

Mr. W's AP Biology Study Questions for *Campbell, Biology in Focus, 2nd Edition*

(aligned to 2019 AP Bio Course and Exam Description)

Links to

- [Condensed 2019 Course Outline](#) (a reformatted version of the College board's Course and Exam Description)
- [Mr. W's AP Bio Review Outline](#)
- Interactive AP Bio tutorials at [Learn-Biology.com](#)

Table of Contents

Course Overview

[Module 1 \(Chapter 1\): Big Ideas/Key Themes of biology](#)

[Unit 1: The Chemistry of Life](#)

[Chapter 2: Basic Chemistry](#)

[Topic 1.1: Chapter 2, Concept 2.5: Water and Life](#)

[Chapter 3, part 1: Carbon and Functional Groups](#)

Topics 1.3 - 1.6: [Chapter 3, part 2: Biochemistry](#)

[Unit 2: Cells Structure and Function](#)

Topics 2.1 - 2.3, 2.10: [Chapter 4: Eukaryotic Cell Structure](#)

Topics 2-5 - 2.9: [Chapter 5, concepts 5-1 to 5.5: Cell Membrane Structure and Function](#)

[Unit 3: Cellular Energetics](#)

Topic 3.1 - 3.4: [Chapter 6: Metabolism \(Energy, ATP and Enzymes\)](#)

Topic 3.6¹: [Chapter 7: Cellular Respiration and Fermentation](#)

Topic 3.5: [Chapter 8: Photosynthesis](#)

[Unit 4: Cell Communication and the Cell Cycle](#)

Topics 4.1 to 4.4: [Concept 5.6: Cell communication](#)

Topic 4.5: [Chapter 32: Feedback Control, Homeostasis, Thermoregulation](#)

Topic 4.6: [Chapter 9, The Cell Cycle](#) and [Control of the Cell Cycle](#)

[Unit 5: Heredity](#)

Topics 5.1 and 5.2: [Chapter 10 and Concept 12.4: Meiosis and Chromosomal Variations](#)

Topics 5.3 - 5.6: [Chapters 11 and 12: Genetics \(Mendelian, blood type, sex linkage, linkage\)](#)

[Unit 6: Gene Expression and Regulation](#)

Topic 6.1: [Chapter 13: DNA Discovery, Structure and Replication](#)

Topics 6.2 - 6.4, 6.7: [Chapter 14: From Gene to Protein \(transcription and translation\)](#)

Topic 6.7: [Chapter 17: Viruses](#)

Topic 6.5, 6.7: [Concepts 24.2, 24.3, and 15.1: Bacterial Genetics](#)

Topic 6.5: [Concepts 15.2, 15.3, 15.4: Eukaryotic Gene Expression and Genomics](#)

Topic 6.6: [Chapter 16: Animal Development, Stem Cells, and Cancer](#)

Topic 6.8: [Concept 13.4: Genetic Engineering](#)

[Unit 7: Natural Selection/Evolution](#)

Topics 7.1 - 7.3, 7.6, 7.8: [Chapter 19: Descent with Modification](#) (Natural Selection, Evidence for Evolution)

Topic 7.9: [Chapter 20: Phylogenetics and Cladistics](#)

Topic 7.4, 7.5: [Chapter 21: The Evolution of Populations/Population Genetics](#)

Topic 7.10, 7.12: [Chapter 22: Species and Speciation](#)

¹ I've always found it easier to teach respiration before photosynthesis, and that's what I'm doing here.

Topics 7.13: [Chapter 24: Origin and Early History of Life](#)

Topic 7.11: [Chapter 23: Broad Patterns of Evolution](#) (including extinction)

[Unit 8: Ecology](#)

Topic 8.1: [Chapter 29: Animal Behavior](#)

Topic 8.3 - 8.4: [Chapter 40: Population Ecology](#)

Topic 8.5: [Chapter 41: Species Interactions](#) (community ecology)

Topic 8.2: [Chapter 42: Ecosystems Energy Transfer and Biogeochemical Cycles](#)

Topics 8.6, 8.7: [Chapter 43: Global Ecology and Conservation Biology](#)

POST AP EXAM

[Chapter 35: The Immune System](#)

[HALLMARKS of CANCER](#)

Mr. W's AP Biology Study Questions

[Jump back to the top](#)

Course Overview: Key Themes

Chapter 1: Themes in the Study of Life

This chapter focuses on what biology is all about, and it will form a conceptual framework for much of what follows throughout our course.

BIG PICTURE QUESTIONS

1. Living things are full of structures that carry out functions. Think of your teeth, set within your mouth, hinged to your jaw, surrounded by lips and lined with tissues that secrete fluid. Think about how all of these combine to perform the function of chewing food before it's swallowed. How did these structures come about?
2. What do you know about cells? What are some of the cells that are in your body? Are all living things made of the same types of cells?
3. Think about yourself as a system. What are your inputs, outputs, components, processes, and boundaries? You can write this out as a short paragraph, or, even better, try to represent this as a simple diagram. Then do the same for a house plant, or a plant in your garden.
4. A key theme in biology is information flow. You obviously inherited genetic information from your parents. How does genetic information, encoded in DNA, work? How does it get passed from generation to generation, and how does it influence bodies on an ongoing basis?
5. Evolution is the most important idea in biology. How does evolution work? What kinds of things does it explain?

GUIDED READING QUESTIONS

Chapter 1 Overview: Inquiring about Life

1. What does it mean to be "adapted?" Think about some organisms you're familiar with (including yourself) and describe a few adaptations.

Concept 1.1: Themes of Biology

2. Define *reductionism*, and contrast it with the idea of *emergent properties*.
3. Describe the relationship between structure and function found in living things. List a few examples. How is this relationship connected to the idea of *adaptation*?
4. How are prokaryotic cells different from eukaryotic cells?
5. Study figure 1.3. We'll use each of the terms connected with the levels of biological organization, so make sure that you can define each one, and explain its relationship to the levels above and below.
6. What's the function of DNA? What's the connection between DNA and genes? Between genes and protein?
7. What's the basic flow of information within cells?
8. What is gene expression? On the most general level, how do you see gene expression in your own body?
9. Use figure 1.8 b to describe the flow of information in cells (and, as you do, define terms like transcription and translation.
10. What's the connection between *genome*, *genomics*, and *bioinformatics*.
11. Summarize the key points of the theme "life requires the transfer and transformation of energy and matter."
12. Summarize the key points of the theme "organisms interact with other organisms and the environment."

Concept 1.2: Evolution

13. Devise a scheme to remember the key features of

- a. The three domains of life (bacteria, archaea, and eukarya)
 - b. The three eukaryotic kingdoms, and the protists. As you do, see if you can figure out why animals, plants, and fungi make up kingdoms, but protists are just a grouping.
14. The text contends that life is characterized by both unity and diversity. Explain.
 15. How does natural selection work?
 16. How does the concept of unity and diversity connect to and explain the concept of the “tree of life.”

[Jump back to the top](#)

Unit 1: Chemistry of Life

Chapter 2: Basic Chemistry

Big Picture Questions

This chapter focuses on the basic chemistry that you’ll need to understand biology. In previous courses, you were almost certainly exposed to many of these concepts, so much of what you’ll read will hopefully be review. However, you’ll learn more if you activate your current understanding, and try to recall what you already know. So, before you read, think about the questions below.

1. Why is understanding chemistry important for understanding biology?
2. What do you remember about each of the following basic chemistry terms: atoms, elements, compounds, ionic bonds, and covalent bonds?
3. What happens during chemical reactions?
4. What are some key chemical reactions that occur in your body?
5. Why is it easier to wipe up dirt with a wet sponge than with a dry sponge?
6. Why is Berkeley so much cooler than Danville or Walnut Creek? *Note that I’m talking about temperature, not culture.*

GUIDED READING QUESTIONS

Chapter 2 Overview

Just read and enjoy.

Concept 2.1: Matter, elements, and compounds

1. Be able to define all of these basic chemistry terms (and you only need to write definitions for the ones you don’t know): element, compound, atom, molecule.
2. Using the mnemonic CHNOPSCaK, list the 8 elements that are the key constituents of life. For each one, you should know the symbol, atomic number, and key characteristics (metal, non-metal, number of valence electrons; and its key properties (solid, liquid, gas, etc.)
3. What’s a trace element?

Concept 2.2: Elements and Atoms

4. You’ve all taken chemistry. Review the key properties of atoms. If you don’t know their basic structure, make up a table that enables you to do retrieval practice on their internal structure (nucleus, location of protons, neutrons, electrons; the charge on each of these particles.).
5. Define atomic number, and mass number.
6. Define *isotope*. Explain
 - a. why some isotopes are radioactive,
 - b. some uses of radioactive isotopes, and
 - c. some of their hazards.

7. Using figure 2.4 and the text, explain what radioactive tracers are, and how they're used.
8. Define *energy* and *potential energy*.
9. Explain the relationship between an electron's energy level and its potential energy. Specifically, what happens when an electron absorbs energy? How do electrons release energy?
10. The "octet rule" (not directly explained in the text) is useful for explaining most of the chemistry you need to succeed in biology. Use figure 2.6 and the text to explain the octet rule. Note: You can also listen to my Octet Rule song on my website.
11. What are valence electrons. Why are they so important?

Concept 2.3: Chemical Bonds

12. What's a covalent bond? In a covalent bond, what's the difference between a single bond and a double bond?
13. Compare/contrast *non-polar covalent* and *polar covalent* bonds
14. What's an ion? What are ionic bonds?
15. Describe hydrogen bonds and Van der Waals bonds.
16. Why is molecular shape so important in biology? What key [course theme](#) is this connected to?

Concept 2.4: Chemical Reactions

17. Review what happens in a chemical reaction? If you need to, make up a flashcard where you define "reactant," "product," and "equilibrium."

Concept 2.5: Hydrogen bonding, Properties of Water

18. Describe why water is a polar molecule, and how this affects how water molecules interact with one another and their surroundings.
19. Compare and contrast *cohesion* and *adhesion*.
20. What is surface tension?
21. Make sure you understand all heat and temperature related concepts (heat, temperature, the Celsius scale, the calorie: write out definitions connected with this discussion of water's effects on temperature.
22. Explain why water has
 - a. a high specific heat,
 - b. high heat of vaporization
23. Explain how evaporative cooling works.
24. Why does ice float in water? How does this affect the "fitness of the environment," especially in ponds and lakes?
25. Why is water such a great solvent? How does it interact with ionic and polar molecules?
26. What's the difference between hydrophobic and hydrophilic substances, and how does this relate to polarity?
27. What's a mole? How can you determine the molar mass of a substance? What's molarity, and how does it relate to the concentration of a solution?
28. Explain the difference between an acid and base (both in terms of H⁺ ions, OH⁻ ions and the pH scale).
29. What are buffers, and how do they work?
30. What's ocean acidification? Why is it a problem? What's acid precipitation? What are its causes and effects?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com. This first series of tutorials covers basic chemistry. This is optional: do it if you don't feel confident about the material above. This second set covers the chemistry and properties of water (and it's required for everyone)

[Jump back to the top](#)

Chapter 3, part 1, Concept 3.1: Carbon and Functional Groups (assign as needed)

Big Picture Questions

This is a big chapter. To make it more digestible, we're going to break it into two chunks. This first chunk focuses on the chemistry of carbon. This might not be an area in which you've had much exposure or context, so, for this one chapter, there's just one pre-reading question:

1. Carbon is the central atom in the molecules that make up living things. What do you know about carbon's structure? What's so special about it? Draw an electron orbital model of carbon, and use what you know about covalent bonds to intuit why carbon is so well suited to play its central role in life.
2. Read the Chapter Review at the end of the chapter. Because we cover the entire chapter, please read all of the concept reviews, and spend a moment thinking about the review questions.
3. Dig in and read the chapter.

Overview

1. What are organic compounds?
2. Define *macromolecule*.

Concept 3.1: Carbon atoms can form diverse molecules...

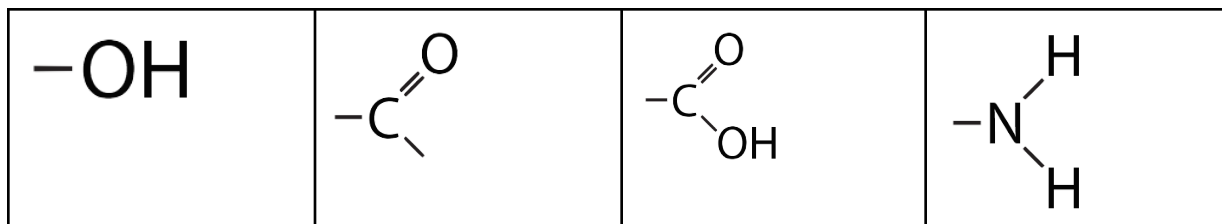
3. Describe how the structure of carbon allows it to form such a wide variety of molecules
4. Describe and draw examples showing how carbon atoms (and other atoms) can form chains, rings, and branched molecules.
5. What are hydrocarbons? Why are they important, both biologically and economically.
6. Distinguish between the three types of isomers (structural, cis-trans, and enantiomers)

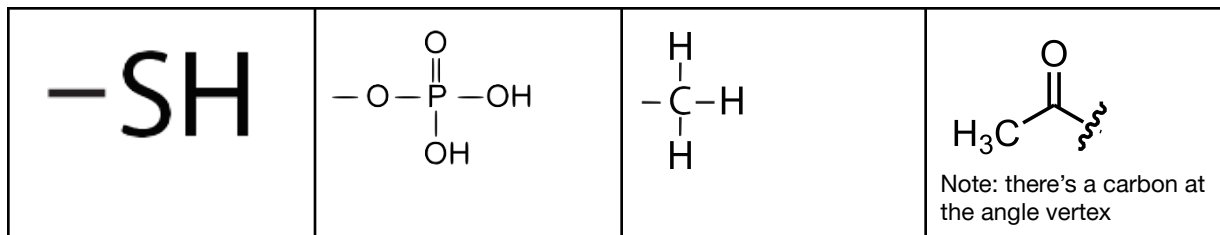
Chemical groups (AKA Functional groups)

7. Learn the following functional groups, and explain how the presence of this group affects the chemistry of the molecule it's attached to:

- a. Hydroxyl,
- b. Carbonyl
- c. Carboxyl
- d. Amino
- e. Sulfhydryl
- f. Phosphate
- g. Methyl

Note: Here's a table with the seven functional groups you'll need for making flashcards. You can put the formula in front, or in back. Or, try hangman questions!





8. Read and summarize the section on ATP: we'll come back to this essential molecule later in the course.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes.

[Jump back to the top](#)

Chapter 3, part 2, Concepts 3.2 to 3.5: Biochemistry

Big Picture Questions

This second part of chapter 3 focuses on the four families of molecules that make up living things. These are the very same molecules that make up your body, and which you encounter as the food you eat. Before you read, think about what you already know about this topic, and answer the following questions

1. Think about the foods you eat.
 - a. Which foods have lots of carbohydrate? Fat? Protein?
 - b. What makes a fat a fat? A carbohydrate a carbohydrate? A protein a protein?
 - c. Some fats are solid, like butter. Others, like oil, are liquid. What makes a solid fat different from a liquid fat?
2. Some carbohydrates, like sugar, have a lot of energy (usually measured in calories). Other foods, like lettuce, have hardly any food energy. Why?
3. Genes (the information you inherited from your parents through their sperm and egg cells) are made of a type of molecule called a nucleic acid. How can these molecules store information?
4. Read the Chapter Review at the end of the chapter. Because we're covering the entire chapter, please read all of the concept reviews, and spend a moment thinking about the review questions.

Concept 3.2: Macromolecules are polymers, built from monomers

1. Define polymer and monomer.
2. Explain how cells synthesize and break down macromolecules (condensation synthesis vs. hydrolysis)
3. There are only about 50 monomers that make up most of life's polymers. Yet polymers are astonishingly diverse. What's a good analogy for this? How does this analogy fall short? How is this related to the theme of unity and diversity?

Concept 3.3: Carbohydrates

4. What are carbohydrates?
5. Describe the key traits (basic structure and function) of
 - a. Monosaccharides (simple sugars)

- b. Disaccharides
 - c. Polysaccharides
6. For the following, be able to describe what *type* of carbohydrate, and its overall function: glucose, fructose, sucrose, lactose, starch, glycogen, cellulose, chitin)
7. Why can we use starch as an energy source, but not cellulose?

Concept 3.4: Lipids

- 8. Describe the unifying characteristics of lipids: what makes a lipid a lipid?
- 9. Describe the structure, properties, and biological importance of fats (AKA triglyceride or triacylglyceride)
- 10. In terms of properties and chemistry, compare and contrast saturated and unsaturated fatty acids.
- 11. What's a *hydrogenated* fat?
- 12. What's the connection between saturated fats (especially trans fats) and heart disease?
- 13. What are the functions of fats in animals?
- 14. What are phospholipids? Why are they important in cells?
- 15. What are steroids? What is cholesterol, and what is good and bad about it?

Concept 3.5: Proteins

- 16. Using the text in the 1st paragraph of this section, and figure 3.17, list some of the functions of proteins.
- 17. What are enzymes, and why are they important?
- 18. What's the relationship between a *polypeptide* and a *protein*?
- 19. Describe the structure of a generalized amino acid, and explain how peptide bonds form (figure 5.17)
- 20. Using figure 3.18, list the types of side chains in amino acids, and when presented with a specific amino acid, be able to identify which type of side chain it has (non-polar, polar, acidic, basic). DO NOT try to memorize the structural formulas of specific amino acids.
- 21. Why is the shape of a protein so important?
- 22. Use figure 3.22 to explain the four levels of protein structure. Briefly describe the kinds of molecular interactions that bring about
 - a. Primary structure
 - b. Secondary structure
 - c. Tertiary structure
 - d. Quaternary structure
- 23. Using 3.23, explain the symptoms and molecular cause of sickle cell anemia (for symptoms, look up the disease in the index or on the Web).
- 24. Describe denaturation and explain how it happens.

Concepts 3.6 and 3.7: Nucleic Acids and Genomics

- 25. Explain the roles that nucleic acids play in living things. As you do, distinguish between the roles of RNA and those of DNA.
- 26. Describe the structure of a nucleotide.
- 27. How are purines different from pyrimidines?
- 28. How do nucleic acid polymers form?
- 29. DNA and RNA are information storing molecules. How do they do this? Which part of the molecule stores the information?
- 30. Why is DNA referred to as a "double helix?"
- 31. What does it mean to say that the two strands of DNA are *antiparallel* in orientation?
- 32. What are the base pairing rules in DNA? In RNA?

Concept 3.7: Genomics

33. How can DNA and protein be used as “tape measures” of evolution?
(jump to chapter 13)

Conclusion/Synthesis (it's not written, but still do it!)

Note that the chapter review diagram (p. 70) has already been set up as a study sheet, which you can use for practice. For each macromolecule family, you should be able to describe the main function (1st column), the components (2nd column), list some examples (3rd column), and describe the function of each example (4th column)

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com, and complete the associated student learning guide.

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes.

[Jump back to the top](#)

Unit 2: Cells and Membranes (AP Bio topics 2.1-2.3, 2.10)

Chapter 4: Eukaryotic Cell Structure

Big Picture Questions

This is possibly your second or third time studying about cells: certainly you studied about them in middle school, and possibly earlier during high school. So, before you read, answer the questions below to activate what you already know

1. What are cells? What are their basic parts? Their internal subdivisions?
2. How are animal cells different from plant cells?
3. Cells are, with a few exceptions, very small. Why is this? Why are you made of trillions of little cells instead of one big cell?
4. Some cells, like your white blood cells, can swallow outside objects or organisms, take them inside, and digest them. How does this happen?
5. Read the Chapter Review at the end of the chapter, and interact with the questions. Take a look at the reviews for sections 4.6 and 4.7, but we're not covering these in much detail.
6. Now dig in and read the chapter, taking cornell notes.

Chapter 4 Overview

Read for interest (no notes required)

Concept 4.1: How cells are studied

1. Describe the relationships between millimeters (mm), micrometers (μm), and nanometers (nm).
2. MICROSCOPE BACKGROUND: Read this material to be an educated person, but no notes are needed.
 - a. Distinguish between magnification, resolution, and contrast.
 - b. Describe why electron microscopes have such greater resolution than light microscopes.
 - c. Compare/contrast transmission and scanning EMs. You don't have to know how they work, but you should understand the kind of images they produce (which you can see in figure 4.3).
 - d. How is cell fractionation used to help learn about cells?

Concept 4.2: Eukaryotic Cells

3. How are eukaryotic cells and prokaryotic cells different?
4. Describe the following cell parts (and make sure that your descriptions include both structure and function).
 - a. Cytosol
 - b. Chromosomes
 - c. ribosomes
 - d. Nucleoid
 - e. Cytoplasm
 - f. Plasma membrane
5. Why are cells small (but not too small)? Use figure 4.6 to explain the upper and lower limits on cell size.
6. What are some special adaptations in cells that exchange lots of materials with their environment.
7. Why are eukaryotic cells divided into compartments?

Concept 4.3: Nucleus and ribosomes

8. Describe the nuclear envelope.
9. What is *chromatin*, and how does the cell's chromatin change in appearance during the cell's life cycle
10. What is the nucleolus?
11. What are ribosomes? What's the difference between free and bound ribosomes?

Concept 4.4: The endomembrane system

12. Explain the structure and function of the endomembrane system. Start by describing the structure and function of the following parts
 - a. Rough Endoplasmic reticulum
 - b. Smooth endoplasmic reticulum
 - c. Golgi apparatus
 - d. Lysosomes
 - e. Vacuoles (food, contractile, and central)
14. Now, pull this together by explaining each of the following processes.
 - a. Describe the flow of materials in cell export
 - b. Describe the reation of lysosomes, digestive enzymes, and membrane components
 - c. Describe how engulfed food particles are digested.

Concept 4.5: Mitochondria and Chloroplasts

15. Describe the overall functions of mitochondria and chloroplasts (note that we'll return to these organelles when we study cellular respiration and photosynthesis).
16. Summarize the endosymbiont theory, and list several pieces of evidence for it.

Concept 4.6: The Cytoskeleton

Note: Just read the very first part of this section.

17. What is the cytoskeleton?
18. What are the two roles played by the cytoskeleton?

Note: SKIP the details (at least for now) about the various components of the cytoskeleton.

Concept 4.7, Extracellular components of cells

19. Describe the structure of the cell wall.

Note: SKIP the material about the extracellular matrix of animal cells, and about cell junctions.

SUMMARY AND SYNTHESIS (How to pull all of this together)

Use the review table in the "Chapter Review" section on p. 98 and figure 4.7 to test yourself on the key features of animal and plant cells.

20. From the Animal Cell diagram, be able to identify the appearance and describe the function of the following parts

- a. Flagellum
- b. Centrosome
- c. Endoplasmic reticulum (both rough and smooth)
- d. Nuclear envelope (AKA nuclear membrane)
- e. Nucleolus
- f. Chromatin
- g. Plasma membrane
- h. Ribosomes (both free and bound)
- i. Golgi apparatus
- j. Lysosome
- k. Mitochondrion
- l. Microvilli
- m. Cytoskeleton

21. From the Plant Cell diagram be able to identify the appearance and describe the function of the following parts. I've only listed those parts unique to plant cells

- a. Central vacuole
- b. Chloroplasts
- c. Plasmodesmata
- d. Cell wall

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 5, Concepts 5.1 to 5.5): Cell Membrane Structure and Function

Big Picture Questions

This first part of chapter 5 focuses on the seven nanometer boundary that defines life: the cell membrane. Before you read, speculate about the questions below.

1. Cells are selectively permeable. Try to imagine (or remember) how something built out of molecules could have the equivalent of gates, pores, channels, and fences
2. What do cells let in? What do they keep in? What do they let out? How does a cell membrane control this exchange with its outside environment?
3. What do you remember, from your previous studies of biology, about diffusion, osmosis, active transport, etc.?
4. Read the Chapter Review at the end of the chapter, but only for concepts 5.1 to 5.5.. Spend a moment thinking about the review questions.
5. Now dig in and read the chapter, and convert this information into interactive flashcards..

Overview

1. How thick is the plasma membrane? How does that compare to the size of a typical prokaryotic cell? Eukaryotic cell? (look this up in chapter 4 or on-line).

2. Define “selective permeability.”

Concept 5.1: Membranes are Fluid Mosaics

3. What is “amphipathic?” Note that this is not a word that we’ll use very much, but explain why that term a good description for a phospholipid molecule.

4. Using figure 3.15, 4.2, and the text, explain the formation of lipid bilayers from phospholipid molecules.

5. What’s the *fluid mosaic model* of membrane structure? How do proteins fit into the phospholipid portion of the membrane?

6. What holds the membrane together?

7. Describe the types of molecular movements that happen within membranes.

8. How fluid is the membrane? How do saturated and unsaturated phospholipids, along with cholesterol, maintain this fluidity?

9. Distinguish between integral and peripheral proteins. What are transmembrane proteins?

10. List and describe some of the functions of membrane proteins (this is in figure 5.7).

11. Describe the functions of membrane carbohydrates.

12. Carefully study 5.8. Try to visualize how a glycoprotein or glycolipid would be positioned on the inside or outside of the membrane.

Concept 5.2: Membrane structure results in selective permeability

13. List the substances that can and can’t pass through the lipid bilayer.

14. Describe the functions of various transport proteins, including aquaporins and carrier proteins.

Concept 5.3: Passive transport

15. Define *diffusion*, *concentration gradient*, and *passive transport*.

16. Define *osmosis*, *hypertonic*, *hypotonic*, *isotonic*.

17. Define/describe osmoregulation: why is it so important, and how is it accomplished in cells with and without cell walls?

18. Using the text and figure 4.11, describe conditions under which plant cells will become turgid or flaccid. What’s plasmolysis?

19. Describe facilitated diffusion.

20. What are ion channels? Gated channels?

Concept 5.4: Active Transport

21. Define active transport. How is it similar to and different from facilitated diffusion?

22. Use figure 5.14 and the text to explain how the sodium-potassium pump works.

23. Describe the following concepts

a. Membrane potential

b. Electrochemical gradients

c. How do cells use electrochemical gradients?

24. How does co-transport work? Use figure 5.17 to explain how plant cells use co-transport to power active transport of sucrose

Concept 5.5: Bulk Transport

25. Read the text and carefully study figure 5.18. Describe endocytosis, exocytosis, phagocytosis, pinocytosis, and receptor-mediated endocytosis.

26. Summarize the passage explaining *familial hypercholesterolemia*. If anyone in your family takes a statin like lipitor or simvastatin (as I do) they may have this condition.

Concept 5.6: Cell Signaling

We'll come back to this later in our course. Skip it for now.

Chapter 25, Overview, and Concept 25.1

1. On a cellular level, how are eukaryotes distinct from prokaryotes.
2. What is endosymbiosis? Describe how endosymbiosis would have given rise to mitochondria and plastids.

Concept 25.2: Origin of Multicellularity

3. Describe the steps involved in the origin of multicellular animals.

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Unit 3: Cellular Energetics

Chapter 6: An Introduction to Metabolism

Big Picture Questions

This chapter focuses on how living systems can channel energy in order to perform the work of maintaining order, staving off entropy, and reproducing. Before you read, think about the questions below.

1. What is energy?
2. Living things spend a huge amount of effort, both in terms of activity (for animals) and the structures they grow (in plants) to acquire energy. Why is energy so important? What do living things do with energy?
3. What is ATP, and how do cells use it?
4. What are enzymes? Why are they important?
5. Read the Chapter Review at the end of the chapter. Because we'll cover the entire chapter, please read all of the concept reviews, and spend a moment thinking about the review questions. Really think about them!

Now dig in and read the chapter. Capture by creating interactive flashcards.

Concept 6.1: Metabolism

1. Define the following terms
 - a. Metabolism
 - b. Metabolic pathway
 - c. Catabolic pathway
 - d. Anabolic pathway
 - e. Bioenergetics
2. What's energy? Define/describe the major forms of energy described in the text:
 - a. kinetic
 - b. heat
 - c. potential

- d. Chemical
- 3. The text says that “organisms are energy transformers.” Explain what this means, and list examples.
- 4. Explain how *you* are an open system.
- 5. Summarize the first and second laws of thermodynamics.
- 6. What is *entropy*?
- 7. In your own words, explain what the text means by an *energetically favorable* or *spontaneous* process.
- 8. What is free energy?
- 9. One of the most profound statements in Campbell is “organisms are islands of low entropy in an increasingly random universe.” What does that mean? Apply it to yourself.

Concept 6.2: Free Energy Change

10. The discussion of the Gibbs free energy equation is pretty tough to understand. What’s more important is to get your head around figure 6.5, and answer these questions:

- a. In the context of this discussion of processes and reactions, when can reactions happen spontaneously?
- b. What’s the relationship between the spontaneity of a process and a system’s stability?
- c. What’ the relationship between spontaneity and equilibrium?
- d. (Note: this might feel like a trick question, but it’s not) What’s the relationship between the spontaneity of a process or reaction, and its speed?
- 11. What are exergonic reactions? In your answer, include how exergonic relates to ΔG and spontaneity.
- 12. Write down some way that you’ll remember this often misunderstood fact about chemistry: FORMING BONDS RELEASES ENERGY. BREAKING BONDS REQUIRES/ABSORBS ENERGY
- 13. Contrast endergonic reactions with exergonic reactions.
- 14. Why is disequilibrium one of the defining features of life?
- 15. Read the section on “equilibrium and metabolism.” Why, in figure 6.7, is diagram “c” the best metaphor for the metabolism of cells, as opposed to “b” or “a”?

Concept 6.3: ATP

- 16. What are the three kinds of cellular work? Describe a specific example of each one that is occurring in your body.
- 17. What is energy coupling?
- 18. Describe the structure of ATP. Draw it.
- 19. What happens when ATP is converted into ADP + P_i?
- 20. What is a *phosphorylated intermediate*?
- 21. How is ATP regenerated from ADP + P_i?
- 22. Using figure 6.9, describe how ATP is used to drive the conversion of glutamic acid and ammonia into glutamine (an endergonic process).

Concept 6.4: Enzymes Speed Up Metabolic Reactions...

- 23. Define “enzyme” and “catalyst.”
- 24. Define activation energy, and explain the relationship between enzymes and activation energy. Note that you should be able to draw, from memory, figure 6.12, which does this in graphic form.
- 25. Summarize the passage about how enzymes speed up reactions.
- 26. Explain the importance of the active site of an enzyme, and describe how the specificity of an enzyme depends on its structure.
- 27. Describe the catalytic cycle of an enzyme (see figure 6.15)
- 28. Explain the “induced fit” model of enzyme action, and list three ways in which enzymes catalyze reactions.
- 29. Explain the effects of temperature and pH affect on enzyme activity.
- 30. What are cofactors? Coenzymes?

31. Describe competitive and non-competitive inhibition of enzymes.

Concept 6.5. Regulation of Enzymes

32. How do cells regulate enzymes? Describe allosteric regulation and inhibition of enzymes

33. What is feedback inhibition?

34. How is cell structure related to control of enzymes?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 7: Cellular Respiration and Fermentation

Big Picture Questions, part 1

This chapter focuses on the specific mechanisms by which cells convert food energy into ATP. Before you read about it, respond to the questions below.

1. Imagine that you're eating an apple. Your digestive system breaks that apple down into sugars, which get absorbed into your bloodstream, and then transported to your cells. How do your cells, once that sugar diffuses across their cell membranes, convert that sugar into ATP?

2. Fermentation is a process that allows cells to make ATP in the absence of oxygen. What do you know about fermentation?

3. Read the Chapter Review at the end of the chapter. Because we covered the entire chapter, please read all of the concept reviews, and spend a moment thinking about the review questions.

Chapter 7 Overview

1. Study figure 7.2.

a. Explain how matter gets recycled between photosynthesis and respiration.

b. Explain the flow of energy shown in this diagram

Concept 7.1: Catabolic Pathways yield energy

2. Memorize the general equation for cellular respiration, as well as the overall, balanced equation (look it up, or figure it out yourself).

3. Compare and contrast oxidation and reduction. Which process releases energy, and which stores it?

4. Describe how cellular respiration is a redox process. What gets oxidized? What gets reduced?

5. What's the role of NAD⁺ and NADH in cellular respiration?

6. What are *dehydrogenases*, and what do they do?

7. What's the role of oxygen in cellular respiration?

8. For most AP Biology students, at this point it's impossible to really understand what's being discussed in this section and in diagrams like 7.5. But give this question your best shot, knowing that you'll come back to it later: what is the electron transport chain, and what does it do?

9. What are the three main phases of cellular respiration (note that we'll add an additional step between Campbell's 1st and 2nd phase: this is actually shown in diagram 7.6, but, confusingly, not added in the text)? Where in the cell does each phase occur?

10. How is oxidative phosphorylation different from substrate-level phosphorylation?

Concept 7.2: Glycolysis

11. Write a paragraph describing glycolysis. Do this on a big picture level. Figure 7.8 and my [Glycolysis Rap](#) gets the detail just about right. What goes in? What happens (don't worry about the names of intermediates, but you should be able to keep track of the number of carbons, the phosphorylations, and the oxidations)? What is the gross and net yield?

Concept 7.3: The Citric Acid/Krebs Cycle

12. What happens to pyruvate before its energy can be harvested in the Citric Acid Cycle?

13. As you did with glycolysis, describe the Krebs (or Citric Acid) Cycle (and do this on the big picture level, as shown in my [Krebs Cycle Song](#), and in figure 7.10). What goes in? What comes out? Why is it a cycle (as opposed to glycolysis)?

Concept 7.4: Oxidative Phosphorylation

14. Where does the electron transport chain happen?

15. Read "The Pathway of Electron Transport." Then, explain what's going on in figure 7.12. How is this process related to oxidation and reduction? What are the big blobs with Roman numerals? What are the little ellipses? What are NADH and FADH₂ doing? What is O₂ doing?

16. Describe chemiosmosis. As you do, explain

- What is the energy that's harvested in the ETC actually used for?
- How does ATP synthase work?
- Mitochondria have a double membrane? Why? Note that this process works in and archaea that don't have a double membrane: why don't the protons just diffuse away?
- How is the ATP actually (and finally) generated?

17. Study figure 7.14. Write a 3 sentence paragraph explaining how the entire process of ATP creation by oxidative phosphorylation works.

18. Looking at figure 7.14 and 7.12, explain why FADH₂ generates less ATP/mole of glucose than NADH?

19. Study figure 7.15. How much ATP is generated in glycolysis, the Krebs (TCA) cycle, and oxidative phosphorylation?

20. In eukaryotic cells, what's the maximum amount of ATP generated/molecule of glucose?

21. How efficient is cellular respiration? How does that compare to the efficiency of a car?

22. Describe the adaptation used by hibernating animals to maintain their body temperature.

23. In the 1940s, some physicians prescribed low doses of a drug called dinitrophenol (DNP) to help patients lose weight. DNP uncouples the chemiosmotic machinery by making the lipid bilayer of the inner mitochondrial membrane permeable to protons. How would this cause weight loss? (By the way: the method was abandoned after several patients died.)

Concept 9.5: Fermentation

24. Compare/contrast aerobic and anaerobic respiration.

25. What's the key point of fermentation? What product does it regenerate? Why does this need to happen?

26. Compare/contrast alcohol and lactic acid fermentation.

27. When do humans ferment?

28. What's a facultative anaerobe? How is this different from an obligate anaerobe? Which type are you?

29. Describe the evolutionary significance of glycolysis.

Concept 9.6: Connecting to other metabolic pathways

30. From the text and from figure 9.19, how can polysaccharides, proteins, and fats serve as fuels for the Krebs cycle?

31. What are some of the feedback mechanisms controlling cellular respiration?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.Learn-Biology.com)

Master the content

2. On your [gwizcards](http://www.gwizcards.com) webpage, create flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later

Chapter 8: Photosynthesis

Big Picture Questions, part 1

This chapter focuses on photosynthesis, the process by which living things convert light energy into chemical energy. Before you read, think about the questions below.

1. How does photosynthesis work? As specifically as you can, describe what you already know about how plants can convert light energy into chemical energy. Make sure that your description includes the following:
 - a. What is light?
 - b. Why are plants green?
 - c. Why do plants need water?
 - d. How do plants make oxygen?
 - e. Why do plants need carbon dioxide?
2. The light reactions of photosynthesis are startlingly similar to the oxidative phosphorylation of ADP that occurs at the end of cellular respiration. Without looking back at your notes, write a short paragraph explaining how cells make ATP.
3. Read the Chapter Review at the end of the chapter. Read all of the concept reviews and spend a moment thinking about how you would answer the review questions.

Overview

1. What happens during photosynthesis?
2. What are autotrophs?
3. What are heterotrophs?

Concept 8.1: Photosynthesis converts light energy into food energy

4. Using the text and figure 8.3, describe the overall structure of a leaf.
5. Describe the structure of a chloroplast (stroma, thylakoids, grana)
6. Write the overall equation for photosynthesis. As you set yourself up to memorize the equation, also be sure to know the following:
 - a. The source of the oxygen released by photosynthesis
 - b. The source of the hydrogens stored in sugar during photosynthesis?
 - c. The source of the carbon stored in sugar during photosynthesis?
7. Describe photosynthesis as a *redox* (reduction-oxidation) process. What gets oxidized? What gets reduced?
8. What are the two stages of photosynthesis? What are the products of each? (see figure 8.5)

Concept 8.2: The Light Reactions

9. Explain the physics of light as it relates to photosynthesis. Specifically cover the following:
 - a. How does the wavelength of visible light correspond to its color?
 - b. What's a photon?
 - c. What's a pigment?

10. Explain why leaves are green. As you do this explain how light, through reflection and absorption, interacts with photosynthetic pigments to generate the green color that we associate with leaves.
11. Compare/contrast the absorption spectrum of chlorophyll and the action spectrum for photosynthesis as a whole. What is each measuring? Why aren't the two exactly equivalent?
12. Use figure 8,9 to explain Englemann's very cool experiment showing the action spectrum for photosynthesis.
13. Using figure 8.10, describe the structure of chlorophyll.
14. What are some of the accessory pigments in photosynthesis, and what do they do?
15. Use the text and figure 8.11 to describe what happens when chlorophyll gets excited by a photon.
16. Referring to the text and to Figure 8.12, describe how photosystems are organized, and how they respond to excitation by a photon. In your description, mention *antennae complex*, *reaction center*, *primary electron acceptor*, and other parts as needed,
17. Describe linear (also known as *non-cyclic*) electron flow. As you do, try to follow the flow of a single electron, as shown in figures 8.13 and 8.14. Focus your explanation on how ATP and NADPH get produced.
18. [Follow this link](#) to read about cyclic electron flow. Then make up a flashcard describing how cyclic electron flow works. Which photosystem is involved? Why does it happen? What gets produced?
19. You've probably already done this as you've responded to the questions above, so new flashcards might or might not be required. But see if you can look at figure 8.16 and explain how the light reactions create ATP and NADPH. In your explanation, include the role of the following.
 - a. Photons
 - b. Water
 - c. Chlorophyll
 - d. Cytochromes,
 - e. ATP synthase
 - f. NADP⁺ reductase
 - g. Thylakoid membrane
20. How is ATP synthesis similar and different in plant and animal cells. Use the text and Figure 8.15 to formulate your answer. Specifically, compare 1) Where are protons pumped to? 2) Where are they pumped from? 3) Where is the electron transport chain? 4) Where is ATP synthesis happening? 5) Across what barrier do protons diffuse in order to generate ATP? 6) Where would there be a high pH? 7) Where would there be a low pH?

Concept 8.3: The Calvin Cycle

21. Read the text and study Figure 8.17. In one sentence, explain what the Calvin Cycle does?
22. Why is glyceraldehyde-3-phosphate (G3P) so important?
23. Write a short summary of each of the three phases of the Calvin cycle
 - a. Carbon fixation
 - b. Reduction
 - c. Regeneration of RuBP
24. Why is *rubisco* and enzyme worth remembering? Why are you personally indebted to this enzyme?

Concept 8.4: Alternative mechanisms of carbon fixation

Skip most of this section, but do read "The Importance of Photosynthesis: A Review

25. What happens to the sugar made by photosynthesis?
26. Why should you think about photosynthesis every time you eat a cookie or drink a cup of coffee?
27. List several reasons why we should be grateful to plants.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.Learn-Biology.com)

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](#) webpage (for Mr. W's BHS students) or [qwizcards.com/wizard](#), or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

Comparing Photosynthesis and Respiration

4. It's worthwhile to spend a few minutes comparing and contrasting photosynthesis and respiration by answering these questions:

- a. What's the relationship between photosynthesis and respiration?
- b. How does each work as a redox reaction?
- c. Which is catabolic?
- d. Which is anabolic?
- e. Which occurs in autotrophs?
- f. Which in heterotrophs?
- g. Which cellular structures are involved in each?
- h. What kinds of phosphorylations occur in each?

[Jump back to the top](#)

Unit 4: Cell Communication and the Cell Cycle

Concept 5.6: Cell Communication

Big Picture Questions

This concept focuses on communication that happens within and between cells. Of everything we've learned so far, it's possible that you have less prior knowledge about what's covered in this chapter than anything else we've learned up to this point. Even so, try to generate a model of some of the key processes that are involved in cell communication by answering the questions below:

1. Cells can respond to signals from other cells. Think, for a moment, of your own body. What are some ways the cells in one part of your body send signals to cells in other parts of your body?
2. When a cell receives a message from another cell, what are some ways in which it might change its behavior in response?
3. Read the review for concept 5.6 at the end of chapter 5, and spend a moment thinking about the review questions.

Concept 5.6: Local and Long Distance Signalling

1. Describe these various types of local signaling: through cytoplasmic junctions, through direct contact, through secretion of messenger molecules, and through synapses.
2. Describe hormones and endocrine signaling.
3. What is transduction? Use figure 5.20 to describe the three steps involved in a signal transduction pathway.

Reception

4. What's the radio station and radio analogy for signal transmission and reception, and how does it relate to cell signaling?
5. What's a ligand?
6. Using figures 5.21, 5.22, and the text, describe the structure and function of
 - a. G-protein coupled receptors
 - b. Ligand gated ion channels

7. Use Figure 5.23 and the text to describe the types of signal molecules that interact with intracellular receptors, and to explain how these receptors work.

Transduction

8. Why can it be beneficial to cellular response for the transduction of a signal to involve many intermediate steps.

9. What are protein kinases? Use figure 5.24 to explain how these molecules can participate in a phosphorylation cascade.

10. What do protein phosphatases do?

11. What are second messengers?

12. Use the text and figure 5.25 to explain how cAMP works as a second messenger.

Response

13. Use the text and figure 5.26 to describe how a signal can activate a gene.

14. Use figure 5.24 to describe a cytoplasmic response to a signal. Explain how this kind of cascade can lead to signal amplification.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your qwizcards webpage, make flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

Thematic reflection

3. [Follow this link](#) and write your end of chapter thematic reflection

[Jump back to the top](#)

Chapter 9. The Cell Cycle

Big Picture Questions

This chapter focuses on how cells divide. Before reading, answer the following questions

1. Think of yourself as a multicellular organism. Why has cell division been so important in your life?

2. You probably studied a bit about cell division in previous biology classes. What do you remember?

Describe what happens when cells divide. Note that the phases of mitosis are deemphasized in the new AP Biology curriculum, so don't just name the phases...describe them.

3. How do cells know when to divide?

4. What happens when the controls on cell division break down, and a cell becomes cancerous? What do you know about cancer and how it works?

5. Read the Chapter Review at the end of the chapter. Because we covered the entire chapter, please read all of the concept reviews, and spend a moment thinking about the review questions.

Overview: The Key Roles of Cell Division

1. Why is cell division important (find 3 reasons)?

Concept 9.1: Cell Division

2. Define genome, chromosome, chromatin.

3. Define somatic cell and gamete. Note that this chapter is about the reproduction of somatic cells.

4. Define sister chromatid and centromere. As you do, study Figures 9.3, 9.4, and 9.5 to develop strong visual images of all of these terms.

5. Distinguish between mitosis and cytokinesis.

Concept 9.2: The Cell Cycle

6. List and describe the phases of the cell cycle (G_1 , S, G_2 , M). What is G_0 ? Practice drawing figure 12.6 until you can do it from memory.

7. Describe the mitotic spindle.

- What is it?
- What does it do?
- What's an aster?
- What's a kinetochore?
- How does the mitotic spindle develop?

8. Study the diagrams and text in figure 9.7. According to the College Board, you won't be tested on the names of the phases of mitosis (prophase, prometaphase, metaphase, anaphase, and telophase), but it's hard to talk about mitosis and meiosis (the cell division process that forms egg and sperm cells) without these terms. Your main goal is to explain how doubled chromosomes are split apart and then "sent" to the daughter cells. Write a brief explanation of how that happens.

9. How are chromosomes moved across the cell during mitosis? In your explanation, summarize the diagrams in Figure 9.9, and jump back to Figure 4.21 to get an image of "chromosome walking."

10. Describe cytokinesis. How is it different in animals and plants?

11. Describe how bacteria reproduce, and explain how mitosis might have evolved from bacterial cell division.

Concept 9.3: Control of the Cell Cycle

12. How is the cell cycle different in different cells within the human body?

13. What's the evidence for control of the cell cycle through cytoplasmic signals?

14. How is the cell cycle controlled?

- What are checkpoints?
- Use the text and figure 9.15 and 9.16 to explain how the cell cycle clock works. Include the role of cyclins
- Describe some of the external signals and conditions regulate cell division. Include PDGF, density dependent inhibition, and anchorage dependence.

15. What's the difference between normal cells and cancer cells? (note: read all the way to the end of this section to get a complete answer).

16. Compare/contrast benign tumors with malignant ones.

17. What's metastasis?

18. How do some cancer treatments relate to events in the cell cycle?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

Chapter 32: Feedback Control, Homeostasis, and Thermoregulation

Big Picture Questions, part 1

This chapter focuses on how organisms use feedback to maintain optimal conditions for life, with a particular focus on regulation of body temperature. Before you read, prepare your mind for learning by answering the following questions.

1. Most homes or buildings have a thermostat that controls the furnace, keeping the temperature at a set point. Write a few lines describing your mental image of how a thermostat works.
2. In earlier studies of biology (going all the way back to elementary school), you probably learned the difference between the “cold blooded” reptiles, fish, and amphibians, and the “warm-blooded” birds and mammals. Based on your current understanding, how do these two groups of animals regulate their body temperature? Linger on your description of how mammals (like you) keep their body temperature at a species-specific set point.

Chapter 32 Overview

1. What’s the difference between anatomy and physiology?

Concept 32.1: Animal Form and Function

2. As needed, define *tissue*, *organ*, and *organ system*.
3. Use Figure 32.2 to answer these questions: What are the four types of tissues? How are they distinct, and what is the function of each?

Concept 32.2: The endocrine and nervous systems

4. Compare and contrast the signalling methods, speed of signal transmission, duration of signals, and overall functions of the nervous and endocrine systems.
5. What are endocrine glands? How are they different from exocrine glands.
6. Compare and contrast negative and positive feedback.
7. Use the text and figure 32.6 to explain how a simple endocrine pathway works.
8. What does oxytocin do, and how does it work?
9. Use the text and figure 32.7 to explain how neuroendocrine pathways work.
10. How do lipid soluble and lipid insoluble hormones differ in their mechanism of bringing about cellular response (note: use this as a way to review what you’ve learned about cell communication in chapter 5).
11. Use figure 32.9 and the text to describe the different effects epinephrine has in different tissues.

Concept 32.3: Feedback control...

12. What’s the difference between a regulator and a conformer? List examples of each.
13. What’s homeostasis? Use Figure 32.12 to describe how a thermostat uses a heater to maintain “homeostasis” in room temperature. Use the terms *set point*, *stimulus*, *sensor*, and *response* in your answer.
14. What’s the difference between a set point and a normal range? Also, how might set points change over the course of an organism’s life?
15. What’s thermoregulation? Why is thermoregulation critical for survival?
16. Compare and contrast endothermic and ectothermic metabolisms.
17. How does body temperature variation relate to endo- and ectothermic lifestyles? What’s wrong with the terms “warm-blooded” and “cold-blooded.”
18. Use figure 32.14 to describe the four ways organisms exchange heat with their environments.
19. Use the text to explain the following thermoregulatory adaptation: insulation, vasodilation, vasoconstriction, and countercurrent exchange.
20. What role does acclimatization play in thermoregulation?
21. Use figure 32.16 to explain how the hypothalamus regulates body temperature in humans (and other mammals).

Note: osmoregulation and the workings of the kidney are unbelievably cool. However, because they're not a part of the AP Curriculum, we're going to end our reading of the chapter here. If, like me, you can't get enough of this stuff, I encourage you to read this for your own pleasure!

Concept 33.5: Feedback circuits regulate...

Skip to the subsection that starts with "Energy Allocation"

22. What is bioenergetics?
23. Think about yourself as an organism. How do you use energy? What are the inputs, processes, and outputs? Formulate an answer that captures the system diagram in 33.18.
24. What is metabolic rate, and how is it measured (short term and long term)?
25. What is *basal metabolic rate*? How is it different from *standard metabolic rate*?
26. How (and why) are metabolic rates different for endotherms and ectotherms?
27. How is metabolic rate related to activity?
28. How do animals regulate energy storage?
29. Describe how insulin and glucagon interact in regulation of blood sugar levels. Note that this is system that is organized in antagonistic pairs.
30. Describe how diabetes works. What's the difference between type 1 and type 2 diabetes?
31. What are some of the health problems associated with overnourishment?
32. What are some of the homeostatic mechanisms that control the storage and metabolism of fat?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your qwizcards webpage, make flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

[Jump back to the top](#)

Unit 5: Heredity

Chapter 10 (Meiosis) and concept 12.4 (chromosomal disorders)

Big Picture Questions, part 1

This chapter focuses on meiosis and sexual reproduction. Before you read, think about the questions below.

1. Siblings inherit their genes from the same source, but they are obviously not identical. What can you explain about the cellular reasons why siblings are different from one another, and from their parents? As you respond to this high-concept question, try to recall the details of what you already know about the biology of meiosis, fertilization, and sexual reproduction.
2. Meiosis can malfunction, and create a variety of chromosomal variations including Down syndrome, Klinefelter Syndrome, and Turner Syndrome. Speculate (or explain what you already know) about how meiosis can malfunction, and what the chromosomal causes and symptoms are of the syndromes listed above.
3. Read the Chapter Review at the end of chapter 10. Then read the section review for concept 12.4. Spend a moment thinking about the review questions connected with all of these concepts.
4. Now dig in and read the chapter. Convert what you've learned into interactive flashcard using qwizcards.

Chapter 10: Overview

1. Make sure you know the meaning of heredity, variation, and genetics.

Concept 10.1: Offspring acquire genes from their parents by inheriting chromosomes

2. Define *gene*, *gamete*, *somatic cell* and *locus*.
3. Contrast *asexual* and *sexual* reproduction.

Concept 10.2: Fertilization, Meiosis, and Sexual Life Cycles

4. Define *karyotype*, and describe how karyotypes are made.
5. What are *homologous* chromosomes?
6. Contrast *sex chromosomes* and *autosomes*.
7. Contrast *haploid* and *diploid*, and discuss their relation to gametes and somatic cells.
8. Using Figure 10.5 and the text, describe the human life cycle in terms of meiosis and fertilization. Use the following terms: *zygotes*, *gametes*, *somatic cells*; *haploid*, *diploid*, n and $2n$

Note that since the AP curriculum dropped (for the most part) plant biology, you can skip “The Variety of Sexual Life Cycles.”

Concept 10.3: Meiosis

9. Using the text and figure 10.7, describe what gets separated in meiosis I and meiosis II.
10. Use figure 10.8 and the text to describe the events of prophase I. Include terms such as *tetrad formation*, *chiasmata*, *crossing over*, *synapsis*.
11. Using the text and Figures 10.8 and 10.9, describe how the events of meiosis I generate variation in offspring. Why are crossing over and independent assortment of chromosomes so important?
12. Use Figure 10.10 to compare and contrast mitosis and meiosis. In terms of function and generation of variation, how are they different?

Concept 10.4. Sexual Reproduction creates variation that contributes to evolution

13. This section focuses on the main idea of the chapter: variation.
 - a. How does meiosis create variation?
 - b. How does fertilization create variation?
 - c. Why is variation evolutionarily important?

Concept 12.4: Errors in Meiosis and Chromosomal Mutation

14. What is nondisjunction?
15. Compare and contrast monosomy and trisomy.
16. What's polyploidy?
17. Describe the following chromosomal mutations
 - a. Deletions
 - b. Inversions
 - c. Translocations
18. Human chromosomal variation. Describe the causes and consequences of
 - a. Down syndrome
 - b. Klinefelter syndrome
 - c. Turner syndrome
19. What's going on with cri du chat and chronic myelogenous leukemia?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.Learn-Biology.com)

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](#) webpage (for Mr. W's BHS students) or [qwizcards.com/wizard](#), or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 11: Mendelian Genetics; and Chapter 12: Genes and Chromosomes

Big Picture Questions, part 1

These chapters focus on how genes get passed from one generation to the next. Before you read, respond to the following questions

1. You've undoubtedly been exposed to genetics in previous biology classes in high school or middle school. Use what you know to respond to the following.
 - a. Mr. W has brown eyes. His wife, Nancy, has blue eyes. Both of Mr. W's children have blue eyes. What's going on?
 - b. If a person with type A blood has children with a person who has type O blood, offspring cannot have Type AB or type B blood. Why?
 - c. Many genetic traits, such as skin color or height, are inherited with a type of blending effect (a tall woman and a short man might have medium height children). What's going on?
 - d. Why are some diseases and conditions, such as the bleeding disorder hemophilia or Red-Green Colorblindness are much more common in males than females. Why?
 - e. Often, genetic traits seemed to be linked to one another. Based on what you know about meiosis, why might that be so?
2. Read the Chapter Reviews at the end of chapters 14 and 15. Spend a moment thinking about the review questions.

Chapter 11 Overview

1. What's the "blending" idea of heredity? What does this hypothesis predict? How is blending different from "particulate" hypothesis?

Concept 11.1: The work of Gregor Mendel

2. Just so that you can be a scientifically literate person, sketch (very briefly) the life of Gregor Mendel.
3. Describe the typical results of Mendel's monohybrid crosses for the F_1 and F_2 generation. As you do, define the key terms involved in Mendel's experiments: *hybrid*, *hybridization*, *monohybrid cross*, *P generation*, *F_1 generation*, *F_2 generation*. Contrast *dominant* and *recessive* alleles, *homozygous* and *heterozygous*, *genotype* and *phenotype*.
4. Describe Mendel's *Law of Segregation*, and draw a Punnett square to show how it works in a monohybrid cross (see figures 11.3 and 11.4, along with Table 11.1).
5. Figure 11.4 describes the molecular basis for dominant and recessive alleles. Summarize why, in terms of DNA and protein, dominant alleles are dominant. In other words, why do organisms that are homozygous dominant have the same phenotype as organisms that are heterozygous?
6. Using figure 11.7 and the text, explain what a test cross is.
7. Describe the principle of Independent Assortment. Use it to explain a dihybrid cross, and draw a Punnett square to show how the whole thing works (see figure 11.8)

Concept 11.2: Inheritance and the laws of probability

8. What's the multiplication rule? What's the addition rule? How does each apply to genetics, and when is each one to be used?

Concept 11.3: Inheritance beyond Mendelian Genetics

9. Compare and contrast *complete dominance*, *codominance*, and *incomplete dominance*.
10. This is an extension of question 11.4 above, and you can add to it or address it separately. How are dominance and phenotype related at an organismal, biochemical, and molecular level?
11. What are multiple alleles?
12. Define/describe polygenic inheritance (note that pleiotropy and epistasis are NOT part of the AP Bio curriculum).
13. How do nature and nurture interact to bring about phenotype? [Note that this is a tremendously deep and nuanced concept: just give it your best shot here based on the text].

Concept 11.4: Mendelian Inheritance in Humans

14. Describe the symptoms and molecular causes of Tay-Sachs, Cystic Fibrosis, Sickle cell disease, achondroplasia, and Huntington's disease.
15. How are the diseases you studied in the previous question different from multifactorial diseases like heart disease, cancer, and diabetes?

Concept 12.1: Chromosome Theory of Inheritance

16. Describe the key idea of the chromosomal theory of inheritance.
17. Use figure 12.2 to answer the following: How is the behavior of chromosomes in meiosis parallel to that of Mendel's alleles? Make sure you account for both Mendel's law of segregation and his law of independent assortment.
18. How did Morgan, through his experiments on fruit flies, establish the chromosome theory of inheritance?

Concept 12.2: Sex Linked Genes

19. How does the XX, XY sex determination system work? What's the molecular genetic basis for this system?
20. What are sex linked genes? How is their inheritance pattern different from genes on autosomes?
21. What are some sex-linked disorders in humans?
22. Describe X inactivation. What's happening on a molecular basis to bring it about?

Concept 12.3: Linked Genes

23. What are linked genes? How are they different, physically and behaviorally, from unlinked genes?
24. What's recombination? What's the recombination frequency for unlinked genes? Why do linked genes sometimes recombine?
25. What's the relationship between the distance of two linked genes and their recombination frequency?
26. What are linkage maps? How is linkage frequency used to create linkage maps?

Note that you've already completed the reading for Concept 15.4

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.Learn-Biology.com)

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://www.qwizcards.com) webpage (for Mr. W's BHS students) or [qwizcards.com/wizard](http://www.qwizcards.com/wizard), or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Unit 6: Gene Expression and Regulation

Chapter 13, Concepts 13.1 to 13.3, also concept 3.6 and 3.7: DNA: Discovery and Replication

Big Picture Questions

This chapter focuses on DNA, the signature molecule of biology. Before you read, think about the questions below.

1. DNA is an informational molecule. How does the structure of DNA allow it to store information? If you don't know anything about this from your previous studies, then ponder this question: how could a molecule store information (in the same way that a page of text stores information).
2. In addition to storing information, DNA can also be copied in a way so that its information can be transmitted to new generations of cells, or entire organisms. How does the structure of DNA allow for DNA to be copied?
3. Read the Chapter Reviews at the end of 13.1 through 13.3. Spend a moment trying to answer the review questions. Remember that you're not expected, at this point, to be able to answer these questions. But the effort of thinking of answers will prepare your mind for the learning to come.
4. Now read the chapter, focusing on the following content.

Chapter 13 Overview

10. Why is DNA so important?

Concept 13.1: DNA is the genetic material

11. Why was protein, at one point in the history of science, considered to be a stronger candidate than DNA for being the genetic material?
12. What is transformation? How did it contribute to our discovering the significance of DNA?
13. Summarize the Hershey Chase experiment (illustrated in figure 13.5): why was it important?
14. What were Chargaff's rules? How did they contribute to deciphering the structure of DNA?
15. What was Rosalind Franklin's contribution to the discovery of DNA's structure? Why didn't she get a Nobel prize (as did Watson, Crick, and Wilkins)? If you're interested, there are many books and websites about Franklin...
16. Summarize the evidence that Watson and Crick used to figure out the structure of DNA.
17. Use figure 13.8 and the text to describe the Watson-Crick model of DNA (nucleotide structure, overall shape, base pairing rules, sugar-phosphate bonds, anti-parallel structure, purines/pyrimidines, etc.).

Concept 13.2: DNA Replication

Note: the chorus for my [DNA Replication Rap](#) is the conclusion to Watson and Crick's paper.

18. Use the text and Figure 13.11 to explain, on a big picture level, how DNA replication works.
19. Why is DNA replication correctly described as *semiconservative* (see figure 13.12, as well as the text)? How was the semiconservative model of replication proved to be correct (summarize Meselson and Stahl's ingenious experiment, described in Figure 13.13)?
20. Describe the parts involved in of DNA replication (use figures 13.17-13.19):
 - a. Origin of replication
 - b. Replication fork
 - c. Replication bubble
 - d. Key enzymes and what they do (DNA helicase, single strand binding proteins, topoisomerase, DNA polymerase, DNA primase, DNA ligase)
21. Explain how synthesis on the leading strand is different from that on the lagging strand (see figure 13.17). Include a description of Okazaki fragments.

22. Explain why all of the models on this page are oversimplifications (briefly summarize the idea of the DNA Replication Complex). You can see a spectacular animation of this at <http://www.hhmi.org/biointeractive/dna-replication-advanced-detail>

23. Describe, in general terms, how DNA is proofread and repaired. Cover mismatch repair, nucleases, and nucleotide excision repair.

24. Why, from an evolutionary perspective, are mutations important?

25. How are the ends of DNA molecules replicated? Why is this a problem for mortal, multicellular eukaryotes like you and me? What are telomeres? Telomerase?

Concept 13.3: Eukaryotic Chromosome Structure

26. Study Figure 13.23. Briefly describe

- a. Histones
- b. Nucleosomes
- c. DNA looping at the 30 nm and 300 nm level.

27. Compare and contrast heterochromatin with euchromatin. How does this relate to gene expression in eukaryotic cells?

Note: we'll come back to genetic engineering (concept 13.4) later.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 14: From Gene to Protein

Big Picture Questions, part 1

This chapter focuses on how information in DNA (your genetic inheritance) is translated into protein (the way you manifest yourself in the world). Later, you'll see that this also referred to as genotype and phenotype. So, before you read, think about the questions below.

1. Do some reviewing of material you've already learned. What are the monomers of proteins? How are these monomers alike? Different? How do they join together to form a polymer? How do these proteins fold into their correct shape?
2. If you like cryptography, there's a lot in this chapter that you'll enjoy. Imagine that you had a code, like the code that DNA is written in, that consists of four letters (A, T, C, and G). You need to use these four letters to spell out the 26 letters in our alphabet. How would you do it?
3. The terms "transcription" and "translation" will be very important in this chapter. Right now, how would you describe the difference between transcribing something and translating something?
4. Review some cell parts. What's the function of ribosomes? Of the rough endoplasmic reticulum?
5. If you've learned about the details of protein synthesis in a previous biology course, write down a response to this question: how do cells synthesize proteins?
6. What do you know about mutations? What causes them? What effects do they have?

Chapter 14 Overview

Note that you can refer to my Protein Synthesis video for an overview of many of the key ideas in this chapter (the link should be below this document.)

1. What is gene expression?

Concept 14.1: Genes Specify Proteins...

2. Use the text and figure 17.2 to answer: What's the one-gene, one enzyme hypothesis, how was it confirmed, and why is it regarded as a bit of an oversimplification?
3. What's the difference between transcription and translation?
4. Why is a *triplet* code required to spell out the amino acids in proteins (why three bases/amino acid, and not one or two)?
5. During transcription what's the template strand? What's the non-template strand? Which one of these is the coding strand?
6. What's a codon?
7. Briefly summarize how the genetic code was deciphered?
8. What's a reading frame?
9. What's the evolutionary significance of the shared genetic code used by (nearly) all living things

Concept 14.2: Transcription

10. Using the text and figure 17.8, describe how transcription works. Include the role of RNA polymerase, and the three stages of transcription (initiation, elongation, termination).
11. During transcription, what's the role of the *promoter* and the *terminator*?

Concept 14.3: Post Transcriptional modification of eukaryotic RNA

12. How do eukaryotic cells modify the ends of transcribed RNA?
13. Describe what happens with introns, exons, and explain how it happens.
14. What are ribozymes?
15. How might the organization of eukaryotic DNA into introns and exons be functional?

Concept 14.4: Translation

Note that my Protein Synthesis song covers about all you need to know about translation.

16. Describe the structure of tRNA. How does its structure relate to its function? Include a discussion of anti-codons.
17. What are *aminoacyl tRNA synthetases*? What do they do, and how do they do it? Again, think about structure/function relationships.
18. Describe the structure of a ribosome. Include the P, A, and E sites.
19. Describe protein synthesis. What happens during initiation? Elongation? Termination?
20. Using the text and figure 14.21, explain how proteins know whether to stay in the cytoplasm, or go to the ER?
21. How does what you are learning in this chapter about protein synthesis change (or enhance) how you think about the four levels of protein structure from chapter 3?

Concept 14.5: Mutations

22. Define mutation.
23. When do mutations cause genetic disease?
24. What's a point mutation?
25. Distinguish between these different types of substitution mutations.
 - a. Silent mutations
 - b. Missense mutations
 - c. Nonsense mutations

26. What are frameshift mutations? How are they caused?

27. What are mutagens?

Concept 17.6: What is a gene?

28. Based on this section, what's the best definition of a gene?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your qwizcards webpage, create flashcards that capture the key ideas from what you've read. You don't need to have one flashcard/question. Chunking the questions together will improve your learning. Each flashcard should have a relatively short question on the front, and a very substantial answer on the back. Spend as much time as needed to memorize the response to these flashcards, as well as cards in the previous chapters. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

[Jump back to the top](#)

Chapter 17 (Viruses)

Big Picture Questions, part 1

This chapter focuses on viruses, which stand on the border between living and non-living. In previous chapters in this course, you've already been exposed to the basics of viral life cycles (remember the Hershey-Chase experiment?). In addition, viruses are frequently in the news, and you've probably missed a day or two of school sometime in the not too distant past because of viral infections. So, before you read, respond to the questions below (which will prepare you for the learning you're about to do)

1. What are viruses? Are they alive? Why or why not?

2. How do viruses attack cells?

3. What is it about viral infection that causes illness?

4. Viral infections can't be treated by antibiotics (which are substances that kill bacteria). But there are certain drugs that can inhibit viral reproduction. Knowing what you do know about viruses (remember the Hershey Chase experiment) how might some of these drugs work?

5. Some viruses (herpes, hepatitis, HIV) infect you for very long periods of time. Use whatever you know about your body, your cells, and biology in general to propose an idea about what might be going on?

6. Read the Chapter Review at the end of the chapter. Spend a few moments verbally answering the review questions at the end of each concept review..

7. Now, you're ready to learn. Dig in and summarize the chapter, answering the questions by creating interactive flashcards.

Overview: A borrowed life

Note that you can refer to my music video I'm a Virus for an overview of the material in this chapter. Use the "Music Videos" link above.

1. What are viruses?

Concept 17.1: Virus structure

2. Describe the structure of a virus: its genome, capsid, envelope.

3. Make a labeled diagram of a bacteriophage.

Concept 17.2: How viruses replicate

4. What is *host range*, and how does it differ for different viruses?
5. Using Figure 17.3 and the text, describe the basic life cycle of viruses.
6. Describe the lytic cycle (using Figure 17.4)
7. Describe the lysogenic cycle (using Figure 17.5)
8. Compare and contrast restriction enzymes with the CRISPR-Cas System.
9. How are animal virus life cycles different from phage life cycles? How do viral envelopes form?
10. What's a retrovirus?
11. Describe the structure and life cycle of HIV. Be able to identify all the parts shown in Figure 17.8.
12. How did viruses evolve?

Concept 19.3: Viruses, Viroids, and Prions

13. How do viruses cause disease?
14. How (on a superficial level for now) do vaccines work (we'll cover this when we learn about the immune system)?
15. How do some antiviral drugs like AZT and acyclovir work?
16. Where do new viral diseases come from? Note that you're reading this more for big picture than for detail.
17. What are some viral diseases in plants, and how do they spread?
18. What's a viroid?
19. What's a prion? How do prions work? What diseases are associated with prions?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Concepts 24.2, 24.3, and 15.1: Bacterial Genetics

Big Picture Questions

These concepts focus on two aspects of bacterial biology: their genetic diversity (and how that comes about), and how they regulate their genes. These are two topics that you probably don't have a lot of context for, and might not have studied in previous biology classes. But you know a lot of biology, so give the following questions a try.

1. Bacteria reproduce themselves by binary fission (dividing themselves in half as they replicate their genetic material). Yet the bacteria of any species are far from clones of one another. What could be the sources of bacterial genetic diversity?
2. You've learned about cell communication. You've also learned about the process of protein synthesis. How might the processes involved in cell communication relate to how bacterial cells, at any moment, "decide" which genes to transcribe and translate?

Concept 24.2

Just to get a sense of how amazing and varied bacteria are, activate your sense of wonder and quickly read the material in Concept 24.2. DO NOT TAKE ANY NOTES.

Concept 24.3: Bacterial Genetic Diversity

1. Describe the mechanisms that promote genetic variation in prokaryotes
 - a. Mutation
 - b. Transformation
 - c. Transduction
 - d. Conjugation
 - e. Transposition via transposons (note that this is not in this section of the text, but you can find it on p. 364. The elements involved in transposition (transposons) work the same in prokaryotes and eukaryotes (at least as far as we're concerned).

Concepts 24.4 and 24.5

This is very cool stuff. However, it's not required. If you love science, you'll choose to read this for entertainment.

Concept 15.1, (Gene Regulation in Prokaryotes)

2. Summarize the example of how control of gene expression can be adaptive.
3. Briefly describe the two ways that *E.coli* can control tryptophan synthesis.
4. Describe the overall structure of an operon. Include the promoter, operator, repressor, regulatory genes, regulatory proteins.
5. Use the text and Figure 15.3 to explain how the trp operon works.
6. Use the text and Figure 15.4 to explain how the lac operon works.
7. What's the difference between how an inducible and how a repressible operon works?
8. How does CAP work, and how does it affect the lac operon?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.learn-biology.com)

Master the content

2. On your [gwizcards](http://www.gwizcards.com) webpage, create flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

[Jump back to the top](#)

Chapter 15: Eukaryotic Gene Expression: includes 15.2, 15.3

Big Picture Questions

This chapter focuses primarily on how and why the cells in your body express the specific genes that they express. A secondary topic is how cells become cancerous. Before you read, prepare yourself for learning by answering the questions below.

1. You learned about prokaryotic gene regulation (the lac and trp operons) earlier in our course. As painful as this might be to recall this information, write a short paragraph describing how operons work. Do this without looking back at your notes (at least the first time through).
2. Now, think about the fact that the cells in your liver and the cells in the lens of your eye have the same DNA...but they're doing completely different things. How can two cells with the same DNA express completely different proteins? See how you can apply some of the principles of prokaryotic gene regulation to this question about eukaryotic gene regulation.
3. Read the concept reviews for 15.2, and 15.3, and spend a moment thinking about how you would answer the review questions.

Concept 15.2 (p. 308): Eukaryotic Gene Expression

1. Think back to when you learned about operons. Why is control of gene expression important in eukaryotes? How does this compare to why it was important in prokaryotes?
2. What is differential gene expression? How is it related to cell specialization? What happens when this process goes wrong?
3. Examine Figure 15.6. What are the processes that allow for regulation of gene expression?
4. Go back to figure 13.23: review the key levels and components involved in DNA packing, especially histones and nucleosomes. How is the structure of chromatin related to gene expression?
5. Use figure 15.7 and the associated material in the text. What's acetylation? What's the connection between histone acetylation and gene expression.
6. What is DNA methylation, and how is it connected to gene expression?
7. What is epigenetic inheritance, and how is it related to the processes you just read about in this section?
8. Review: Use figure 15.8 and the text to describe the organization of a typical eukaryotic gene.
9. What are transcription factors? What's the difference between a general transcription factor, and a specific one?
10. Use the information in figures 15.9, 15.10 and the text to summarize how enhancers and transcription activators set the stage for gene transcription.
11. Figure 15.11 explains why cells in the liver and the lens of the eye have the same genes, but have different patterns of gene expression. Using the images, the caption, and the associated text, see if you can explain why gene expression is different in these different cells.

Mechanisms of Post transcriptional regulation

12. What's alternative RNA splicing, and how does it "expand the repertoire of a eukaryotic genome?"
13. How is mRNA degradation involved in regulation of gene expression?
14. How does gene regulation occur at the level of protein production (translation), processing, and degradation?

Concept 15.3: Non-coding RNAs and gene expression

15. What are non-coding RNAs. If mRNA is the rock star, what are these non-coding RNAs?
16. Use figure 15.13 to explain how miRNA can regulate gene expression.
17. Explain the process of RNA interference, and the molecules responsible for it (siRNAs)

DO THE INTERACTIVE TUTORIALS ON EUKARYOTIC GENE REGULATION AT Learn-Biology.COM.

[Jump back to the top](#)

Animal Development: Concept 36.4 and Chapter 16

Big Picture Questions

This hybrid chapter focuses on how (and other multicellular animals) you develop from a single cell into a complex, integrated, multicellular animal. Before you read, prepare yourself for learning by answering the questions below.

1. How does one cell develop into a complex multicellular organism. Briefly tell the story of what happened to you in the three months between the time that your father's sperm fertilized your mother's egg, and three months later, when you were a tiny fetus with arms, legs, organs, brain etc.
2. Cancer is a disease of cell division. Early in the course, you learned about how problems with regulation of the cell cycle can result in cancer. Now, use concepts from previous chapters (cell cycle, DNA, mutation, and cell communication) to speculate about how a cell might become cancerous.

3. Read the concept reviews and spend a moment thinking about how you would answer the review questions.

Concept 36.4: Highlights of Animal Development

Note: There's a lot of amazing material in this concept 36.4 (and in the rest of this chapter)...but a lot of it isn't covered in the AP Curriculum. If you have time, definitely read through it and enjoy.

1. Using the text and Figure 36.13, describe the process of development, starting with sperm and egg, and ending with the adult.
2. Find Figure 36.15, and read the associated text. Describe the earliest phases of development, ending with the hollow ball of cells called a blastula.
3. Study figure 36.16 and the associated text. What is gastrulation? What's organogenesis. Describe the three germ layers, and be able to associate each germ layer with some of the structures that it develops into. For this purpose, knowing the top one or two bullets in figure 36.17 is sufficient. As you read, here's a few things that might be helpful (and which don't need to be committed to memory): 1) the "vegetal" pole is the side of the blastula with more yolk. 2) *Mesenchyme* is a derivative of the mesoderm. The *archenteron* and *filipodia* are two more terms that you don't have to know.
4. What is organogenesis?

Feel free to read to the end of this concept (but, unfortunately, this is not part of our curriculum). If you like this stuff, take Anatomy!

Chapter 16: Development, Stem Cells, and Cancer

Chapter 16 Overview

1. What's the connection between gene expression and development.

Concept 16.1: A Program of differential gene expression

2. Describe the three processes that occur during development: cell division, cell differentiation, and morphogenesis
3. Use the text and figure 16.3a to answer the following: what are cytoplasmic determinants, and how do they influence early cell differentiation?
4. Use the text and figure 16.3b to explain induction, and how it relates to what you've learned about cell signaling?
5. What's determination (in the cellular context). Using the text and figure 16.4, explain how muscle cells become determined and differentiated.
6. How is apoptosis important in development.
7. What's the connection between positional information and the process of pattern formation as an animal (like *Drosophila*, the example in the text) develops?
8. What are homeotic genes?
9. Explain how the head-tail (anterior-posterior) axis is established during *Drosophila* development. Cover these two key features:
 - a. Maternal effect or egg-polarity genes
 - b. How the bicoid gene acts as a morphogen.

Concept 16.2: Cloning and Stem Cells

Note: I've got a song about cloning: "I Want a Clone." It might be useful to view it before or after reading and answering the questions below.

10. Define "cloning" and "stem cells."
11. What is totipotency, and how was it first demonstrated in plants.
12. Describe the technique of animal cloning through nuclear transplantation (see figure 16.11)

13. Describe how cloning of mammals works (using Dolly as an example). What have been some gene regulatory problems found in cloned animals?

14. What are embryonic stem cells, and what are they used for?

15. What are pluripotent stem cells?

16. What are induced pluripotent stem cells, and how are they deprogrammed?

Concept 16.3: Gene expression and Cancer

18. What are oncogenes and proto-oncogenes. Use the text and figure 18.23 to explain how the former might turn into the latter.

19. Describe what tumor suppressor genes do, and how mutations in these genes can lead to cancer.

20. Use the text and figure 16.18 to explain what the ras gene does, how it acts as a proto-oncogene, and how a mutation in ras can lead to cancer.

21. Use the text and figure 16.19 to explain how the p53 gene acts as a tumor suppressor gene.

22. What is the multi-step model of cancer development. Use colon cancer to describe how this model works.

23. Focusing on colorectal cancer and breast cancer, explain how a predisposition to cancer can be inherited.

24. Analyze the text and images in 16.21 and explain how Herceptin works.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your qwizcards webpage, make flashcards that capture the key ideas from what you've read.

[Jump back to the top](#)

Concept 13.4: Genetic Engineering

Before you read, part 1

This chapter focuses on the genetic engineering, “a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms.” (Wikipedia). This technology has staggering medical, agricultural, environmental and industrial implications, and might be (for better or worse) the basis for the next steps in human evolution. To prepare yourself for the reading to come, answer the following questions.

1. Based on what you know about DNA, RNA, and protein, what would you have to do to change an organism's genome?

2. We've been changing organism's genes for centuries: just think about how different domesticated dogs are from wolves: that all human artifice. That's just as true of corn and what as it is of sheep and cows (to mention some more genetically altered, domesticated species). Is directly manipulating DNA and mixing DNA from different species somehow different from these more traditional forms of animal and plant breeding? Justify your answer.

3. Now read and summarize the chapter, converting your answers to the questions below into interactive flashcards.

Overview

1. Define genetic engineering, Why is it important?

DNA Cloning

2. Why do biologists need to clone genes?

3. What are plasmids? How do molecular biologists use plasmids to clone genes?
4. What is recombinant DNA?
5. What's a cloning vector?
6. What are two uses of cloned genes?

Restriction Enzymes

7. How do can restriction enzymes be used to create recombinant DNA? In your answer, cover the following, and be able to explain what's happening in figure 13.25:
 - a. What are restriction enzymes?
 - b. What's the natural function of these enzymes?
 - c. What's a restriction site?
 - d. What are restriction fragments?
 - e. What are "sticky ends" and how are they used in genetic engineering?
8. Once you have restriction fragments, how do you use DNA ligase to create recombinant DNA?
9. What is gene electrophoresis, and how does it work?

Amplifying DNA

10. Use the text and figure 13.27 to answer the following: What's PCR? What is it used for? How does it work? What enzymes are used?

DNA Sequencing

11. The text is very brief, and we'll add material in class. What is DNA sequencing? Why is it important?

Editing Genes and Genomes

12. Using figure 13.31, explain how genes can be edited through CRISPR-Cas9.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your [qwizcards](http://qwizcards.com) webpage, make flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

[Jump back to the top](#)

Chapter 21: Genomics

Big Picture Questions

This chapter focuses on genomes: how they're analyzed, and what we've learned from analyzing them. Before you read, answer the following questions.

1. The Human Genome Project was completed just before you were born. It's been compared to the "Moon Landing" for biology. Write down everything you know about what this project achieved.
2. What is the message in your DNA. Speculate about how much of it codes for proteins? How much of it might be regulatory? Meaningless? Make your speculation as specific as possible.
3. Gene duplication is a common thing within genomes. How could this happen? Why might it be a good thing?
4. How similar are we to chimpanzees? Speculate about some specific ways in which our genomes have diverged?

Chapter 18, Overview: Reading Leaves from the Tree of Life

1. What's a genome (you might have to look this up). Define *genomics* and *bioinformatics*.

Concept 18.1: The human genome project and sequencing

2. What was the Human Genome Project? What did it accomplish?
3. Describe the *whole-genome shotgun approach* to sequencing.

Concept 18.2: Using Bioinformatics

4. Just to get a sense of the accessibility of this information, go to www.ncbi.nlm.nih.gov, and look around at the resources available.
5. Type "BLAST" into any Web browser. Go to BLAST, and use the text and what you see at the site to find three things that this tool lets you do.
6. What is the ENCODE project, and what have been some of its findings?
7. What is proteomics?
8. How is systems biology and genomics being applied to the study (and eventual treatment) of cancer.

Concept 18.3:

9. Using the text and Table 18.1, write some generalizations (just a few sentences) about comparative genome size between bacteria, archaea, and eukaryotes.
10. How many genes are in the human genome? Why is this surprising? How might vertebrate genomes be able to increase their complexity without increasing their genome size?
11. How are bacterial genomes different from eukaryotic ones? Use the term *gene density* in your answer.

Concept 21.4: Non-coding DNA and Multigene Families in Eukaryotes

12. Use figure 18.5 and the text to describe the types of DNA that make up the human genome. The numbers to commit to memory are the percentage of exons, introns, and repetitive DNA.
13. What's some evidence that non-coding regions of DNA might be playing some important function?
14. What are pseudogenes?
15. What are transposable elements? What % of the genome do they make up? How do these sequences get there?
16. List some of the other types of repetitive DNA in the human genome.
17. What are multigene families, and what might the the function of identical multigene families (like the genes for rRNAs) and non-identical ones (like the globin genes)

Concept 18.5: Duplication, Rearrangement, and DNA mutation in genome evolution

18. Describe the mechanism and consequences of each of the following mechanisms of genome evolution.
 - a. Duplication of entire chromosome sets
 - b. Alteration of chromosome structure (and make sure you study and marvel at figure 18.10)
 - c. Duplication and divergence of gene-sized regions
19. Use the text and figure 18.13 to explain how human globin genes have evolved over time.
20. Using the genes for lysozyme and alpha-lactalbumin as an example, explain how gene duplication can lead to the evolution of genes with entirely new functions.
21. How can genomes evolve through exon duplication and shuffling, and what advantages might accrue to the species in which this occurred?
22. Use the text and figure 18.14 to explain how transposable elements can contribute to genome evolution.

Concept 18.6: Comparative Genomics, Evolution, and Development

23. What's been learned about human/chimp evolution by a comparison of their genomes? Focus on the FOXP2 gene as you tell this story.
24. What's been learned about the evolution of various human populations by comparative genome analysis.

25. What's evo-devo? What's the significance of the fact that homeotic genes have been so widely conserved among animals. What do these genes code for, and how do they exert their control over development?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com (still under development: sorry!)

Master the content

2. On your [qwizcards](#) webpage, make flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

Additional Resources

[DNA, The Human Race](#) (Nova Documentary about the Human Genome Project)

[Jump back to the top](#)

Unit 7: Natural Selection/Evolution

Chapter 19: Descent with Modification

Big Picture Questions

This chapter goes into depth about how evolution works. So, before you read, think about the questions below.

1. Use previous knowledge from other life science classes and from chapter 1 to explain how evolution works? Specifically, explain what you already know about Darwin's theory of evolution by natural selection.
2. Many traits of living things aren't easily explained by the process of natural selection. How do we explain features of living things like the beauty of a [male wood duck](#), or the differences in size between [male and female sea elephants](#),
3. How does evolution explain both the unity and the diversity of life?
4. What's the evidence for evolution?
5. Read the Chapter Review at the end of the chapter. As I instructed you in chapter one, note that at the end of each concept review, there's a question. Spend a moment thinking about the answer. You don't have to write down an answer, but don't skip this step. Asking questions before learning is a proven strategy for enhancing memory.
6. Now read the chapter, focusing on the following content.

Chapter 19 Overview

1. Define *evolution*. How is it both a pattern and process?

Concept 19.1: The Darwinian revolution

Read the material about Linnaeus, Cuvier, Lyell for historical context/background.

2. What are fossils? How do they form? What are *strata*?
3. What were the two main points of Lamarck's theory of evolution?

Note: through the field of *epigenetics*, Lamarck's ideas have come back into vogue. Feel free to preview some upcoming course material by researching that topic...

Concept 19.2: Descent with Modification...

Read the material Darwin's early life and the Beagle's voyage.

4. What are *adaptations*?

5. Who was Alfred Russell Wallace, and what was his influence upon Darwin?
6. What is *descent with modification*? How does it explain the tree-like, branching pattern of evolution?
7. Explain artificial selection, and describe how it led Darwin to his notion of natural selection.
8. Describe Malthus's influence on Darwin.
9. The text emphasizes that "individuals do not evolve." What does evolve? As briefly as you can, explain natural selection.

Concept 19.3: Evidence for Evolution

10. Describe the recent evolution of the soapberry bug and *Staphylococcus aureus*
11. What's a homologous structure? How are these related to vestigial structures?
12. What is convergent evolution? Use this idea to differentiate between homologous structures and analogous structures.
13. How does the fossil record provide evidence for evolution?
14. What is biogeography, and how does it provide evidence for evolution?

Concept 21.4: Sexual Selection (p. 427)

Note: Just read the section on "sexual selection"

18. Define sexual selection and sexual dimorphism.
19. How does intrasexual selection work? What kind of sexual dimorphism does it generate in males and females? Use the internet to find four examples of species with intrasexual selection.
20. How does intersexual selection work? What kind of sexual dimorphism does it generate in males and females? As above, use the internet to find four examples of species in which intersexual selection is at work.
21. Speculate: which kind of selection is at work in humans? Justify your response.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.learn-biology.com)

Master the content

2. On your [gwizcards](http://www.gwizcards.com) webpage, make a flashcard deck or an interactive quiz that will help you master the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

[Jump back to the top](#)

Chapter 20: Phylogenetics

Big Picture Questions

This chapter focuses on phylogeny: the part of biology that deals with determining evolutionary relationships. This material is not something that a typical first year biology student has much context for. But let's prepare our minds for learning by trying to answer the following pre-reading questions.

1. Say that you're presented with four species. Your job is to determine which species are most closely related to one another. How would you do it? As you answer this, draw on the considerable amount of biology that you've learned in this course. What similarities would you use to group these species?
2. Read the concept reviews at the end of this chapter. Because this is unfamiliar material read it slowly, and thoughtfully consider the review questions.

Chapter 20, Overview

1. What is phylogeny?
2. What is systematics?

Concept 20.1. Phylogenies show evolutionary relationships

3. What is binomial nomenclature?
4. What are Linnaeus' hierarchical classification categories (from domain all the way down to species). To do this, you can use the mnemonic *Daring Kings Play Chess on Fine Gray Satin*. Get it?
5. What is a taxon?
6. It's not in the book, but you should know how YOU (a human being) are classified. You can start with figure 20.3 for reference, but look up the rest (from order on down).
7. What are phylogenetic trees? What are their key features? What is a branch point? Note that there's a lot of very specialized vocabulary here that is *not* important to learn.
8. What are three important things to know about phylogenetic trees (just summarize the section "what we can and can't learn...")

Concept 20.2. Inferring Phylogenetic Relationships

9. When constructing phylogenies, why is it important to distinguish between homologies and analogies, and how can you do that?
10. What's the key thing to look for in constructing *molecular* homologies?

Concept 20.3. Using shared characters to construct phylogenetic trees

11. Since cladistics is the method of choice for understanding phylogeny, this is vocabulary that's worth knowing. Use the text and figure 26.10 to define
 - a. Cladistics
 - b. Clade
 - c. Monophyletic
 - d. Polyphyletic
 - e. Paraphyletic

12. What's the differences between a shared ancestral character and a shared derived character?
13. Read (but don't make flashcards for) the sections from "Inferring Phylogenies" to the end of "Phylogenetic Trees as hypotheses." As you read, carefully try to connect the ideas in the text to the various trees shown. Full disclosure from Mr. W: I generally find this kind of thinking pretty difficult....

Concept 20.4. Molecular Clocks

14. How do molecular clocks work? How are these clocks set? What are some of the problems associated with molecular clocks?
15. Summarize the examples of DNA sequences that change slowly, and those that change more rapidly. Which type is useful for exploring ancient evolutionary events and which is more useful for recent events?
16. How do we know when HIV first entered the human population.

Concept 20.5: Revising the tree of life

17. Describe the evidence that led to the three domain system? Within this system, who (which domain) is most closely related to whom?
18. What's horizontal gene transfer? Briefly describe the "ring of life."

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com (still under development)

Master the content

2. On your [qwizcards](#) webpage, make flashcards that capture the key ideas from what you've read. Alternatively, take notes in Cornell Note format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

Chapter 21: The Evolution of Populations

Big Picture Questions

Because evolution is the most important idea in biology, we started our course by looking at Darwin's theory of evolution by natural selection. Now, with the benefit of months of studying biology, we're going to come back to evolution, and look at it once again with our enhanced conceptual powers. Chapter 21 brings together genetics and evolution. Use what you already know, in addition to what you've learned about in previous biology courses, to address the following questions.

1. Evolution can be thought of as the change in the genes in a population over time. Think of an example of natural or sexual selection (any of the material we've already covered in this course, or new material). Now, try to explain this evolutionary change as a genetic change. For example, as the [leafy sea dragon](#) became adapted to living in kelp beds, how did its genes change? Don't think of an individual...think of a population evolving over time to become more camouflaged. Write out how this could have happened.
2. Next time you're in a crowd of people, look around, and marvel at how different people are. Why are we so different? What are the sources of variation in any sexually reproducing population?
3. You learned in the previous unit about the transmission of dominant and recessive alleles. Do dominant alleles, over time, become more common in populations? Explain your reasoning.
4. Some populations have very little genetic diversity. Why might that be?
5. Read the Chapter Review at the end of the chapter. Take a good look at the review questions at the end of each section, and try to verbally answer them. Skipping this will compromise the learning that you're about to do, so don't skip it.

Chapter 21 Overview

1. Use the description of the Grants' study of the medium ground finch to explain why evolution is a *population* (as opposed to an *individual*) phenomenon.
2. What is microevolution?
3. As a preview of what you'll learn in this reading, what are the three causes of microevolution?

Concept 21.1: Genetic Variation

4. What is genetic variation?
5. What's the difference between genetic variation that's "either-or", and variation that's gradual (or *graded*)? Think about human beings, and list a few examples of each.

6. How can gene variation be quantified?
7. Why is nucleotide variation not necessarily translatable into phenotypic variation?
8. List some examples of variation that *aren't* genetic.
9. Describe the following sources of genetic variation
 - a. Mutation at the molecular level
 - b. Chromosomal mutations
 - c. Rapid reproduction
 - d. Sexual reproduction

Concept 21.2: Hardy-Weinberg

10. Define
 - a. Population
 - b. Gene pool
 - c. Fixed allele
 - d. Allele frequency
11. What's the Hardy-Weinberg equation?

12. What are the five conditions required for a population to remain in Hardy-Weinberg equilibrium?

Concept 21.3: Natural selection, genetic drift, and gene flow alter allele frequency

13. How can natural selection affect allele frequencies?

14. Define *genetic drift*, and use the case study of the greater prairie chicken to describe why it's usually bad for a population's long term survival prospects.

15. Compare and contrast the *bottleneck effect* with the *founder effect*.

16. What is *gene flow*, and explain its possible effects upon a population's adaptiveness. Incorporate the the study of *Paris major* into your answer.

Concept 21.4: Natural selection and adaptive evolution

17. Describe natural selection in terms of allele frequencies.

18. What is relative fitness?

19. Write a few sentences clarifying the differences between directional, disruptive, and stabilizing selection.

20. Summarize the section about "the key role of natural selection in adaptive evolution."

21. Explain how each of the following maintain genetic variation in populations:

- a. Diploidy
- b. Balancing selection
- c. Heterozygote advantage
- d. Frequency-dependent selection

22. Note: we read this material about sexual selection [much earlier in the year](#). Use this as an opportunity to review what it is, how intersexual and intrasexual selection work, and how both processes generate sexual dimorphism.

23. With reference to figure 21.15, explain why sickle cell disease is in such high frequency in certain African populations.

24. Summarize the section listing four reasons why natural selection cannot fashion perfect organisms.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](#)

Master the content

2. On your [qwizcards](#) webpage, make flashcards that capture the key ideas from what you've read.

[Jump back to the top](#)

Chapter 24: Speciation

Big Picture Questions

This chapter focuses on one of the key entities in biology: the species. This includes a discussion of what species are, how species emerge. Before you start reading, answer the questions below.

1. What is a species?
2. What keeps closely related species (like [mallard ducks](#) and [pintail ducks](#)) from breeding with one another?
3. Sometimes, very closely related species (like wolves and dogs) can breed together. What keeps these species' gene pools distinct?
4. How does one species split into two descendant species?
5. How can one species change over time into another species?
6. Read the Chapter Review at the end of the chapter. Spend a moment deeply contemplating possible answers to the review questions that follow each concept.

Overview

1. What is *speciation*?
2. Compare microevolution to macroevolution? What different topics do they cover? How are they related?

Concept 22.1: Biological Species Concept

3. What is the *biological species concept*?
4. What are reproductive barriers? Describe some cases where these barriers break down.
5. Use the text and figure 22.3 to compare and contrast prezygotic and postzygotic isolating mechanisms (going into some depth on the various types of reproductive barriers associated with each one). You should be able to list five prezygotic barriers and three post zygotic barriers from memory.
6. What are some of the limits of the biological species concept? Describe why the *morphological*, *ecological*, and *phylogenetic* species concepts are useful additions to the biological species concepts.

Concept 22.2: Mechanisms of speciation

7. How does allopatric speciation work?
8. What's the evidence for the allopatric speciation model?
9. What is sympatric speciation?
10. Describe some of the chromosomal changes (various types of polyploidy) that can cause sympatric speciation in plants.
11. How can habitat differentiation and sexual selection lead to sympatric speciation?

Concept 22.3: Hybrid Zones

12. What are hybrid zones?
13. What are the three possible outcomes of hybrid zones?

Concept 24.4: The pace of speciation

14. Contrast gradualism with punctuated equilibrium. What's the evidence for each model?
15. Describe some of the genetic changes that underlie speciation?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 23 (Broad Patterns of Evolution)

Big Picture Questions

1. What are fossils? How do they form? How do we know how old they are?
2. Look over the review page for chapter 23, then just examine the reviews for concepts 24.1, 25.1, and 25.2.

Chapter 23 Overview

1. What is macroevolution?

Concept 23.1, The Fossil Record...

2. How do fossils form?
3. Explain the paradoxical reality that the fossil record is both detailed and incomplete.
4. How are fossils dated?
5. Combine the next questions into one flashcard
 - a. Based on the fossil record, when did life first emerge (and what's the evidence for that)?
 - b. What was life like for the next 1.5 billion years?
 - c. When did eukaryotes first emerge?
6. What's the central message of the section "The Origin of New Groups of Organisms," and it's accompanying image (figure 23.5).

Concept 23.2, The Rise and Fall...

7. How has plate tectonics/continental drift contributed to the rise and fall of major groups of organisms.
8. What are mass extinctions and how do they affect the pattern of life on earth?
9. What is adaptive radiation? What are the main factors that influence it?

Concept 23.3, Major changes

10. Explain the intersection between developmental biology and evolutionary change. In your answer, cover *heterochrony*, *paedomorphosis*, and *homeotic genes* (though knowing the terms is less important than knowing the underlying biology)
11. How can changes in gene sequence and gene regulation have evolutionary impacts.

Concept 23.4, Evolution is not goal oriented

12. Why is evolution like tinkering?
13. Creationists love to criticize evolutionary thinking by saying "what good is half an eye!" What's the problem with this argument, and how would you respond to a creationist who said this to you? Use the text and the images in figure 23.22 in your counter-argument.
14. Summarize the section on evolutionary trends. How do such trends work?

After Reading

We'll save this until after chapter 20. Note that you've already read what's immediately below)

[Jump back to the top](#)

Concepts 24.1 (Origin of life) Pre Reading questions

1. If you could travel back in time to around 3.8 billion years ago, right at the time that life was emerging on Earth, how would this earlier Earth be different from the Earth today? Think, in particular, about the atmosphere and the energy inputs to our young planet.
2. You know, at this point, a ton about life. Explaining the origin of life involves thinking through a conceptual "chicken and the egg" problem. Life involves, at a bare minimum, a genetic system (like DNA) that encodes agents (like proteins) for recreating that genetic system. In life today, DNA codes for proteins, which are the enzymes that are involved in recreating DNA. But how could that system have arisen in the first place? Spend a few minutes speculating about how that system could have spontaneously arisen.
4. The information here repeats some of what you covered in question 5 above. Add to that question
 - a. When did Earth first form?
 - b. Why was life impossible for the 1st few hundred million years after the Earth formed?

Chapter 24.1: Conditions on Early Earth and the Origin of Life

5. What are the four main stages (proposed in this text: there are other scenarios) that would have led to the emergence of life on earth.
6. What were conditions like on the early earth?

7. How was Earth's early atmosphere different from today's atmosphere?
8. What was Oparin and Haldane's idea about the origin of monomers and the "primitive soup?"
9. The Miller-Urey experiment was one attempt to test the Oparin-Haldane hypothesis. Read this [article](#) and study the associated diagram. Then explain the setup of this experiment, how it attempted to simulate conditions on the early earth, and what it established.
10. The "classical" idea about the origin of life proposes that life arose in the seas of early Earth. What are some other places where life may have originated, or where significant amounts of chemical evolution may have occurred?
11. What's the name for the type of reaction in cells in which monomers are formed into polymers (note: this question harkens back to chapter 3)? How could monomers could have been combined *abiotically* into polymers?
12. How might the first cells (protocells) have arisen?
13. Describe the RNA world. Why is it likely that RNA (and not DNA) was the first genetic system?
14. Describe Campbell's scenario for how protein came to be associated with RNA.
15. How could DNA have taken over the role of genetic material from RNA?
16. What's the fossil evidence for the earliest life?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your [qwizcards](#) webpage, make flashcards that capture the key ideas from what you've read.

Alternatively, take notes in Cornell Notes format, or even make physical flash cards. Choose a strategy that will allow you to do retrieval practice later.

[Jump back to the top](#)

Unit 8: Ecology (including Animal Behavior)

[Jump back to the top](#)

Chapter 39, Concepts 39.3 to 39.6 (Animal Behavior)

Big Picture Questions, concepts 39.3 to 39.6

This second half of chapter 39 focuses on animal behavior, an amazing topic that can have some personal implications (since, we are after all, animals). Prepare your mind for reading by answering the following questions.

1. What do you know about migration? How do animals know where to go?
2. You may have had the experience of having traveled or moved, at least once, far out of your time zone. If so, you probably experienced jet lag. Speculate about what was going on in your body to cause this.
3. To what degree is behavior innate, and to what degree is it learned. If identical twins are reared separately, are they more like their foster families, or more like one another?
4. Much earlier in the course, you learned about sexual selection. Review this concept by explaining how differences in sexes arise.
5. Altruism means benefiting others at one's own expense. Why might it be evolutionarily beneficial for an animal to be altruistic?
6. Read the Chapter Review, limiting yourself to concepts 39.3 to 39.6. Spend a moment thinking about your answers to the review questions for these concepts

Concept 39.3: Discrete sensory inputs can stimulate simple and complex behaviors

1. What is behavioral ecology?
2. What is a fixed action pattern? A sign stimulus? Describe the sign stimulus and the fixed action pattern that Tinbergen observed in his three-spined sticklebacks.
3. What's migration? List some of the ways that migrating animals orient themselves during their journeys.
4. What is a circadian rhythm? A circannual rhythm? How do these rhythms influence animal behavior?
5. What is a stimulus-response chain? Describe either the stimulus response chain involved in *Drosophila* mating, or the stimulus-response chain involved in honeybee communication.
6. What are pheromones? List a few examples of how pheromones are used in animal communication

Concept 39.4. Learning

7. What are cross-fostering studies, and what are they designed to prove? What have these studies proved about behavior in mice of the genus *Peromyscus*?
8. What is the purpose of twin studies in humans. If you have time, [read this astonishing story of two sets of identical twins who were mixed up at birth.](#)
9. What is learning? Describe the following (which will probably have to be organized into several flashcards)
 - a. Imprinting
 - b. Spatial learning and cognitive maps
 - c. Associative learning (including both classical and operant conditioning)
 - d. Cognition and problem solving
 - e. Sensitive periods
 - f. Social learning

Concept 39.5 Selection for individual survival and reproductive success...

10. What is foraging? What are the two alleles that influence foraging behavior in *Drosophila* larvae?
11. Distinguish between promiscuous, monogamous, polygamous, and polygynous mating systems.
12. What's sexual dimorphism, and how is it connected with monogamous and polygynous mating styles?
13. In birds, what's the connection between the independence of offspring and whether a species is monogamous or polygynous?
14. What's the relationship between certainty of paternity and parental (especially paternal) care?
15. What are some of the factors that influence female mate choice.

Concept 39.6, Genetic Analysis and Inclusive Fitness

16. What's the genetic and physiological basis for the differences in pair bonding strategies and parenting styles in the two species of *Microtus* voles? Use this as an opportunity to review some key ideas about cell communication (signals, receptors, etc.)
17. What's the evolutionary basis for prey preference (to each or not to eat banana slugs) in distinct populations California garter snakes?
18. What is altruism? What are some examples of altruism? How can the idea of inclusive fitness explain how altruistic behaviors can be selected for within a gene pool?
19. Hamilton famously quipped that he would give his life to save two siblings or eight cousins. Use this quote as a starting point to summarize *Hamilton's rule*, and relate it to the idea of *kin selection*.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.Learn-Biology.com)

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](#) webpage (for Mr. W's BHS students) or [qwizcards.com/wizard](#), or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 40 (Population Ecology, with some human population biology (43.5))

Big Picture Questions

1. The [California clapper rail](#) lives in a narrow stretch along the California coast, near the Bay Area. Speculate about why this species only lives in one area. Why isn't it found in other habitats? Why doesn't it spread to other areas? Why, in general, do species live where they live?
2. Think of a human population, such as the population of your school. How would you describe it. Now think of a population of [redwood trees](#) in a forest. How would you describe that population?
3. How does a population have to change in order to grow? If you say "it has to get bigger," you're not doing yourself the favor of trying to develop subtle concepts. What about a population has to change for it to increase in size?
4. What keeps populations in check? Why don't they grow forever?
5. Read the Chapter Review at the end of the chapter. Please read all of the concept reviews, and spend a moment thinking about the review questions.

Note: you can skip 40.1 and 40.2

Concept 40.3: What limits the distribution of species

1. What's the difference between evolutionary factors and ecological factors?
2. What is dispersal, and how does it limit species distribution?
3. What's the difference between a species actual range and its potential range?
4. What are biotic factors, and how can biotic factors affect a species' distribution?
5. What are the abiotic factors that impact a species distribution?

Concept 40.4 Factors Affecting Populations

1. What is population ecology? Describe some key aspects of populations: density and dispersion.
2. Compare/contrast clumped, uniform, and random dispersion patterns.
3. Use figure 40.14 to describe the four processes that impact population size
4. What's a life table? How are survivorship curves derived from life tables, and what are the three types of survivorship curves?
5. Summarize the section on reproductive rates.

Concept 40.5: Exponential and Logistic Growth Models

6. Read the first section, which explains how the formula for exponential growth works. Then memorize the last formula, and describe what exponential growth is.
7. What's carrying capacity? How is it related to the logistic growth model? Memorize the formula for logistic growth.
8. Describe three ways of approaching K. What's the overshoot?

Concept 40.6: Population Dynamics, Life History, and Density

9. What are the three main components of life history?
10. Contrast r v. K selection: how does this relate to life history?
11. Compare/contrast density dependent and density independent limiting factors (list examples of each using figure 40.23 for reference).
12. Summarize the discussion on population dynamics.
13. What are metapopulations? Why is this an important/useful concept?

Concept 43.5: Human Population

14. Summarize human population growth over the last 10,000 years.
15. How has the human population's growth rate shifted since 1950. Describe the thinking about how this has happened.
16. Summarize the section on global carrying capacity. How many people should live on our planet? Why did you choose that number?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com (sorry: still under development)
- 2.

Master the content

3. On your [qwizcards](#) webpage, make flashcards that capture the key ideas from what you've read.

[Jump back to the top](#)

Chapter 41: Species Interactions

Big Picture Questions

This chapter focuses on how populations interact in ecological communities. Before you read, think about the questions below.

1. What causes competition between different populations, and what might be the consequences of competition?
2. What traits make a predator a good predator? How can potential prey avoid predation?
3. What's a parasite?
4. Sometimes, a single species that is not very common can be so important that removing it from an ecosystem causes that ecosystem to drastically change, or even collapse. Speculate on what ecological role such a species would play, and how its removal could cause such big changes.
5. Imagine a forest. A huge fire sweeps through, reducing the forest to ashes. If nature is allowed to take its course, describe how you imagine what will happen in this area over the next few hundred years.

Chapter 41 overview

1. What is a community? What are the key traits that characterize a biological community?

Concept 41.1: Community Interactions

2. What's an ecological niche?
3. Define/describe interspecific competition. Also: describe the three phenomena/concepts associated with competition:
 - a. Competitive exclusion
 - b. Resource partitioning
 - c. Character displacement
4. Describe exploitation.
5. What are the key traits associated with being a predator or prey? Explain the following associated concepts
 - a. Cryptic coloration/camouflage
 - b. Aposematic coloration
 - c. Batesian mimicry

- d. Mullerian mimicry
- 6. Describe some of the adaptations associated with herbivory. What are some of the key adaptations of herbivores, and their prey (plants).
- 7. What is parasitism (summarize this section).
- 8. What are positive interactions? Describe.
 - a. Mutualism
 - b. Commensalism

Concept 41.2: Diversity and trophic structure

- 9. What is species diversity, and what are its two components?
- 10. In your own words, describe why community 1 in figure 41.1 has higher diversity than community 2.
- 11. What's the relationship between a community's diversity and its resilience?
- 12. What is trophic structure? As you explain this concept, include both *food chains* and *food webs*.
- 13. What are the two hypotheses that explain the length of food chains? Which one is better supported by the evidence?
- 14. Compare and contrast dominant species, keystone species, and ecosystem engineers.
- 15. What's the difference between the bottom-up and top-down model of community organization?

Concept 41.3: Disturbance

- 16. What's the nonequilibrium model of communities? How is this different from the notion of a climax community?
- 17. Describe the intermediate disturbance model of community diversity.
- 18. Describe ecological succession. What's the difference between primary and secondary succession?

Concept 41.4: Biogeography and community diversity

- 19. What are latitudinal gradients, and how can they impact community diversity?
- 20. Why is there a correlation between community diversity and richness, and evapotranspiration?
- 21. What is the species area curve? How does this apply to predicting the biodiversity of islands of various sizes?

Pathogens alter community structure

- 22. What are the effects of pathogens on community structure?
- 23. What are zoonotic pathogens? Why should you care about them?

After Reading

Interact

- 1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

- 2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

[Jump back to the top](#)

Chapter 42: Ecosystems and Energy

Big Picture Questions

This chapter focuses on how energy and matter flow through ecosystems. Before you read, think about the questions below.

- 1. In any ecosystem, big, fierce carnivores are rare. Think, for example, of how much land it takes to support a pride of lions. Why is this?

2. From other biology courses you've taken at the high school or middle school level, you probably already know a lot of the vocabulary from this unit. Define these terms as best as you can: producer, primary consumer, secondary consumer.
3. As energy gets transferred from the plants in an ecosystem to the animals that eat them, a huge amount of useful energy is lost. Where does it go?
4. Whereas energy flows through an ecosystem and dissipates, matter recycles. See how well you can tell the story of the carbon atoms in your arm. Where were they before they were in you. Where will they be next?
5. Read the Chapter Review at the end of the chapter, and spend a moment thinking about your answers to the review questions at the end of each concept.

Now dig in and read the chapter, converting the questions below into interactive flashcards.

Chapter 42 Overview

1. What's an ecosystem?
2. What are the two key processes involved in ecosystems?
3. What's the difference between how energy and matter flow through ecosystems?

Concept 42.1: The laws of physics and chemical cycling

4. Review: you should, as an educated person and an accomplished student of biology, be able to state from memory the following physical laws. Write down a few notes about how each is related to ecology.
 - a. First law of thermodynamics
 - b. 2nd law of thermodynamics
 - c. Law of conservation of mass
5. Describe the following trophic levels (or ecological roles).
 - a. Primary producers
 - b. Primary consumers
 - c. Secondary consumers
 - d. Tertiary consumers
 - e. Detritivores
 - f. Decomposers

Concept 42.2: Primary production

6. What is primary production?
7. What's the difference between GPP (gross primary production), NPP (net), standing crop, and NEP (net ecosystem production)?
8. What limits primary production in aquatic ecosystems? What about in terrestrial ecosystems?
9. What are some adaptations that have evolved to reduce the effect of nutrient limitations?

Concept 42.3: Energy Transfer between trophic levels

10. What is production efficiency? Using the caterpillar as an example, where does all that energy go?
11. What is trophic efficiency? Why is it less than production efficiency, and why is it, on average only about 10%? In your answer, account for the 90% that's lost.
12. Be able to draw, on demand, a typical pyramid of net production (also known as an energy pyramid).
13. What does a typical biomass pyramid look like? Why is this pyramid sometimes inverted? Refer to figure 55.12 in your answer.

Concept 42.4: Biogeochemical Cycles

14. How does decomposition affect nutrient recycling rates?

15. In biogeochemical cycles, there are reservoirs and fluxes. The fluxes are the movements between the reservoirs, typically represented by arrows. Use figure 42.13 to describe the key reservoirs and fluxes in the carbon, nitrogen, water, and phosphorus cycles.

16. What were the main lessons learned about nutrient recycling from the Hubbard Brook experimental forest?

Concept 42.5: Restoration Ecology

17. Compare and contrast bioremediation and bioaugmentation.

18. Spend some time studying 42.18 and reflecting on the key points of ecology that are so beautifully illustrated in this diagram.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your qwizcards webpage, make flashcards that capture the key ideas from what you've read.

[Jump back to the top](#)

Chapter 43: Global Ecology and Conservation Biology

Big Picture Questions, part 1

This chapter focuses on threats to biodiversity. Before you read, think about the questions below.

1. Biological diversity (or biodiversity) has several dimensions. One is simply the number of different species in a particular area. What are some other dimensions of biodiversity?
2. Humans benefit (a lot) from biodiversity. Describe as many of these benefits as you can.
3. What are the biggest human-caused threats to biodiversity? See if you can describe four.
4. What's causing climate change? How might that impact biodiversity?
5. The ozone layer is another global atmospheric human-caused problem. It's completely distinct from climate change. What is the ozone layer, and why should we worry about it?
6. Read the Concept Reviews. Spend a moment thinking about how you would answer the review questions.

Chapter 43 Overview

17. How many species have been described on our planet? How many might there be?
18. Just to get an overview, what are some of the ways that humanity is impacting the biosphere.
19. In terms of mass extinctions, how big might our impact be?

Concept 43.1

20. List and briefly summarize the 3 levels of biodiversity discussed in the text.
21. What's the difference between an endangered and a threatened species?
22. What is ecosystem diversity? How do humans benefit from biodiversity (diversity of species) and genetic diversity within species?
23. What are ecosystem services? List several examples.
24. Be able to list four threats to biodiversity. As you do, be able to describe each one
 - a. Habitat loss
 - b. Introduced species
 - c. Overharvesting
 - d. Global change

Concept 43.2: Population Conservation

25. What is the extinction vortex. Describe how this concept has been applied to the greater prairie chicken.

26. What is minimum viable population size?
27. What is effective population size?
28. Summarize the case study of the grizzly bear, using this as an opportunity to deepening your understanding of small population conservation ecology.

29. What is the declining population approach? Summarize the case study of the red-cockaded woodpecker to develop your understanding of this approach.

Concept 43.3: Landscape and Regional Conservation

30. Describe the importance of boundaries and edges to ecosystem viability.
31. What are corridors, and why are they important?
32. What are the best strategies for establishing protected areas.
33. Spend about five minutes reading about the [biological hot spot that we live in](#). Write a brief paragraph summarizing what you learned.
34. What are zoned reserves?

Concept 43.4: Earth is rapidly changing as a result of human actions

35. What's the problem with nutrient enrichment? What can be done about it?
36. Summarize the section on toxins and explain how biological magnification works.
37. What are greenhouse gases, and how are greenhouse gases causing global climate change?
38. Read "biological effects of climate change, and look over figure 48.28. How might climate change impact ecosystems and their inhabitants? In short, why is climate change making every problem described in this chapter harder to manage?

Concept 43.6: Sustainable Development

39. What are the key principles of sustainable development? How has this played out in Costa Rica.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](#)

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](#) webpage (for Mr. W's BHS students) or [qwizcards.com/wizard](#), or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

HOLY COW. YOU DID IT. THAT'S THE LAST STUDY QUESTION BEFORE THE AP EXAM

POST AP EXAM

Chapter 35: The Immune System

Big Picture Questions

This chapter focuses on immunity: how your body protects itself from dangerous pathogens. To prepare yourself for learning about this amazing material, respond to the questions below.

1. Earlier in the course, you learned about viruses. Spend a moment quickly reviewing the life cycles of
 - a. Lytic viruses
 - b. Lysogenic viruses
 - c. HIV

2. Like everyone, you've had the experience of having a viral infection (such as a cold), and then recovering. Describe what you think is going on inside your body when this happens.
3. You've also had the experience of having an injury (spraining your ankle or wrist, perhaps) or having a localized infection (like a pimple). In both cases, you've experienced some redness, heat, and swelling. This is called *inflammation*. What do you think is going on?
4. Several times in your life, you've been to your physician's office to get vaccinated. Once you're vaccinated, you're immune to infection from that virus or bacterium. How does that work?
5. Read the Chapter Review at the end of the chapter, and spend a moment thinking about the answers to the review questions.

Answer the questions below. Render your learning into interactive flashcards so that you can use recall methods to quiz yourself on this material.

Chapter 35 overview

1. What are pathogens?
2. What's the difference between innate and adaptive immunity.
Note: study figure 35.2 to get a conceptual map of the territory this chapter covers.

Concept 35.1: Innate Immunity

3. Invertebrates, such as insects, share some features in common with vertebrates (the focus of this chapter). Describe three of them
 - a. insect barrier defenses,
 - b. lysosome, and
 - c. Phagocytosis
4. Describe barrier defenses in mammals
5. List and describe the key players involved in vertebrate cellular innate defenses. Cover neutrophils, macrophages, and dendritic cells. How, at this level of immunity, do we recognize pathogens?
6. What do natural killer cells do?
7. Briefly describe the lymphatic system, where much of the action of the immune system happens. If you want a visual, there's one in the preceding chapter, in figure 34.12 on page 7.16.
8. Describe what interferons and complement do.
9. What is the inflammatory response? Include a description of histamines and fever.
10. What's pus?
11. Despite all of these innate defenses, some pathogens break through. How?

Concept 35.2: Recognizing pathogens

12. What are lymphocytes? How are T and B cells different,
13. What's an antigen? An epitope? How do B and T cells recognize antigens?
14. Describe the structure of antibodies. What's the connection between a *B cell receptor* and an *antibody*?
15. How do T Cells recognize antigens?
16. Describe the function of MHC proteins.
17. Use the text and figure 35.10 to answer the following: What is the genetic and functional basis for antibody diversity?
18. What is self-tolerance, and how does it come about.
19. Why is a store like the Gap, as opposed to a custom tailor, the best metaphor for recognition of and response to antigens?
20. Describe how clonal selection works.
21. What are memory cells? How do they form, and how do they provide an organism with immunological memory?

Concept 35.3: Adaptive Immunity

22. Describe the mechanism/steps/cells involved in the cell-mediated response. If you can tell the story of what's happening in figures 35.13 and 35.16 without looking at the captions, you've got it.

23. Describe the mechanism/steps/cells involved in the humoral immune response. Use figures 35.14 and 35.15 in developing your answer.

24. What's the difference between active and passive immunity?

25. How is the immune system connected to

a. Blood type

b. Organ transplants (and rejection)

Disruptions of the immune system

26. How do allergies work?

27. What are autoimmune diseases (and how do they work)?

28. What is antigenic variation, and how does it explain the need for annual flu vaccinations (as opposed to the way we're vaccinated for childhood diseases like mumps)?

29. Explain why Helper-T cells are so important. What is the effect of HIV infection upon the immune response?

30. What's the connection between cancer and immunity.

31. Synthesizing what you know: Use figure 35.17 to answer the question: *how does the immune system work?*

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

2. On your qwizcards webpage, make flashcards that capture the key ideas from what you've read.

HALLMARKS of CANCER (POST AP EXAM PROJECT)

READING 1: Readings about Cancer Biology from *Campbell*

Note: I've provided pages for reading this material in your textbook (Campbell, *Biology in Focus*), or in the class set of Campbell, *Biology*, 9th Edition in the bookshelf in the back of the room, by the window.

Instructions. Answer these questions

Textbook Reading 1: Campbell, *Biology in Focus*, p. 192 – 197; Campbell *Biology*, 9th ed, p. 238 to 253.

1. What are checkpoints? What are some of the signals and conditions that cell cycle checkpoints respond to?
2. What are growth factors? In your answer, explain how PDGF works.
3. Describe density dependent inhibition and anchorage dependence.
4. List (and describe) at least four ways that cancer cells behave differently than normal cells.
5. What's the difference between a benign and a malignant tumor?
6. (top of page 196) List (and describe) three more unique properties of cancer cells.
7. How does radiation work to treat localized tumors?
8. How does chemotherapy work, and what are some of its problems.

9. Briefly explain how Herceptin works? (briefly, because you'll come back to this question at the end of the next section).

Textbook Reading 2; Campbell, Biology in Focus, p 334 – 340; Campbell, Biology, 9th ed., p. 373 to 377.

Genes Associated with Cancer

1. What's the difference between an oncogene and a proto-oncogene?
2. Describe three ways that proto-oncogenes become oncogenes.
3. What are tumor suppressor genes? What are some of the function of the proteins that tumor suppressor genes code for?
4. Using figure 16.18 and the information in the text, write a paragraph about how a mutation in the ras gene can promote abnormal cell proliferation.
5. Using figure 16.19 and the information in the text, write a paragraph about how a mutation in the p53 gene can promote abnormal cell proliferation.

The Multistep Model of Cancer Development

6. Describe the multistep model of cancer development.
7. Describe cancer screening for colorectal and breast cancer.

Inherited Predisposition to Cancer

8. How can you inherit a predisposition to cancer?
9. Copy and complete: Tumor suppressor genes can be thought of as _____ alleles, because it takes two mutations for them to induce cancer. That makes sense because...
10. Copy and complete: Oncogenes can be thought of as dominant genes because....
11. Write a brief summary of the information about the APC and BRCA genes.
12. How can a virus cause cancer?

Genomics, Cell Signalling, and Cancer (pages 338-339). Note that this is ONLY in Biology in Focus (your textbook.

13. Look again at how Herceptin works. This time you should be able to explain it in much more detail.

READING 2: Questions from Cell Biology and Cancer (this reading is in the AP Biology Hallmarks of Cancer reader.

Introduction

1. What's the one thing that all cancer cells have in common?
2. What causes the changes that lead to cancer.

What is cancer

3. Write a summary of this section that between 3 and five sentences long.

Genetics of Cancer

4. Describe what oncogenes are and how they work. Give one example. Why are oncogenes dominant mutations?
5. Describe how tumor suppressor genes work. Why are they recessive mutations?
6. Explain how RB works.
7. What's the connection between DNA repair genes and cancer?

Cell Cycle

8. Describe the importance of CDKs to the cell cycle. What's the connection between CDKs and cancer.
9. Describe how mutations in p21 and p53 can lead to cancer.

What causes cancer

10. Write a one sentence summary of this section

Tumor Biology

11. Define these three cancer-related terms: hyperplasia, dysplasia, anaplastic.
12. What is angiogenesis, and why is it so important to tumor progression and metastasis?

Viruses and Cancer

13. What are some viruses that can induce cancer? How does that work.

Environmental factors

14. What are some environmental factors that induce cancer, and how do they do they work.

Detecting Cancer

15. What are tumor markers (such as PSA and CA125) and how are they used in cancer detection.

16. What are SNPs, and how can they be used for cancer detection.

17. Traditional Treatments

18. Describe surgery, radiation, and chemotherapy.

19. Newer treatments

20. Describe SERMs, Gleevec, angiogenesis inhibitors, chemoimmunotherapy, bone marrow replacement

Prevention and Screening

21. How can cancer be prevented?

22. What are some early detection screens for cancer?

Reading 3: Read the Summary of the Hallmarks of Cancer from Wikipedia. In your notes, list each hallmark, and, in your own words, write a one or two sentence description of it .

[Jump back to the top](#)

Unit 11: Animal Biology, Part 1: Homeostasis

3.

[Jump back to the top](#)

Unit 13: Topics in Plant Biology

[Jump back to the top](#)

Chapter 31, Concepts 31.1 and 31.2 Plant Responses to Light

Big Picture Questions

This chapter focuses on plant responses to light, material for which you might not have much context or prior knowledge. . Nevertheless, prepare yourself for learning by responding to the following questions.

1. Recall what you've learned about cell communication (which is what this chapter is all about). What are the three steps involved in signal transduction pathways?
2. If you've ever grown a houseplant, or observed plants outdoors, you've probably noticed that plants bend toward the light. Based on what you know about cell communication, plant cell structure, control of cell division and all the other biology you've learned, speculate about how this might work.
3. Same question as above, but for a different plant example. If you leave a potato in a closed drawer for a long time, it will start to look [like this](#): If you move the potato into the light, it will start to develop a stem, leaves, etc. Use the biology you know to speculate about what's happening.
4. Same question as above, but for yet another. Some plants (like [radishes](#)) only flower when the days are long. Other plants, like [poinsettias](#), only flower when days are short. What could be controlling this?
5. At the end of the chapter, read the concept reviews for concepts 31.1 and 31.2. Think about your answers to the review questions for these sections (and note that we're skipping the rest of this chapter).

Chapter 31, Overview

1. How is the way that plants respond to stimuli different from the way animals respond?

Concept 31.1 (plant hormones, focusing on auxin)

2. What are some differences and similarities between plant hormones and animal hormones?
3. Using the text and figures 31.2 and 31.3, describe 1) the mechanism behind the positive phototropism observed in grass seedlings, and 2) how we know about this mechanism.
4. Read only the top line of Table 31.1 (the row about auxin). Then read the section about auxin in the text, and answer the following questions
 - a. What are auxins?
 - b. How do auxins move through plants (refer to figure 31.4 as you answer this question)?
 - c. How do auxins affect a plant's growth pattern (refer to figure 31.5 for this question)?

Note: after auxin, you're done with this section, and you can jump to concept 31.2

Concept 31.2

5. What is photomorphogenesis?
6. What is etiolation? How is it adaptive? What happens when an etiolated plant is exposed to light? Use the text and figure 31.11 to explain the de-etiolation response in plants
2018-2019: STOP HERE
7. What are phytochromes? Blue-light receptors?
8. Use the text and figure 31.13 to describe the mechanism by which phytochromes control seed germination.
9. How do phytochromes influence the "shade avoidance" response?
10. Summarize the section on biological clocks and circadian rhythms.
11. How does light sensing by phytochromes synchronize circadian rhythms to a 24 hour day?
12. What is photoperiodism?
13. Contrast short day, long-day, and day-neutral plants.
14. How do phytochromes interact with light to control flowering in plants?

After Reading

Interact

1. Do the interactive exercises connected with this chapter on Learn-Biology.com (which will be completed sometime in the future: sorry)

Master the content

2. You have 3 options: Cornell Notes, flashcards on your [qwizcards](#) webpage (for Mr. W's BHS students) or [qwizcards.com/wizard](#), or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes. Click [here](#) for why I'm having you do this.

Chapter 29, Concepts 29.2 and 29.5: Transpiration and Water Transport in Plants

Big Picture Questions

The two concepts we cover in this chapter focus on how plants transport water, with a specific focus on transpiration, the process that moves water to the top of a plant stem. Prepare yourself for reading by answering the following questions.

1. Recall what you've learned about osmosis. What is osmosis? What's the difference between a hypertonic and a hypotonic solution? Describe how water moves in response to concentration gradients. (Note: if you are having trouble with this, review the relevant notes from chapter 7 and then try these questions again).

2. If you let a houseplant (or a plant in your garden) get too dry, it wilts. When you water it, it perks up. Use what you know about cells and osmosis to explain what's going on.
3. Redwood trees can be 100 meters tall. Yet they have no trouble getting water up to their highest leaves. You pump fluids around your body using a pump (your heart). But trees have no parallel adaptation. Speculate about how plants can get water up to their leaves.

Concept 29.2

READ THIS: Our curriculum only touches on some aspects of plant biology, and very little plant anatomy. Plants, like animals, have vascular tissue for moving fluids around their multicellular bodies. The xylem consists of tubes that move fluid from the roots to the shoot (the stem and leaves). Xylem tissue can be dead or living (and still be functional). Phloem consists of tubes that move sugary sap from the leaves to other parts of the plant.

Now, read about the two basic pathways that water can move through a plant. Note the difference between the *apoplastic* pathway and the *symplastic* pathway (but you don't need to memorize these terms). Then start to carefully read at the section entitled "Short-Distance Transport of Water"

1. What is water potential? What two factors does it involve? What's the equation for water potential?
2. Compare and contrast solute potential and pressure potential.
3. Use figure 29.5 and the text to answer this and the next few questions.
 - a. What is turgor pressure?
 - b. Describe what happens when a cell becomes flaccid. How is this related to plasmolysis (something you observed in Elodea cells in our diffusion/osmosis lab way back in October)?
 - c. What happens when a plant cell becomes turgid?
 - d. What causes wilting?
4. In the reading, you'll encounter specific types of xylem (such as tracheids and vessels) and phloem (such as sieve tubes). Don't worry about these. However, use these paragraphs to define "bulk flow" (which is what we'll be focused on in the next topic).

Concept 29.5 (p. 609)

Study figure 29.16 so that you have a sense of the two routes (again, symplastic and apoplastic) by which water can make it to the vessels of the xylem. The description of the Casparian strip is very cool, but you can skip it. Start reading carefully at "Bulk Flow Transport via. The Xylem" on page 610.

5. What is transpiration? Just to provide yourself with some context for the enormity of this process, record how much water flows by transpiration through a single maize (corn) plant during a growing season. Also, note how fast and how far xylem sap can move.
6. What is the cohesion-tension hypothesis for xylem sap's upward flow? Use figures 29.17 and 29.18 to answer this question, and the next.
7. Summarize how transpirational pull and negative pressure get water to flow up the stem of a plant.
8. How are adhesion and cohesion involved in the ascent of xylem sap?
9. What provides the energy for the ascent of xylem sap?

Concept 29.6

10. Describe the structure of stomata. What features of leaf anatomy ensure that water loss in plants is through the controllable stomata, and not other parts of the leaf?

11. Use the text and figure 29.19 to describe how stomata open and close.
12. Describe the effects of transpiration on wilting and leaf temperature.
13. What are some adaptations that reduce water loss? Note: Don't worry about CAM metabolism, which we're not covering.

After Reading

Interact

1. Do the interactive exercises connected with this chapter on [Learn-Biology.com](http://www.Learn-Biology.com)

Master the content

2. On your [gwizcards](http://www.gwizcards.com) webpage, make flashcards that capture the key ideas from what you've read.

~~*Thematic reflection*~~

- ~~3. [Follow this link](#) and write your end of chapter thematic reflection~~

Questions and Chapters that aren't part of the revised AP Curriculum or found in the 2nd edition textbook.

[Jump back to the top](#)

Chapter 37: Nervous System 1: Neurons

Big Picture Questions, part 1

This chapter focuses on the cellular mechanisms that underlie the nervous system: neurons, and how neurons communicate with other neurons. Before you study the material in this chapter, prepare your mind for learning by responding to the following questions.

1. Way back at the beginning of the course, when we were learning about membranes, we learned about the sodium-potassium pump, and electrochemical gradients. Without looking at your notes, write down what you remember about both of these concepts. Afterwards, if you need to (if you're really drawing a blank), review your notes and write your answer again.
2. Imagine that you're walking around your house in bare feet, and you step on a tack (ouch!). A signal is going to have to move through a nerve cell from your foot, and go all the way to your spinal cord. There, the signal has to be transmitted to at least one other nerve cell, which is going to send a signal from your spinal cord back to your leg, initiating a reflex that will move your foot away from the tack. This will all happen a short moment before another nerve cell will move a signal up your spinal cord to your brain, which is when you'll become aware of the fact that you hurt yourself and had a self protective reflex.
 - a. You already know a lot about cells. Think of a mechanism by which a signal could move, in one very long cell, from your foot to your spinal cord?
 - b. In your spinal cord, one cell (the sensing cell) is going to communicate with another cell (the cell that initiates the reflex in your leg muscles). You know a lot about cell communication. How is the first cell going to communicate with the second cell.
3. Read the Chapter Review at the end of the chapter. Spend a moment thinking about your answers to the review questions.

Chapter 37: Overview

1. Buried in this interesting introduction is the answer to the question: What are the two ways that neurons send signals? Find the answer.

Concept 27.1: Neuron structure and organization

2. Identify the parts and explain the function of the parts of a neuron.
 - a. Cell body
 - b. Dendrites
 - c. Axon
 - d. Axon hillock
3. What are the structures at the end of the neuron?
 - a. Synaptic terminal
 - b. Synapse
 - c. Neurotransmitters
4. What are glial cells, and what do they do?
5. What are the three stages of information processing by nervous system.
6. Describe the function and basic parts of a nervous system
 - a. Sensory, inter-, and motor neurons
 - b. Central nervous system v. peripheral nervous system

7. What are *nerves*?

Concept 37.2: Resting Potential

8. What is the resting potential of a neuron, and how is it formed? What ions get pumped in which direction (meaning into or out of the cell)? What's diffusing in which direction? If you can explain figure 37.6 (without looking at the caption), you're set.

Note: read the sections on "modeling the resting potential," and "Figure 37.8, Make Connections," but you don't to master them (or make flashcards)

Concept 37.3: Action Potential

9. How do gated ion channels cause depolarizations or hyperpolarizations?

10. Describe/define *graded potential*, *threshold potential*, and *action potential*.

11. Outline the key events that occur during an action potential. Your basic job here is to explain the five steps outlined in figure 37.12.

12. What's the refractory period?

13. Explain how action potentials become nerve impulses (this is in the section entitled "Conduction of Action Potential). See figure 37.13

14. Explain how Schwann cells and the myelin sheath make saltatory conduction possible (which vastly speeds up nerve impulse conduction

Concept 37.4: The synapse

15. What happens at a chemical synapse? Summarize what's in figure 37.16 and the text.

16. Explain EPSPs, IPSPs, and summation. How do each of these relate to the idea of threshold potential?

17. Describe how the neurotransmitter acetylcholine works. Then, quickly read the list of other neurotransmitters, just so that you'll have some familiarity with them (but detailed understanding and note-taking/flashcard making are not required)

After Reading

Interact

Do the interactive exercises connected with this chapter on Learn-Biology.com

Master the content

You have 3 options: Cornell Notes, flashcards on your [qwizcards](http://qwizcards.com) webpage (for Mr. W's BHS students) or qwizcards.com/wizard, or physical flashcards. Always spend time reviewing previous flashcards or Cornell notes.

NOTE: The AP Biology curriculum focuses on the nervous system at the level of neurons and reflexes, but doesn't really include the brain, learning, etc. If you're like me, and the idea of skipping this material is intolerable, then go ahead and read chapter 38...But we're going to skip it for now.

Concept 11.5: Apoptosis

15. What is quorum sensing? How is it connected to biofilm formation?

16. What is apoptosis, and what happens during apoptosis?

17. Why is apoptosis important in the soil worm *C. elegans*, and describe how cell signaling works to control apoptosis (see figure 11.21)

18. Partly because this is just so amazing, and also because it's a great way to show how well you've integrated the material in this chapter, summarize the section about apoptotic pathways.

[Jump back to the top](#)

Chapter 49: Nervous System 2: The Brain

NOTE: This is amazing stuff, but we're going to skip it for now.

Note: There's only one concept related to the vertebrate brain that's specified in the AP Biology Course and Exam

Description: different regions of the brain have different functions. With our scope limited to that one idea, our work in this chapter is going to be very circumscribed, and we're going to skip our usual pre-reading preliminaries. Just answer the questions below (using Cornell Notes format, of course).

Concept 49.1

1. Use figure 49.3 to describe how a simple reflex (like the knee jerk reflex) works.
2. Draw a diagram to describe how the vertebrate brain integrates information to produce a response (note that this is L.O. 3.50). To do this, you should be able to reproduce, from memory, the top three quarters of figure 49.7.

Concept 49.2

3. Why do we sleep? As you answer this question, also explain..
 - a. What part of the brain controls sleep, and how does this control work?
 - b. What are some evolutionary adaptations displayed by dolphins related to sleep?
4. Use figure 49.9 to describe the function of the cerebrum. As you do, describe the function of each of the following sub-parts:
 - a. cerebral cortex
 - b. The cerebral hemispheres
 - c. corpus callosum
 - d. Basal nuclei
5. Use figure 49.9 to describe the function of the cerebellum
6. (Also in figure 49.9) What are the key parts of the brainstem? In addition, be able to describe the function of
 - a. The midbrain
 - b. The pons and medulla
7. (Also in figure 49.9) What are the key structures of the diencephalon. In addition, be able to describe the function of the
 - a. Thalamus
 - b. Hypothalamus
 - c. epithalamus/pineal gland
8. What is the biological clock? What part of the brain controls this clock and how?
9. What is the limbic system? What is the amygdala, and how do we know what we know about its function?