of evolution have been identified and what mechanisms are responsible for each of these patterns?

Week 6 Vocabulary:

-Reducing Atmosphere	-Analogous Structures/Organs	-Fitness
-Proteinoids	-Homologous Structures/Organs	-Stabilizing selection
-Chemical Selection	-Vestigial Structures	-Directional selection
-Heterotrophs	-Adaptive Radiation	-Disruptive Selection
-Autotrophs	-Endemic Species	-Genetic Drift
-Chemosynthesis	-Adaptation	-Founder Effect
-Artificial Selection	-Hardy Weinberg Principle	-Allopatric Speciation
-Fossil	-Natural Selection	-Sympatric Speciation

Week 6 Multiple Choice Questions:

1. The introduction of antibiotics such as penicillin several years ago was immediately effective in combating infections caused by *Staphylococcus* in 1958. However, there were several outbreaks of staphylococcal infections. People with the infections did not respond to treatment with any of the antibiotics and there was a large number of deaths. The best explanation for this situation is that
 - (A) The bacteria reproduced in hosts that were not contaminated with antibiotics
 - (B) The bacteria from other hosts such as birds, cats, and dogs migrated into human hosts
 - (C) The bacteria exposed to nonlethal doses of antibiotics quickly learned to avoid them
 - (D) Each generation of bacteria acquired the ability to use antibiotics as nutrients
 - (E) Antibiotic-resistant bacteria survived and multiplied and these were the forms causing the infections
2. The external similarity of dolphins to sharks is an example of

(A) Convergent evolution	(C) Divergent evolution	(E) Behavioral isolation
(B) Geographic isolation	(D) Adaptive radiation	

Questions 3-6: Use one of the following terms to match to the definition.

- | | | |
|------------------------|--------------------------|---------------------------|
| (A) Founder effect | (C) Kin selection | (E) Competitive exclusion |
| (B) Adaptive radiation | (D) Convergent evolution | |
3. The evolution of several species from a single species, each occupying a different niche.
 4. The survival, through apparently altruistic behavior, of related individuals with common alleles.
 5. The establishment of a genetically unique population through genetic drift
 6. The independent development of similarities between unrelated groups resulting from adaptation to similar environments
 7. The wing of a bat, the flipper of a whale, and the forelimb of a horse appear very different, yet detailed studies reveal the presence of the same basic bone pattern. These structures are examples of

(A) analogous structures	(C) homologous structures	(E) vestigial structures
(B) balanced polymorphism	(D) convergent evolution	
 8. S. L. Miller's classic experiment demonstrated that a discharge of sparks through a mixture of gases could result in the formation of a large variety of organic compounds. All of the following gases were used in this experiment EXCEPT

(A) hydrogen	(B) methane	(C) ammonia	(D) oxygen	(E) water vapor
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9. In a population that is in Hardy-Weinberg equilibrium, the frequency of a recessive allele for a certain hereditary trait is 0.20. What percentage of the individuals in the next generation would be expected to show the dominant trait?
 (A) 8% (B) 16% (C) 32% (D) 64% (E) 96%
10. The bones of a human arm are homologous to structures in all of the following EXCEPT a
 (A) whale flipper (B) bat wing (C) butterfly wing (D) bird wing (E) frog forelimb

Question 11 & 12

In a certain flock of sheep, 4 percent of the population has black wool and 96 percent has white wool. Assume that the population is in Hardy Weinberg Equilibrium

11. If black wool is a recessive trait, what percentage of the population is heterozygous for the trait?
 (A) 4% (B) 20% (C) 32% (D) 64% (E) 80%
12. What percentage of the population is homozygous for white wool?
 (A) 20% (B) 40% (C) 64% (D) 80% (E) 96%
13. All of the following conditions would result in a change in the frequency of a specific allele in a population EXCEPT
 (A) Selection against the recessive phenotype (D) Selection against the dominant phenotype
 (B) Genetic drift (E) Random mating in a large population
 (C) Mutation of the dominant allele to the recessive allele
14. In a population at equilibrium, thousands of eggs and hundreds of tadpoles are produced by a single pair of frogs. About how many offspring will live to maturity and reproduce?
 (A) 0 (B) 2 (C) 10-20 (D) 100 (E) more than 100
15. A new species of organism has evolved when
 (A) The climate of a population's area has changed greatly
 (B) A population can no longer interbreed under natural conditions with other closely related organisms
 (C) Variation has occurred within the species due to mutations
 (D) Population has been recently isolated from the rest of the species by a geographic barrier

Week 6 Essay Questions:

- Describe the special relationship between the two terms in each of the following pairs.
 - Convergent evolution of organisms and Australia
 - Birds of prey and DDT
 - Blood groups and genetic drift
- Describe the modern theory of evolution and discuss how it is supported by evidence from two of the following areas.
 - population genetics
 - molecular biology
 - comparative anatomy and embryology
- Genetic variation is the raw material for evolution.
 - Explain three cellular/molecular mechanisms that introduce variation into the gene pool of a plant or animal population.
 - Explain the evolutionary mechanisms that can change the composition of the gene pool.
- Do the following with reference to the Hardy-Weinberg model.
 - Indicate the conditions under which allelic frequencies (p and q) remain constant from one generation to the next.
 - Calculate, showing all work, the frequencies of the alleles and the frequencies of the genotypes in a population of 100,000 rabbits, of which 25,000 are white and 75,000 are agouti. (In rabbits the white color is due to a recessive allele, w , and the agouti is due to a dominant allele, W .)
 - If the homozygous dominant condition were to become lethal, what would happen to the allelic and genotypic frequencies in the rabbit population after two generations?
- Evolution is one of the major unifying themes of modern biology.
 - Explain the mechanisms that lead to evolutionary change.
 - Describe how scientists use each of the following as evidence for evolution.
 - Bacterial resistance to antibiotics
 - Comparative biochemistry
 - The fossil record.

WEEK 7: Diversity of Organisms (8%)

Week 7 Concepts:

- What are the major body plans of plants and animals?
- What are representative organisms from the Bacteria, Archaea, and Eukarya?
- What are representative members of the major animal phyla and plant divisions?
- What are the distinguishing characteristics of each group (domains, kingdoms, and the major phyla and divisions of animals and plants)?
- What is some evidence that organisms are related to each other?
- How do scientists study evolutionary relationships among organisms?
- How is this information used in classification of organisms?

Week 7 Vocabulary:

-Asexual reproduction	-Monophyletic	-Chemosynthesis
-Parthenogenesis	-Polyphyletic	-Heterotrophs
-Hermaphroditism	-Kingdoms -> Animalia, Fungi, Prokaryotae, Protista, Plantae	-Nitrifying Bacteria
-Altruism	-Domains -> Archaea, Eukarya, Bacteria	-Legumes
-Binomial Nomenclature	-Saprobies	-Parasitism
-Kingdom, Phylum, Class, Order, Family, Genus, Species	-Transduction	-Commensalism
-Taxon	-Transformation	-Mutualism
-Phylogeny	-Conjugation	-Algae
-Divergent evolution	-Obligate Anaerobes	-Phytoplankton
-Convergent evolution	-Facultative Anaerobes	-Mycorrhiza
-Vestigial structures	-Autotrophs	-Epiphytes
-Homologous structures		-Lichen

Week 7 Multiple Choice Questions:

Questions 1-4: From the fields of study listed below, choose the field that has provided each of the following pieces of evidence that biological evolution has occurred.

- | | | |
|------------------------------|-------------------------|-------------------------------|
| (A) Comparative biochemistry | (C) Paleontology | (E) Geographical distribution |
| (B) Comparative embryology | (D) Comparative anatomy | |

1. Archaeopteryx is an extinct feathered reptile.
2. Peripatus has claws like an insect and paired nephridia like a segmented worm.
3. Most human diabetics can use insulin derived from either pigs or from humans.
4. During early development, a human fetus has a tail and gill arches.
5. All members of which of the following groups have the greatest number of characteristics in common?

(A) Class	(B) Order	(C) Family	(D) Genus	(E) Phylum
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6. Some varieties of *Neisseria gonorrhoeae* are now resistant to penicillin. These varieties of bacteria most probably developed as a result of

(A) Natural selection	(C) Hybrid vigor	(E) coevolution
(B) Adaptive radiation	(D) convergent evolution	
7. The differences in cricket calls among sympatric species of crickets are examples of

(A) habitat isolation	(C) temporal isolation	(E) physiological isolation
(B) behavioral isolation	(D) geographic isolation	
8. Which of the following is probably the best explanation for the fact that Antarctic penguins cannot fly, although there is evidence that millions of years ago their ancestors could do so?

(A) Penguins live on land and feed in the water.
(B) The Antarctic home of penguins is flat and barren therefore there is no place to fly.
(C) Ancestral penguins without large wings were better able to swim and feed in the water, therefore they passed their genes for shorter wing structure on to their offspring.

- (D) Ancestral penguins did not use their wings therefore today's penguins have only tiny nonfunctional wings.
 (E) The cold and wind of Antarctica make flight impossible, therefore penguins that live there have the best ability to fly.

9. Members of the kingdom Fungi generally differ from members of the kingdom Plantae in that
 (A) have cell walls (C) are multicellular (E) are heterotrophic
 (B) are both aquatic and terrestrial (D) are eukaryotic
10. A species of malaria-carrying mosquito lives in a forest in which two species of monkeys, A and B, coexist. Species A is immune to malaria but species B is not. The malaria-carrying mosquito is the chief food for a particular kind of bird in the forest. If all of these birds are eliminated suddenly by hunters, which of the following would be the immediate observable consequence?
 (A) Increased mortality in monkey species A
 (B) Increased mortality in monkey species B
 (C) Increased mortality in the malaria-carrying mosquitoes
 (D) Emergence of malaria-resistant strains in monkey species B
 (E) Emergence of malaria-resistant strains in monkey species A
11. One of the most pronounced differences between animal and plant cells is that
 (A) animal cells alone have one or more large vacuoles
 (B) animal cells alone have a nucleolus
 (C) animal cells alone have their nuclear chromatin attached to the spindle fibers during mitosis
 (D) plant cells alone have rough endoplasmic reticulum
 (E) plant cells alone have relatively thick rigid cell walls
12. Which of the following statements about a typical aquatic angiosperm is correct?
 (A) It forms spines (D) It has fleshy leaves for water storage
 (B) It has extensive taproot systems (E) It has stomata in sunken cavities
 (C) It has stomata on the upper leaf surfaces
13. The ancestors of land plants most likely resembled modern day members of the
 (A) Cyanobacteria (blue-green algae) (D) Rhodophyta (red algae)
 (B) Chlorophyta (green algae) (E) Phaeophyta (brown algae)
 (C) Chrysophyta (diatoms and golden-brown algae)
14. Which of the following features of angiosperms has probably contributed most to their evolutionary success relative to all other land plant groups?
 (A) Phloem (C) Cutinized aerial surfaces (E) Flowers and fruits
 (B) True leaves and roots (D) Xylem

Week 7 Essay Questions:

1. Select two of the following three pairs and discuss the evolutionary relationships between the two members of each pair you have chosen. In your discussion include structural adaptations and their functional significance.

PAIR A:

green algae
 vascular plants

PAIR B:

prokaryotes
 eukaryotes

PAIR C:

amphibians
 reptiles

2. Describe the process of speciation. Include in your discussion the factors that may contribute to the maintenance of genetic isolation.
3. Angiosperms (flowering plants) and vertebrates obtain nutrients from their environment in different ways:
 a. Discuss the type of nutrition and the nutritional requirements of angiosperms and vertebrates.
 b. Describe 2 structural adaptations in angiosperms for obtaining nutrients from the environment. Relate structure to function.
 c. Interdependence in nature is evident in symbiosis. Explain two symbiotic relationships that aid in nutrient uptake, using examples from angiosperms and/or vertebrates. (Both examples may be angiosperms, both may be vertebrates, or one may be from each group.)
4. Define, discuss, and give an example of each of the following close interactions of species.
 a) Predator-prey relationships b) Commensalism c) Mutualism

WEEK 8: Plant Structures and Growth (8%)

Week 8 Concepts:

- How does the organization of cells, tissues, and organs determine structure and function in plant systems?
- How are structure and function related in the various organ systems?
- What adaptive features have contributed to the success of various plants on land?

Week 8 Vocabulary:

-seed coat	-cork cambium
-dicotyledons	-cork/outer bark
-apical meristem	-endosperm
-root cap	-coleoptile
-zone of elongation	-capillarity
-epidermis	-leaching
-root hairs	-Casparian Strip
-cortex	-plasmodesmata
-root hairs	-lignin
-fibrous root system	-tracheids
-cuticle	-pits
-turgor	-vessels/vessel elements
-stomata (stoma)	-sapwood
-guard cells	-root pressure
-palisade mesophyll	-transpiration pull-water cohesion mechanism
-vascular cambium	-sieve tube elements
-secondary vascular tissues	-sieve tubes
-secondary xylem	-companion cell
-wood	-mass flow/pressure flow model
-secondary phloem	

Week 8 Multiple Choice Questions:

1. One of the most pronounced differences between animal and plant cells is that
 - (A) animal cells alone have one or more large vacuoles
 - (B) animal cells alone have a nucleolus
 - (C) animal cells alone have their nuclear chromatin attached to the spindle fibers during mitosis
 - (D) plant cells alone have rough endoplasmic reticulum
 - (E) plant cells alone have relatively thick rigid cell walls

2. Which of the following is LEAST likely to be a factor in the movement of water through a terrestrial plant?
 - (A) The cohesion of water
 - (B) Capillary action
 - (C) Root pressure
 - (D) The influence of gibberellin on cell expansion
 - (E) The evaporation of water from the leaves

3. Root hairs are extensions of which of the following kinds of cells?
 - (A) Cortical
 - (B) Xylem
 - (C) Phloem
 - (D) Epidermal
 - (E) Meristematic

4. Girdling of a tree by completely removing a ring of bark most directly affects the process of
 - (A) Translocation
 - (B) Photosynthesis
 - (C) Transpiration
 - (D) Countercurrent exchange
 - (E) Cellular respiration

5. All of the following are found in the cells of higher plants EXCEPT
 - (A) Plasma Membrane
 - (B) Cell Wall
 - (C) Chloroplast
 - (D) Ribosome
 - (E) Centriole

6. A plant that has a stem with scattered vascular bundles, leaves with parallel venation, and seeds with a single cotyledon is probably a

(A) Pine (B) Moss (C) Corn Plant (D) Bean Plant (E) Liverwort

7. Which of the following statements about xylem and phloem is correct?
 (A) Both are produced as secondary growth by vascular cambium (D) Both have companion cells
 (B) Both conduct glucose in the plant (E) Both are found in bryophytes
 (C) Both actively move fluids up and down stems
8. Which of the following factors is most important in the movement of water up a tall tree?
 (A) Guttation (C) Capillarity in the phloem (E) Active transport in the xylem
 (B) Air Pressure (D) Transpiration
9. Plants with floral parts that occur in multiples of three, have scattered vascular bundles, leaves with parallel veins, and have one cotyledon are
 (A) Mosses (B) Liverworts (C) Trees (D) Monocots (E) Dicots
10. Bryophytes generally differ from tracheophytes in that bryophytes have
 (A) a protective layer around their gametes (D) conducting tissues
 (B) stomates in leaf surfaces (E) waxy cuticles on their outer surface
 (C) water-borne motile sperm

Week 8 Essay Questions:

- Relate the structure of an angiosperm leaf to each of the following:
 - Adaptations for photosynthesis and food storage.
 - Adaptations for food translocation and water transport.
 - Specialized adaptations to a desert environment.
- Describe the structure of a bean seed and discuss its germination to the seedling stage. Include in your essay hormonal controls, structural changes, and tissue differentiation.
- Trace the pathway in a flowering plant as the water moves from the soil through the tissues of the root, stem, and leaves to the atmosphere. Explain the mechanisms involved in conducting water through these tissues.
- Discuss the adaptations that enable flowering plants to overcome the following problems associated with life on land.
 - The absence of an aquatic environment for reproduction.
 - The absence of an aquatic environment to support the plant body.
 - Dehydration of the plant.
- Angiosperms (flowering plants) and vertebrates obtain nutrients from their environment in different ways.
 - Discuss the type of nutrition and the nutritional requirements of angiosperms and vertebrates.
 - Describe 2 structural adaptations in angiosperms for obtaining nutrients from the environment. Relate structure to function.
 - Interdependence in nature is evident in symbiosis. Explain two symbiotic relationships that aid in nutrient uptake, using examples from angiosperms and/or vertebrates. (Both examples may be angiosperms, both may be vertebrates, or one may be from each group.)

WEEK 9: Plant Reproduction and Behavior (8%)

Week 9 Concepts:

- ❑ What patterns of reproduction and development are found in plants and how are they regulated?
- ❑ What is the adaptive significance of alternation of generations in the major groups of plants?
- ❑ What are the responses of plants to environmental cues, and how do hormones mediate them?

Week 9 Vocabulary:

-Alternation of Generations	-Phototropism	-Pollen grains
-Spores	-Amyloplasts	-Self pollination
-Sporophyte	-Short Day Plant	-Pollen tube
-Gametophyte	-Long Day Plants	-Sperm nuclei
-Embryophytes	-Critical daylength	-Micropyle
-Auxin	-Senescence	-Sperm nuclei
-Gibberellins	-Sepals	-Double Fertilization
-Cytokinins	-Stamen	-Endosperm
-Abscisic Acid	-Anthers	-Seed coat
-Ethylene	-Stigma	-Fruit
-Apical Dominance	-Style	-Germinate
-Gravitropism	-Ovary	-Plant grafting
-Thigmotropism	-Ovules	

Week 9 Multiple Choice Questions:

1. Which of the following statements about a typical aquatic angiosperm is correct?

(A) It forms spines	(D) It has fleshy leaves for water storage
(B) It has extensive taproot systems	(E) It has stomata in sunken cavities
(C) It has stomata on the upper leaf surfaces	

Questions 2-5: Use the terms below to answer questions 2-5

(A) Angiosperms (B) Gymnosperms (C) Mosses (D) Ferns (E) Green algae

2. These represent the most primitive tracheophytes.
3. Fruit development assists in seed dispersal.
4. These produce naked seeds.
5. The sporophyte generation consists of a foot, a stalk, and a single sporangium that remains attached to the dominant gametophyte.
6. Phototropism in plants is mediated by what plant growth substance?

(A) Auxin	(B) Colchicine	(C) Chlorophyll	(D) Ethylene	(E) Lenticels
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7. During germination in most angiosperm seeds, food for the growing embryo is provided by the

(A) microgametophyte	(B) female gametophyte	(C) endosperm	(D) hypocotyl	(E) ovary
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8. A response of an organism to seasonal change is

(A) phototropism	(B) photoperiodism	(C) circadian rhythm	(D) photolysis	(E) the biological clock
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9. Flowering in plants such as tobacco and cocklebur and the germination of certain lettuce seeds are induced primarily by

(A) Photoperiodism	(C) Temperature	(E) Negative feedback
(B) Circadian rhythms	(D) Lunar phases	
10. In angiosperms, the endosperm functions in

- (A) pollen formation
- (B) seed coat formation
- (C) nourishment of the embryo
- (D) fruit formation
- (E) direction of the growth of the pollen tube

11. Which of the following features of angiosperms has probably contributed most to their evolutionary success relative to all other land plant groups?

- (A) Phloem
- (B) Flowers and fruits
- (C) Xylem
- (D) Cutinized aerial surfaces
- (E) True leaves and roots

12. The result of meiosis in angiosperms is the production of

- (A) gametes
- (B) A diploid gametophyte
- (C) a haploid sporophyte
- (D) Haploid megaspores and microspores
- (E) A diploid sporophyte

Week 9 Essay Questions:

1. In the life cycles of a fern and a flowering plant, compare and contrast each of the following:

- a. The gametophyte generation.
- b. Sperm transport and fertilization.
- c. Embryo protection.

2. Define the following plant responses and explain the mechanism of control for each. Cite experimental evidence.

- a. Phototropism
- b. Photoperiodism

3. Describe the effects of plant hormones on plant growth and development. Design an experiment to demonstrate the effect of one of these plant hormones on plant growth and development

WEEK 10: Structure and Function in Animals (8%)

Week 10 Concepts:

- What patterns of reproduction and development are found in animals and how are they regulated?
- How does the organization of cells, tissues, and organs determine structure and function in animal systems?
- How are structure and function related in the various organ systems?
- How do the organ systems of animals interact?
- What adaptive features have contributed to the success of various animals on land?
- What are the responses of animals to environmental cues and how do hormones mediate them?

Week 10 Vocabulary:

-Herbivore	-Hemoglobin	-Aldosterone
-Carnivore	-Carbonic anhydrase	-Renin
-Omnivore	-Coelom	-Ovaries
-Vitamin	-Gastrovascular cavity	-Ovulation
-Gizzard and Crop	-Open vs. Closed Circulatory Systems	-Uterus
-Stomach	-Capillaries	-Vas deferens
-Caecum	-Veins and Arteries	-Testes
-Saliva (salivary amylase)	-Systolic and Diastolic Pressures	-Testosterone
-HCl	-Vasodilation	-Luteinizing Hormone (LH)
-Pepsin	-Adrenal Glands	-Follicle Stimulating Hormone (FHS)
-Trypsin	-Epinephrine (aka adrenalin)	-Human Chorionic Gonadotropin (HCG)
-Bile	-Thrombin	-Corpus Luteum
-Duodenum / Small Intestine	-Urea	-Oxytocin
-Colon / Large Intestine	-Uric Acid	-Blastulation
-Symbiotic Bacteria	-Hypotonic, Hypertonic, Isotonic	-Gastrulation
-Villi	-Flame Cells	-Cleavage
-Ruminants	-Nephridium	-Blastocoel
-Homeotherms	-Malpighian Tubules	-Ectoderm
-Poikilotherms	-Nephrons	-Endoderm
-Gills	-Ureter	-Mesoderm
-Countercurrent Exchange	-Vasopressin (aka antidiuretic hormone or ADH)	-Neurulation
-Alveoli		
-Diaphragm		
-Tracheae		
-Spiracles		

Week 10 Multiple Choice Questions:

1. During development, individual cells of the same organism begin to produce different proteins because

(A) The cells have different numbers of chromosomes	(D) Not all cells can synthesize proteins
(B) The cells have different kinds and amounts of DNA	(E) Specific genes are activated in the cells
(C) Genes are permanently lost as somatic cells differentiate	
2. Hormones stimulate the uterine lining to thicken in preparation for

(A) Ovulation	(B) Fertilization	(C) Lactation	(D) Menstruation	(E) Implantation
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3. Which of the following is LEAST involved in respiratory gas exchange in the frog?

(A) Lining of the mouth	(B) Lungs	(C) Skin	(D) Large intestine	(E) Blood
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4. Fats are emulsified by which of the following substances synthesized by the liver?

(A) Cholesterol	(B) Hydrochloric Acid	(C) Lipase	(D) Bile salts	(E) Glycerol
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5. All of the following processes occur in the nephron EXCEPT
 (A) tubular secretion (D) glomerular filtration
 (B) erythrocyte formation (E) cellular respiration
 (C) selective reabsorption
6. All of the following statements about the placenta are correct EXCEPT:
 (A) It permits an interchange of CO₂ and O₂ between material and fetal blood.
 (B) It forms from tissues of both the embryo and the uterus
 (C) It permits the mixing of maternal and fetal blood
 (D) It functions as an endocrine gland.
 (E) It provides the embryo with a way to dispose of its nitrogenous waste products.
7. Which of the following is most directly influenced by antidiuretic hormone (ADH)?
 (A) The rate of glomerular filtration
 (B) Countercurrent exchange in the loop of Henle
 (C) Reabsorption of water from the collecting duct
 (D) Reabsorption of sodium ions from the distal convoluted tubule
 (E) Secretion of potassium and hydrogen ions into the proximal convoluted tubule.
8. Which of the following describes the correct sequence of stages during embryogenesis?
 (A) Cleavage, blastula formation, gastrulation (D) Cleavage, gastrulation, blastula formation
 (B) Blastula formation, gastrulation, cleavage (E) Blastula formation, cleavage, gastrulation
 (C) Gastrulation, cleavage, blastula formation
9. Which of the following is most effective in lowering the body temperature of a mammal?
 (A) Erection of the fur (D) Involuntary contraction of skeletal muscles
 (B) Increased epinephrine (adrenaline secretion) (E) Increased flow of blood to the skin
 (C) Increased metabolic activity
10. In humans primary oocytes are located in the
 (A) cervix (B) uterus (C) corpus luteum (D) oviduct (E) ovary
11. Which of the following is LEAST likely to be associated with diabetes mellitus?
 (A) insulin receptors are insensitive to insulin
 (B) Urinalysis indicates a high concentration of sugar in the urine
 (C) Pancreatic islet cells are destroyed
 (D) Liver cells absorb sugar from the blood at a rate that is greater than normal
 (E) Muscle cells readily oxidize fats and proteins
12. The function of the acrosome of the sperm is to
 (A) Orient the pattern of the microtubules for motility (D) Carry genetic information
 (B) Carry the enzymes that facilitate fertilization (E) Provide energy for movement
 (C) Regulate protein synthesis in the sperm

Questions 13-16: Use the choices below to answer the following questions

- (A) LH (Luteinizing Hormone) (D) FSH (Follicle Stimulating Hormone)
 (B) Testosterone (E) Adrenalin
 (C) Progesterone

13. A steroid hormone, produced by the placenta, which functions in maintaining the uterine lining during pregnancy.
14. A hormone that brings about the formation of the corpus luteum
15. A pituitary hormone that causes ovulation to occur
16. Primary hormone produced in male gonadal tissue.

17. If an invertebrate possesses malpighian tubules, a tracheal breathing system, and an open circulatory system it is most likely to be:
(A) a snail (B) a sponge (C) a butterfly (D) an earthworm (E) a flatworm
18. The moist skin of earthworms, the lenticels of plants, and the spiracles of grasshoppers are all associated with the process of:
(A) excretion (B) respiration (C) circulation (D) digestion (E) reproduction
19. Which structure in an annelid has a function similar to that of the alveoli of a human?
(A) Malpighian tubules (B) Nephridia (C) Flame Cells (D) Gills (E) Skin
20. Human identical twins develop when
(A) Two identical eggs are fertilized
(B) A single egg is fertilized by two sperm
(C) Two different eggs are fertilized by two different sperm
(D) The embryo splits and each portion continues to develop
(E) A diploid egg is fertilized by a diploid ovum

Week 10 Essay Questions:

- The action of organs and organ systems must be coordinated. Discuss the interaction of factors involved in controlling heart rate and breathing rate in mammals during periods of relaxation and periods of stress.
- Discuss the intake, transport, exchange, and release of gases in mammals.
- Describe the structure and function of the stomach, pancreas, and small intestine as digestive and endocrine organs in the human. (For each organ, include the relevant cell types and their functions.)
- Describe the structure and function of the mammalian kidney. Include a discussion of the regulation of water balance by kidney and hormonal interaction.
- Describe the processes of fat and protein digestion and product absorption as they occur in the human stomach and small intestine. Include a discussion of the enzymatic reactions involved.
- Describe negative and positive feedback loops, and discuss how feedback mechanisms regulate each of the following:
 - The menstrual cycle in a nonpregnant human female.
 - Blood glucose levels in humans.
- Many physiological changes occur during exercise.
 - Design a controlled experiment to test the hypothesis that an exercise session causes short-term increases in heart rate and breathing rate in humans.
 - Explain how at least three organ systems are affected by this increased physical activity and discuss interactions among these systems.
- Feedback mechanisms are used by organisms to maintain the steady-state physiological condition known as homeostasis. Choose three of the following and for each, explain how feedback mechanisms maintain homeostasis.
 - Blood glucose concentration
 - Body temperature in mammals
 - Pulse rate in mammals
 - Calcium ion concentration in blood
 - Osmolarity of the blood

WEEK 11: Structure and Function in Animals (8%)

Week 11 Concepts:

*Same as Week 10

Week 11 Vocabulary:

- | | |
|--|---|
| -Radial vs. Bilateral Symmetry | -Synapse |
| -Endoderm, ectoderm, mesoderm | -Resting and Action Potential |
| -Coelom | -Myelin |
| -Porifera | -Nodes of Ranvier |
| -Cnidaria | -Acetylcholine |
| -Platyhelminthes (flatworms, flame cells) | -Dopamine |
| -Nematoda | -Serotonin |
| -Annelida (nephridia) | -Reflex Arc |
| -Mollusca | -Smooth, Cardiac, and Skeletal Muscle |
| -Arthropods (chitin, malphigian tubules, tracheae) | -Sarcomere |
| -Echinodermata | -Sarcolemma |
| -Chordata (notochord, pharyngeal gill slits) | -Myofibrils |
| -Amniotic eggs (amnion, yolk sac, chorion) | -Sliding Filament Theory |
| -Deuterostomes | -Actin, Myosin, Troponin, and Tropomyosin |
| -Protostomes | -Endocrine gland |
| -Mast cells | -Thyroxin |
| -Complement | -Calcitonin |
| -Interferons | -Parathyroid Hormone |
| -B cells and T cells | -Fight or Flight Response |
| -Antibody | -Circadian Rhythm |
| -Antigen | -Imprinting |
| -Macrophage | -Innate Behavior |
| -Humoral vs. Cell Mediated Immunity | -Habituation |
| -Neuron | -Classical Conditioning |

Week 11 Multiple Choice Questions:

- Which of the following sequences describes the passage of a nerve impulse through a simple reflex arc in humans?
 - Receptor, sensory neuron, motor neuron, association neuron, effector
 - Receptor, motor neuron, association neuron, sensory neuron, effector
 - Receptor, sensory neuron, association neuron, motor neuron, effector
 - Effector, motor neuron, association neuron, sensory neuron, receptor
 - Receptor, association neuron, sensory neuron, motor neuron, effector
- Vertebrates became truly terrestrial with the development of the amniotic egg in

(A) Fish	(B) Amphibians	(C) Reptiles	(D) Birds	(E) Mammals
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- All of the following are deuterostomes EXCEPT

(A) Mollusks	(B) Reptiles	(C) Amphibians	(D) Echinoderms	(E) Mammals
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- The “all-or-none” law, as it applies to impulse transmission, states which of the following?
 - If a stimulus is applied, either all neurons fire or none do
 - A stimulus causes either all the sodium to leak into the neuronal membrane or none of it
 - Either all neurons develop an action potential upon stimulation or none do
 - If a stimulus is at or above the threshold an action potential will be generated, if not, then the neuron will not fire
 - Either all neurons will be repolarized or none will be

5. Many birds, insects, and terrestrial reptiles excrete nitrogenous wastes in the form of uric acid that
- (A) Is synthesized in the kidneys from ammonia and CO_2
 - (B) Forms crystals that are relatively insoluble and nontoxic
 - (C) Readily decomposes on exposure to air
 - (D) Is readily excreted through feathers and scales
 - (E) Can be recycled and utilized as an additional energy source
6. All of the following are examples of countercurrent exchange mechanism EXCEPT
- (A) Heat exchange in the limbs of seals and whales
 - (B) Gas exchange in the gills of fish
 - (C) Chloride transport in the loop of Henle of humans
 - (D) Heat exchange in the legs of wading birds
 - (E) Gas exchange in the alveoli of humans
7. If young male zebra finches are raised by foster parents of another species, the Bengalese finch, they will court female Bengalese finches instead of females of their own species. This behavior results from which of the following?
- (A) Imprinting
 - (B) Habituation
 - (C) Conditioning
 - (D) Reinforcement
 - (E) Pheromones
8. Which of the following offers the best description of neural transmission across a mammalian synaptic gap?
- (A) Neural impulses involve the flow of K^+ and Na^+ across the gap
 - (B) Neural impulses travel across the gap as electrical currents
 - (C) Neural impulses cause the release of chemicals that diffuse across the gap
 - (D) Neural impulses travel across the gap in both directions
 - (E) The calcium within the axons and dendrites of nerves adjacent to a synapse acts as the neurotransmitter
9. Which of the following is most often associated with the elaborate courtship rituals conducted by many birds?
- (A) Species recognition
 - (B) Feeding responses
 - (C) Kin selection
 - (D) Migration
 - (E) Altruism
10. Which of the following would result if the sodium-potassium pump of a neuron were inoperative?
- (A) The movement of chloride ions would produce action potential
 - (B) An impulse would travel from the axon to the dendrites of the neuron
 - (C) The rate of transmission of the impulse would greatly increase
 - (D) The rate of ATP synthesis would increase
 - (E) An action potential would not occur.
11. A nerve cell sends messages to other cells by means of membrane-enclosed sacs containing transmitter molecules that fuse with the nerve cell
- (A) Exocytosis
 - (B) Facilitated Diffusion
 - (C) Endocytosis
 - (D) Phagocytosis
 - (E) Active Transport
12. A severe dose of x-ray radiation results in conditions such as anemia, atypical sperm production, and a depressed immune system because the cells affected
- (A) are fully differentiated
 - (B) are the most actively dividing cells in the body
 - (C) contain more protein than any other cells in the body
 - (D) are the largest cells in the body
 - (E) contain pigments that reflect radiation

Week 11 Essay Questions:

1. Biological recognition is important in many processes at the molecular, cellular, and organismal levels. Select three of the following, and for each of the three that you have chosen, explain how the process of recognition occurs and give an example.
- a. Organisms recognize others as members of their own species.
 - b. Neurotransmitters are recognized in the synapse.
 - c. Antigens trigger antibody responses.

- d. Nucleic acids are complementary.
e. Target cells respond to specific hormones.
2. Beginning at the presynaptic membrane of the neuromuscular junction, describe the physical and biochemical events involved in the contraction of a skeletal muscle fiber. Include the structure of the fiber in your discussion.
3. Describe the following mechanisms of response to foreign materials in the human body.
a. The antigen-antibody response to a skin graft from another person.
b. The reactions of the body leading to inflammation of a wound infected by bacteria.
4. Describe the structure and function of the reflex arc in higher vertebrates. Include a description of the cell types and a discussion of the mechanism of transmission of the impulse.
5. The complexity of structure and function varies widely across the animal kingdom. Despite this variation animals exhibit common processes. These include the following:
-transport of materials -response to stimuli
-gas exchange -locomotion
- a) Choose two of the processes above and for each, describe the relevant structures and how they function to accomplish the process in the following phyla.
Cnidaria (e.g. hydra, jellyfish) Annelida (e.g. earthworm) Chordata (e.g. mouse)
- b) Explain the adaptive (evolutionary) value(s) of the structural examples you described in part a.
6. In biological systems, structure and function are related. Choose three of the following components of organ systems:
alveolus villus sarcomere
nephron neuron capillary
- a) For each component, describe the structure of the component and explain how that structure is responsible for the function of that component.
b) For the three components that you chose in part a, explain how the structure of the component contributes to the functioning of the organ system to which it belongs.
7. To survive, organisms must be capable of avoiding, and/or defending against, various types of environmental threats. Respond to each of the following.
a) Describe how adaptive coloration, mimicry, or behavior function as animal defenses against predation. Include two examples in your answers.
b) Describe how bacteria or plants protect themselves against environmental threats. Include two examples in your answer.
c) Compare the human primary immune response with secondary immune response to the same antigen.
8. Communication occurs among the cells in a multicellular organism. Choose THREE of the following examples of cell-to-cell communication, and for each example, describe the communication that occurs and the types of responses that result from this communication.
- Communication between two plant cells
 - Communication between two immune system cells
 - Communication either between a neuron and another neuron, or a neuron and a muscle cell
 - Communication between a specific endocrine-gland cell and its target cell

WEEK 12: Ecology (10%)

Week 12 Concepts:

- What models are useful in describing the growth of a population?
- How is population size regulated by abiotic and biotic factors?
- How is energy flow through an ecosystem related to trophic structure (trophic levels)?
- How elements (e.g. carbon, nitrogen, phosphorus, sulfur, oxygen) cycle through ecosystems?
- How do organisms affect the cycling of elements and water through the biosphere?
- How do biotic and abiotic factors affect community structure and ecosystem function?
- In which ways are humans affecting biogeochemical cycles?

Week 12 Vocabulary:

- | | |
|--|---|
| <ul style="list-style-type: none"> -Biomes -Tropical Rainforest -Savanna -Desert -Temperate Forest -Chaparral -Temperate Grassland (Prairie) -Taiga -Tundra -Oligotrophic Lake -Eutrophic Lake -Littoral Zone -Plankton -Climax Community -Primary Succession -Secondary Succession -Autotrophs -Decomposer -Consumer -Herbivore | <ul style="list-style-type: none"> -Carnivore -Heterotroph -Trophic Level -Omnivore -Primary Productivity -Biomass -Carbon Cycle -Nitrogen Cycle -Phosphorus Cycle -Exponential Growth -r-strategy (reproduction) -K-strategy (reproduction) -Carrying capacity -density dependent factors -density independent factors -Competitive exclusion theory -niche -predator -prey |
|--|---|

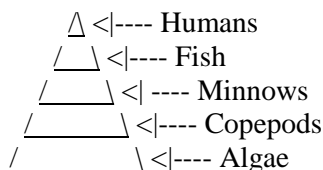
Week 12 Multiple Choice Questions:

1. A scientist measured the water content of leaves from two different groups of oak trees on three different summer days. One group of leaves, the *T* group, came from trees that had been defoliated by gypsy moths the previous year. The other leaves, the *C* group, came from trees that had not been defoliated. The results, in milliliters of water per gram of dry weight, are shown in the table below.

	June 10	June 30	July 28
T Group	26.8	20.4	12.7
C Group	32.5	28.4	22.7

All of the following are valid interpretations of these data EXCEPT:

- (A) *C* leaves typically contain more water than do *T* leaves
- (B) Both *C* and *T* leaves show declines in water content as the summer goes on.
- (C) *T* leaves show greater declines in water content than do *C* leaves.
- (D) Defoliation by gypsy moths has no effect on the water content of next year's leaves.
- (E) Differences in the water content between *C* and *T* leaves grow greater as the summer goes on.



2. In the food pyramid above, which of the following organisms are herbivores?
 (A) Humans (B) Fish (C) Minnows (D) Copepods (E) Algae
3. Species that utilize the same source of nutrition within a food web can best be described as
 (A) providing double links in a food chain (D) being homeothermic relative to energy flow
 (B) being autotrophs, heterotrophs, or omnivores (E) occupying the same trophic level
 (C) being secondary consumers within a complex food web
4. In traveling from a forest ecosystem to a grassland, one notes that the trees gradually give way to prairies grasses. The critical factor governing this shift is usually the
 (A) Length of the growing season (D) Annual mean temperature
 (B) Availability of carbon dioxide (E) Availability of water
 (C) Availability of oxygen

Grass → Cricket → Prairie chicken → Coyote → Vulture

5. In which organism in the food chain above would the biological magnification of DDT concentration be most obvious?
 (A) Grass (B) Cricket (C) Prairie chicken (D) Coyote (E) Vulture
6. In a population at equilibrium, thousands of eggs and hundreds of tadpoles are produced by a single pair of frogs. About how many offspring will live to maturity and reproduce?
 (A) 0 (B) 2 (C) 10-20 (D) 100 (E) More than 100
7. Eutrophication in lakes is usually the direct result of
 (A) Nutrient enrichment (D) Industrial poisons
 (B) A diminished supply of nitrates (E) An increase in predators
 (C) Decreased light penetration
8. A study of the metabolic rate in a terrestrial community shows that the energy released by respiration exceeds the energy captured in photosynthesis. Which of the following situations is occurring?
 (A) Community biomass is decreasing (D) Community biomass is increasing
 (B) A climax community has been reached (E) The first law of thermodynamics is not in effect
 (C) The second laws of thermodynamics is not in effect
9. Which of the following led most directly to a decrease in the amount of ultraviolet radiation reaching the Earth's surface?
 (A) Fermentation (D) Heterotrophs
 (B) Anaerobic respiration (E) Photosynthesis
 (C) A reducing atmosphere

Questions 10-12

- (A) Grassland (B) Taiga (C) Deciduous forest (D) Tundra (E) Tropical rain forest
10. This biome exhibits the greatest diversity in plant species
11. In this biome, agriculture is commonly practiced in a "cut-burn-cultivate-abandon" mode.
12. This biome can be recognized by its coniferous forests and relatively infertile, acidic soil.
13. A microscopic, unicellular organism that has a cell wall impregnated with silicon and is important as plankton in a food chain belongs to which of the following groups?
 (A) Diatoms (B) Mosses (C) Cyanobacteria (blue-green algae) (D) Ferns (E) Brown algae
14. All of the following are density-dependent factors that limit annual population EXCEPT
 (A) weather (B) predation (C) birthrate (D) food competition (E) mortality
15. Which of the following is true about secondary consumers in an ecosystem?
 (A) They are fewer in number than are primary consumers

- (B) They are eaten by primary consumers
- (C) They are smaller and weaker than are primary consumers
- (D) They eat only plants
- (E) They contain the greatest total biomass in the system

16. During the carbon cycle, which of the following carbon compounds would be utilized as an energy source by heterotrophs?

- (A) Calcium carbonate
- (B) Carbon dioxide
- (C) Carbonic acid
- (D) Carbon monoxide
- (E) Organic molecules

17. In the nitrogen cycle, the transformation of gaseous nitrogen into nitrogen containing compounds is performed primarily by

- (A) fungi
- (B) bacteria
- (C) green plants
- (D) herbivores
- (E) carnivores

18. Which of the following best explains why there are seldom more than five trophic levels in a food chain?

- (A) Most carnivores function at more than one trophic level.
- (B) Trophic levels above this number contain too many individuals.
- (C) Top carnivores are too few in number to prey effectively.
- (D) The ecosystem contains too much biomass.
- (E) Energy is lost from each trophic level.

19. The process by which some bacteria use nitrates for their own respiration and release nitrogen into the atmosphere is

- (A) ammonification
- (B) excretion
- (C) assimilation
- (D) denitrification
- (E) nitrogen fixation

Week 12 Essay Questions:

1. Describe the trophic levels in a typical ecosystem. Discuss the flow of energy through the ecosystem, the relationship between the different trophic levels, and the factors that limit the number of trophic levels.
2. Describe the process of ecological succession from a pioneer community to a climax community. Include in your answer a discussion of species diversity and interactions, accumulation of biomass, and energy flow.
3. Describe the biogeochemical cycles of carbon and nitrogen. Trace these elements from the point of their release from a decaying animal to their incorporation into a living animal.
4. Using an example for each, discuss the following ecological concepts.
 - a) Succession
 - b) Energy flow between trophic levels
 - c) Limiting factors
 - d) Carrying capacity
5. Living organisms play an important role in the recycling of many elements within an ecosystem. Discuss how various types of organisms and their biochemical reactions contribute to the recycling of either carbon or nitrogen in an ecosystem. Include in your answer one way in which human activity has an impact on the nutrient cycle you have chosen.
6. Interdependence in nature is illustrated by the transfer of energy through trophic levels. The diagram below depicts the transfer of energy in a food web of an Arctic lake located in Alaska
 - a) Choosing organisms from four different trophic levels of this food web as examples, explain how energy is obtained at each trophic level.
 - b) Describe the efficiency of energy transfer between trophic levels and discuss how the amount of energy available at each trophic level affects the structure of the ecosystem.
 - c) If the cells in the dead terrestrial plant material that washed into the lake contained a commercially produced toxin, what would be the likely effects of this toxin on this food web? Explain.

Final Checklist of Things to Know

- ❑ What are the properties of water that make life on earth possible?
 - Discuss examples of hydrogen bonding in living organisms, how water has a high specific heat, high boiling point, etc. See **pages 47-53** in your text.
- ❑ How does the structure of carbon lead to diversity of life?
 - Carbon's versatility comes from its atomic structure that allows it to form covalent bonds with four other atoms. Carbons can form rings, chains, etc. See **pages 58-62** of your text.
- ❑ What allows cells to synthesize and breakdown molecules?
 - Protein synthesis on ribosomes. Digestion in lysosomes. Know condensation and hydrolysis reactions. See **pages 69 and 107-108** of your text.
- ❑ How do structures of lipids, proteins, carbohydrates, and nucleic acids relate to their functions?
 - Lipids are nonpolar, proteins have R groups, carbohydrates may have chains, nucleic acids use complementary bases. See **pages 74-80 and 87** of your text.
- ❑ How do reaction thermodynamics occur in a cell?
 - Enzymes lower activation energies. Differences between exergonic and endergonic reactions. See **pages 147, and 151-155** of your text.
- ❑ What affects enzyme function?
 - Inhibitors, substrate concentration, pH, temperature, phosphorylation, cleavage, etc. See **pages 154-157** of your text.
- ❑ What are the similarities and differences between prokaryotic and eukaryotic cells and how are they evolutionarily related?
 - See **pages 8f, 98-99 and 312f** of your text.
- ❑ What is the current model of membrane structure?
 - Fluid mosaic model. Lipid bilayer. See **page 124** of your text.
- ❑ How does the structure of the membrane provide for transport, recognition, and energy transformations?
 - Channel proteins, pumps, diffusion, MHC/HLA markers, electron transport chains, proton gradients. See **pages 127-137** of your text.
- ❑ What factors limit cell size?
 - High surface area:volume ratio. See **page 99** of your text.
- ❑ What are the roles of: ribosomes, endoplasmic reticulum (smooth and rough), Golgi complex, lysosomes, mitochondria, chloroplasts, chromoplasts, amyloplasts, vacuoles, and the cytoskeleton (microtubules and microfilaments)?
 - See **pages 103-118** of your text.
- ❑ How does the cell cycle assure genetic continuity?
 - DNA is replicated semiconservatively. Enzymes check for mistakes. Sister chromatids are pulled apart during anaphase. See **pages 219-220** of your text.
- ❑ What are the mechanisms of cytokinesis?
 - Cytokinesis in animal cells and Cell Plate in plant cells. See **pages 223 and 225** of your text.
- ❑ How can abnormalities in the cell cycle lead to tumor formation?
 - Mutations in DNA may lead to changes in protein sequence and structure. See **pages 232-233** of your text.
- ❑ What is the role of ATP?
 - Chemical energy to drive reactions. It is a nucleotide. See **page 66** of your text.
- ❑ What is chemiosmosis?
 - The production of a proton gradient to produce ATP. See **pages 171-173 and 740** of your text.
- ❑ What is the role of oxygen in cellular respiration and what happens if no oxygen is present?
 - Oxygen is a final electron acceptor. Fermentation occurs when no oxygen is present. Two types of fermentation are lactic acid fermentation and alcoholic fermentation. See **pages 174-176** of your text.

- ❑ How does photosynthesis convert light energy into chemical energy? How does this chemical energy lead to the synthesis of carbohydrates?
 - Know how light energy is used to produce ATP and NADPH in the light reactions. The ATP and NADPH are then used to drive the Calvin Cycle (where carbon dioxide is synthesized into PGAL and sugars). See **pages 181-194** of your text.
- ❑ What are examples of photosynthetic adaptations to various environmental conditions?
 - C₄ and CAM. See **pages 196-197** of your text.
- ❑ How does meiosis lead to genetic diversity?
 - Crossing Over (recombination). Also how the homologous chromosomes line up results in differences. Finally, the random joining of a sperm and egg will result in diversity. See **pages 247-249** in your text.
- ❑ What are Mendel's Laws of Heredity? How are they different than what may really happen?
 - Law of Segregation (two alleles separate from each other when gametes are made) and Law of Independent Assortment (two different genes will separate independently of each other). Sex linkage can break the Law of Segregation since some genes only have one allele (eg. one X chromosome for male). Linked genes on the same chromosome will tend to inherit together breaking the Law of Independent Assortment. See summary on **page 271** of your text.
- ❑ What are the basic types of inheritance patterns?
 - Dominant/recessive, incomplete dominance, codominance, sex linkage, linkage, polygenic inheritance. See **pages 260-264 and 277-812** of your text.
- ❑ How do the structures of nucleic acids relate to their ability to store genetic information?
 - Complementary bases allow for pairings. DNA is transcribed into mRNA. mRNA codons are matched to amino acids through tRNA molecules. See **page 331** of your text.
- ❑ How do prokaryotic and eukaryotic gene regulations differ?
 - Prokaryotes - operons. Eukaryotes - transcription factors, introns/exons, enhancers. See **pages 353-354 and 364-365** of your text.
- ❑ How do mutations occur and what are their effects?
 - Substitutions, insertions, deletions, frame-shifts, polyploidy. See **pages 320-328** of your text. Some common diseases are Sickle Cell Anemia (base pair substitution, affects red blood cells, recessive), Tay-Sachs (lacks enzyme to break down lipid, recessive), Cystic Fibrosis (defect in channel protein, recessive), Huntington's (dominant, brain degeneration), PKU (defect in metabolic pathway, recessive), Hemophilia (can't clot blood, recessive, sex linked on X chromosome).
- ❑ What is the structure of a virus?
 - Nucleic acid surrounded by protein coat (sometimes lipid envelope). See **pages 334-336** of your text.
- ❑ What is the difference between the lysogenic and lytic cycles of viruses?
 - Lysogenic - virus stays dormant in host DNA. Lytic - virus is actively dividing and will lyse the cells. See **page 339** of your text.
- ❑ What are some current recombinant technologies for DNA and how could they be used practically?
 - Using restriction enzymes to cut DNA and PCR to amplify DNA. Plasmids can be made to hold certain genes and then inserted into bacteria. These bacteria can be made to produce that specific protein (eg. insulin). See **pages 384-387** of your text.
- ❑ What are the current models for the origin of biological macromolecules?
 - No oxygen in early Earth. Ammonia, hydrogen gas, methane, and water vapor may have reacted together to begin to form amino acids. These amino acids may have begun to polymerize from heat. These may have then started to congregate in cells. See **pages 512-514** of your text.
- ❑ What are the evidences for evolution?
 - Artificial Selection, Fossil Record, Comparative Anatomy, Comparative Biochemistry, Developmental Biology, Biogeography. See **pages 446-451** of your text.
- ❑ How does natural selection work?
 - Varied individuals -> limited resources -> individuals with favorable traits survive and pass these on. See **pages 438 and 460-466** of your text.
- ❑ What are mechanisms by which evolution can occur?

- Mutations, natural selection (including stabilizing, directional, and disruptive selections), genetic drift, founder effect, bottleneck effect, heterozygote advantage. See **pages 460-470** of your text.
- What are the major body plans of plants?
 - Vascular tissue of land plants (xylem/phloem); roots (tap, fibrous, adventitious), stems, leaves (stomata, palisade mesophyll, spongy mesophyll, bundle sheath cells), Vascular cambium (secondary growth into secondary phloem and secondary xylem), Cork cambium. See **pages 712-728** of your text.
- What are the major body plans of animals?
 - Symmetry (radial, bilateral, asymmetry), Endoderm/mesoderm/ectoderm, Coelom. See **pages 630-631** of your text.
- What are representative organisms from the Monera, Fungi, and Protista Kingdoms?
 - Bacteria (cyanobacteria can photosynthesize, chemosynthetic bacteria, nitrogen-fixing bacteria in legumes); Fungi (body plans with spores, hypha, and mycelium); Protista (phytoplankton can photosynthesize, algae). Also remember mycorrhizae (fungi associated with plant roots) and Lichens (association of fungi and cyanobacteria or green algae). See **pages 534-572 and 608-625** of your text.
- What are representative organisms from the plant divisions?
 - Nonvascular (mosses, liverworts, hornworts) and Vascular (Club Mosses, Horsetails, Ferns, Cycads, Ginkgos, Conifers, Angiosperms). See **pages 575-579** of your text.
- What are representative organisms from the animal phyla?
 - Cnidaria (jellyfish, corals, sea anemones), Platyhelminthes (flatworms), Nematoda (roundworms), Annelida (segmented worms - earthworms), Mollusca (snails, squid, clams), Arthropods (insects, crabs, shrimp), Echinodermata (starfish, sea urchins), Chordata (split into Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia). See **pages 626-707** of text.
- What patterns of reproduction are found in plants?
 - Alternation of generations (sporophyte and gametophyte). Asexual reproduction (grafting, vegetative reproduction, tubers). Flowering. Seeds. See **pages 580-583 and 591-604** of text.
- What patterns of reproduction are found in animals?
 - External fertilization, internal fertilization followed by external development, internal fertilization and development. Some asexual reproduction (parthenogenesis, budding). See **pages 239 and 964-978** of your text.
- Describe various structure-function relationships in the digestive, reproductive, excretory, respiratory, and circulatory systems.
 - Digestion (enzymes, length, microorganisms), Reproductive (how structures fit together, cycles), Excretory (osmolarity gradients, receptors for ADH, flame cells), Respiratory (high surface area, moist, thin), Circulatory (single vs. double, hemoglobin in red blood cells and how it binds). See **pages 853-855, 884-895, 867-883, 922-931, 967, and 949** of your text.
- What adaptive features of plants have led to their success on land?
 - Water transport features in roots (high surface area) and xylem/phloem. Stomata. Strength of wood to gain height. Reproductive structures such as seeds. See **pages 573-574** of your text.
- What adaptive features of animals have led to their success on land?
 - Sturdy bones, lungs/trachea (not gills), waterproof body surface. See **pages 684-700** of your text.
- What are the basic hormones and their effects in plants?
 - Auxin (phototropism, gravitropism, develops fruit), Gibberellins (elongation of cells, growth of leaves), Cytokinins (production of fruit and seed, cell division), Abscisic Acid (dormancy, closure of stomata), Ethylene (ripens fruit). See **page 794** of your text.
- What are the basic hormones and their effects in animals?
 - Oxytocin (uterine contractions), Vasopressin/ADH (water resorption), TSH (secretion of hormones by thyroid, FSH (production of gametes), LH (secretion of sex hormones, ovulation in females), Prolactin (mammary gland growth and lactation), Somatotropin/Growth Hormone (growth), Thyroxin (stimulation of growth and metabolism), Calcitonin (decrease in blood calcium), Parathyroid Hormone (increase in blood calcium), Insulin (decrease in blood sugar), Glucagon (increase in blood sugar), Gastrin (secretion of HCl in stomach), Epinephrine/Norepinephrine (dilation of blood vessels, increase in blood pressure, increase in

- blood sugar), Cortisol (metabolism of carbohydrate, protein, and fat), Aldosterone (Na⁺ and K⁺ retention in kidney - thus more water resorption), hCG (released by fetus to signal pregnancy), Progesterone (maintenance of endometrium), Estrogen (secondary sexual characteristics in females), Testosterone (secondary sexual characteristics in males). See **page 949** of your text.
- ❑ How can population growth be described?
 - Exponential growth, r & K reproductive strategies. Carrying capacity. See **pages 1146-1147** of text.
 - ❑ What factors affect population size?
 - Density dependent (disease, breeding sites, predation, food supply). Density-independent (weather). See **pages 1147-1148** of your text.
 - ❑ How is energy flow related to trophic levels?
 - Energy decrease as you move up trophic levels. See **pages 1192-1193** of your text.
 - ❑ How does carbon, nitrogen, phosphorus, sulfur, and oxygen cycle through the ecosystem?
 - See **pages 1196-1197** of your text.

Also, be sure to review the 12 Mandated Labs. An excellent source of review can be found online at:
http://www.phschool.com/science/biology_place/labbench/index.html



AP Biology Exam- Essay Writing Recommendations

AP Exam Format:

The Essay portion of the AP exam has 4 required essays. You will have 90 minutes total to answer all of these questions. This averages out to about 22 minutes per essay. The essay portion is worth 40% of your final AP score. To help you write your AP essays, refer to the tips below.

Before you start writing:

1. **Read all of the questions before you start writing.** If you don't know how to answer a question, go on to another question and come back to it. You can answer the questions in any order—for example, you could answer question 1, then 4, then 3, then 2. Just make sure that you answer the sections within each question (a,b,c,d) in the correct order.
2. **Read the question at least 3 times.** You need to make sure you know what the question is asking before you start writing a response. Just writing about the general topic will not give you credit. It is very important for you to actually address the question that is being asked. Sometimes there will be multiple parts to a question—make sure you address them all. It may help to underline the main parts of the question on the sheet (it's fine for you to write on the question sheet).
3. **Make an outline of your response before you begin writing your essay.** You won't get a grade for this outline, but it will help you collect your thoughts and organize your response. If a question asks for 2 examples, just give 2 examples—there is no point in writing about more examples than they ask for. If you give them 3 examples, when they ask for 2, they will only grade the first two. So decide on what you want to talk about before you start writing.

Writing the Essay:

4. **Don't worry about writing an introduction or conclusion.** You just need to make sure you have answered the question completely. In addition, spelling and grammar aren't extremely important. As long as the reader can figure out what you are talking about, it should be ok.
5. **Define any terms that you use.** It isn't enough to mention a term. You need to define it to get credit.
6. **Answer the question in the order it is asked for.** For example, answer part (a) first, then (b), etc. Also make sure you label each part appropriately (a, b, etc.). This helps you make sure you have addressed ALL parts of the question and it helps the reader score your essay.
7. **Use specific biological example to elaborate on processes that you describe,** even if it isn't required. Credit is often given for these examples. For example, if you were talking about embryonic structures, you could describe gill slits.
8. **You can use a diagram** to help you support your answer, but if you do, make sure it is labeled. In addition, make sure you put your diagram in a part of the essay where it is relevant. You can't just have a diagram though—you need to also have your answer in essay form.
9. To help you save time, **you can also use lists as part of your essay**—but again, you still need to have your answer in essay form. For example, if you were writing about types of mutations you could say: "Several types of mutations in DNA include:
 - Nonsense mutation—This is when the DNA codes for an early stop codon
 - Silent mutation— This is when the DNA codes for the same amino acid, making this mutation harmless
 - Missense mutation— This is when the DNA codes for a different amino acid, potentially changing the shape and function of the protein that is made "
10. **Answer ALL parts of the question.** Don't spend too much time on any one part. There is a maximum score for each section. So it's wisest to address all parts of a question to maximize your score.
11. **Write legibly!** This is very important. If they can't read it, they won't read it.

AP Biology Exam- **Multiple Choice Recommendations**

AP Exam Format:

The Multiple Choice portion of the AP exam has 100 multiple choice questions. You will have 80 minutes total to answer all of these questions. This averages out to about 48 seconds per question. The multiple choice portion is worth 60% of your final AP score. To help you answer these questions, refer to the tips below.

1. Read the question and ALL of the answer choices before you pick an answer.
2. Try to eliminate choices that are NOT correct. Each question will typically have 5 answer choices. If you can eliminate some of these choices and then make an educated guess, you increase your odds of getting it correct.
3. There is a correction for guessing. Your final raw score is determined by taking the total that you got correct – $\frac{1}{4}$ of the number you got wrong. So it's in your best interest to guess, but only after you have tried to eliminate the wrong answers and then make an educated (not random) guess.
4. Don't spend too much time on any one question. If you are unsure about your answer, mark it down so that you will know which questions to revisit when you finish going through all of the questions.
5. For the answer choices that are provided try to think about why something might NOT be the right answer. Just because it is multiple choice, doesn't mean you shouldn't apply the same critical thinking skills ☺
6. Often, your first instinct is correct (but not always!).