What follows is a listing of chapters and topics from the text to be dealt with in the lecture/discussion portion of the course. The questions or statements associated with each chapter should be helpful as a study guide when preparing for the major tests and well as for periodic quizzes.

**01/14 - 01/16. Chapter 27. Prokaryotes.**
1. Describe the three forms characteristic of most species of prokaryotes.
2. Distinguish between Gram positive and Gram negative bacteria.
3. Explain the function of an endospore.
4. Describe characteristics of the following nutritional types: photoautotrophs, chemoautotrophs, photoheterotrophs, and chemoheterotrophs.
5. Distinguish among the following: obligate aerobes, facultative anaerobes, and obligate anaerobes.
6. Discuss nitrogen fixation as a function of some prokaryotes.
7. Discuss the similarities that archaea share with eukaryotes as well as those they share with bacteria.
8. Contrast exotoxins and endotoxins.

**Chapter 28. Protists.**
1. Explain why the kingdom Protista is sometimes referred to as a “catch-all” kingdom.
2. Discuss the part endosymbiosis is thought to have played in the evolution of the various groups of protists.
   What follows are several questions based on organisms or groups of organisms that illustrate various protist structures or characteristics as well as lines of evolution leading to multicellular eukaryotes.
3. Describe the types of locomotion typified by organisms such as species of *Euglena* (see text p. 554 and Figure 28.8), ciliates (see text pp 556-558 and Figure 28.12), and amoebozoans (see text pp 564-566 and Figures 28. 24-27).
4. Explain why the red and green algae are considered the closest relatives of the land plants.
5. Why is it accurate to say that *Ulva* has true multicellularity but *Caulpera* does not?

**01/18 - 01/23. Chapter 31. Fungi.**
1. List characteristics that distinguish fungi from members of other multicellular kingdoms.
2. Explain how fungi acquire nutrients.
3. Describe the basic body plan of a fungus.
4. Describe the processes of plasmogamy and karyogamy in fungi.

**Chapter 29. Plant Diversity I: How Plants Colonized Land.**
1. Describe the evidence linking plants to carophycean ancestry.
2. What is sporopollenin?
3. Identify each of the following structures as being haploid or diploid: sporophyte,
spore, gametophyte, zygote, gamete.
4. Describe the life cycle of bryophytes as is exemplified by the mosses.
5. Describe the life cycle of seedless vascular plants as exemplified by the ferns.
6. Discuss the nature of vascular tissue in terms of xylem and phloem.

1. Compare the dominance of the gametophyte generation in nonvascular plants with dominance of the sporophyte generation in the vascular plants.
2. Identify the following floral structures and describe a function for each: sepal, petal, stamen, carpel, anther, filament, stigma, style, ovule.
3. Diagram the generalized life cycle of an angiosperm. Indicate which structures are part of the gametophyte generation and which are part of the sporophyte generation.
4. Describe the role of the generative cell and the tube cell within the angiosperm pollen grain. Also, explain the process and function of double fertilization.
5. Most flowering plants can be placed in one or another of two groups known as monocots and dicots (eudicots). What characteristics distinguish members of these groups?

1. Describe the characteristics and functions of the three tissue systems of plants: dermal, vascular, and ground.
2. Be able to identify dermal, vascular, and ground tissue in cross sections of leaves; roots; and monocot, dicot, and woody stems.
3. Distinguish between primary and secondary growth in plants.
4. Contrast the type of growth arising from apical and lateral meristems.

1. Explain what routes are available to water and minerals moving into the vascular cylinder of the root.
2. Explain how mycorrhizae enhance uptake of materials by roots.
3. Define the term transpiration.
4. Explain how transpirational pull moves xylem sap up from the root tips to the leaves.
5. Describe the role of guard cells in photosynthesis and transpiration.
6. Define and describe the process of translocation. Trace the path of phloem sap from a primary sugar source to a sugar sink.

02/01 - 02/04. Chapter 32. An Introduction to Animal Diversity.
1. Describe the early stages of embryonic development characteristic of most animals.
2. Explain the significance of the Cambrian explosion.
3. Distinguish between radial and bilateral symmetry. Explain how animal symmetry may match the animal’s way of life.
4. Distinguish among the acoelomate, pseudocoelomate, and coelomate grades.
5. Distinguish between the following pairs of terms: diploblastic and triploblastic, spiral and radial cleavage, determinate and indeterminate cleavage, schizocoelous and enterocoelous development.
6. Compare the developmental differences between protostomes and deuterostomes, including: pattern of cleavage, fate of the blastopore, and coelom formation.

**02/06. Chapter 33. Invertebrates.**
1. Describe the basic structure of sponges and describe the functions of porocytes, choanocytes, amoebocytes, and spicules.
2. List the characteristics of the phylum Cnidaria that distinguish it from the other animal phyla.
3. Describe the specialized cells known as cnidocytes (nematocytes).
4. Describe the two basic body plans in Cnidaria and their role in Cnidarian life cycles.
5. List the characteristics of the phylum Platyhelminthes that distinguish it from the other animal phyla.
6. Describe the life cycle of a fluke that parasitizes humans. Also, describe the basic anatomy and generalized life cycle of a tapeworm.
7. Define *parthenogenesis* and describe asexual forms of rotifer reproduction.
8. List the characteristics that distinguish the phylum Mollusca from the other animal phyla.

**02/08. Major Test I.**

**02/11. Chapter 33. Invertebrates continued.**
9. List the characteristics that distinguish the phylum Annelida from other animal phyla.
10. List the characteristics of the phylum Nematoda that distinguish it from other worm-like animals. Also, give examples of both parasitic and free-living species of nematodes.
11. List the characteristics of arthropods that distinguish them from the other animal phyla. List the features that account for the success of this phylum.
12. Distinguish between hemocoel and coelom.
13. List the characteristics of echinoderms that distinguish them from other animal phyla. Also, describe the developmental similarities between echinoderms and chordates.

**02/13 - 02/15. Chapter 34. Vertebrates.**
1. Describe the distinguishing traits that define the phylum Chordata.
2. Distinguish among the three subphyla of the phylum Chordata and give examples of each.
3. What are hagfish and why are they not considered true fish? Also, describe the way of life and unique characters of the lamprey.
4. Explain one hypothesis for the evolution of the jaws of gnathostomes.
5. Describe and distinguish between Chondrichthyes and Osteichthyes.
6. Discuss the evolutionary significance of the lobe-finned fish as ancestors of the tetrapods.
7. Describe the common traits of amphibians.
8. Describe an amniotic egg and explain its significance in the evolution of reptiles and mammals.
9. Describe the distinguishing characteristics of reptiles and explain why reptiles and birds are grouped closely together.

10. Explain the significance of Archaeopteryx.

11. Describe the distinguishing characteristics of mammals.

12. Distinguish among monotreme, marsupial, and eutherian mammals.

13. Describe the general characteristics of primates.

1. Describe the overall summary equation for the process of cellular respiration.
2. Distinguish between substrate level phosphorylation and oxidative phosphorylation.
3. Explain how the exergonic oxidation of glucose is coupled to the endergonic synthesis of ATP.
4. Explain what a coenzyme is and how coenzymes are involved in respiration.
5. Write an equation summarizing glycolysis and explain where it occurs in the cell.
6. Describe how the carbon skeleton of glucose changes as it proceeds through glycolysis.
7. Describe where pyruvate is oxidized to acetyl CoA, what molecules are produced and how it links glycolysis to the citric acid (Krebs) cycle.
8. Describe the progression of the citric acid cycle.
9. Explain how the exergonic “slide” of electrons down the electron transport chain is coupled to the endergonic production of ATP by chemiosmosis.
10. Describe the process of chemiosmosis.
11. Summarize the net ATP yield from the oxidation of a glucose molecule by constructing an ATP ledger which includes coenzyme production during the different stages of glycolysis and cellular respiration.
12. Describe the fate of pyruvate in the absence of oxygen and distinguish between aerobic and anaerobic metabolism.
13. Describe how the citric acid cycle is a central metabolic process for the oxidation of molecules other than glucose.

1. Distinguish between autotrophic and heterotrophic nutrition.
2. Describe the location and structure of the chloroplast as well as the function of the pigment chlorophyll.
3. Write a summary equation for photosynthesis.
4. Describe characteristics of the electromagnetic spectrum.
5. Describe the wavelengths of light that are most effective for photosynthesis.
6. Describe the characteristics of the light dependent reactions of photosynthesis.
7. Summarize the light reactions of photosynthesis in terms of materials entering them and materials exiting them.
8. Compare the chemiosmosis of photosynthesis with that of aerobic respiration.
9. Summarize the carbon-fixing reactions of the Calvin cycle and describe changes that occur in the carbon skeleton of the intermediates.
10. Describe the role of ATP and NADPH in the Calvin cycle.
11. Describe what happens to rubisco when the O₂ concentration is much higher than
CO₂ and describe the major consequences of photorespiration.
12. Describe two important photosynthetic adaptations that minimize photorespiration.
13. Explain the significance of the statement that 94% of a plant’s dry weight results from the products of photosynthesis.

**02/27 - 02/29. Chapter 16. The Molecular Basis of Inheritance.**
1. Explain Why researchers originally thought protein was the genetic material.
2. Explain how Watson and Crick deduced the structure of DNA and describe the evidence they used.
3. Describe the structure of DNA. Explain the base-pairing rule and describe its significance.
4. Describe the semiconservative model of DNA replication.
5. Describe the process of DNA replication, including the role of the origins of replication and replication forks.
6. Discuss the role of DNA polymerases in replication.
7. Explain what energy source drives the polymerization of DNA.
8. Define antiparallel and explain its significance in the synthesis of DNA.
9. Distinguish between the leading strand and the lagging strand.
10. Discuss the roles of DNA ligase, primer, primase, helicase, topoisomerase, and single-strand binding proteins.
11. Discuss the repair mechanisms operational during DNA replication.
12. Describe the structure and function of telomeres and explain their significance in the aging of tissues.
13. Discuss the significance of the enzyme telomerase in germ cells.

**03/10 - 03/12. Chapter 17. From Gene to Protein.**
1. Compare RNA with DNA in terms of differences.
2. Briefly explain how information flows from gene to protein.
3. Distinguish between transcription and translation.
4. Define codon and explain the relationship between the linear sequence of codons on mRNA and the linear sequence of amino acids in a polypeptide.
5. Explain the significance of start and stop codons.
6. Explain what it means to say that the genetic code is redundant and unambiguous.
7. Discuss the evolutionary significance of a nearly universal genetic code.
8. Explain, in general terms, how the genetic code in DNA is transcribed to messenger RNA and then, through the help of transfer RNA, translated into an amino acid sequence.
9. Explain the function of ribosomes.
10. Distinguish between introns and exons.
11. Compare protein synthesis in prokaryotes and in eukaryotes.
12. Define point mutations. Distinguish between base-pair substitutions and base-pair insertions. Give examples of each and note the significance of such changes.
13. Describe several examples of mutagens and explain how they cause mutations.

**03/14. Chapter 18. The Genetics of Viruses and Bacteria.**
1. Describe the basic structure and function of viruses.
2. Describe the general features of viral reproductive cycles.
3. What are viroids and prions and how do they function?
4. Describe the reproductive process in bacteria and explain how genetic material can be transferred from one cell to another.
5. Explain the adaptive advantage of genes grouped into an operon.
6. Using the trp operon as an example, explain the concept of an operon and the function of the operator, repressor, and corepressor.
7. Distinguish between structural and regulatory genes.
8. Describe how the lac operon functions and explain the role of the inducer, allolactose.

03/17. Major Test II.

03/19. Chapter 20. DNA Technology and Genomics.
1. Explain how advances in recombinant DNA technology have helped scientists study the eukaryotic genome.
2. Describe the natural function of restriction enzymes and explain how they are used in recombinant DNA technology.
3. Explain how the creation of sticky ends by restriction enzymes is useful in producing a recombinant DNA molecule.
4. Outline the procedures for cloning a eukaryotic gene in a bacterial plasmid.
5. Describe techniques that allow identification of recombinant cells that have taken up a gene of interest.
6. Describe the polymerase chain reaction (PCR) and explain the advantages and limitations of this procedure.
7. Explain how gel electrophoresis is used to analyze nucleic acids and to distinguish between two alleles of a gene.
8. Discuss methods for sequencing the genomes of various species.
9. Discuss the applications of DNA technology in medicine, forensic science, and environmental and agricultural work.

03/265. Chapter 40. Basic Principles of Animal Form and Function.
1. Explain how physical laws constrain animal form.
2. Explain how the size and shape of an animal’s body affect its interactions with the environment.
3. Define tissue and list the four basic types of tissue found in animals.
4. Define metabolic rate and explain how it can be determined for animals.
5. Distinguish between endothermic and exothermic animals.
6. Describe the relationship between metabolic rate and body size.
7. Define homeostasis. Describe the functional components of a homeostatic control system.
8. Distinguish between positive and negative feedback mechanisms.

1. What chemical powers most of the energy requiring metabolic processes?
2. Distinguish among undernourishment, overnourishment and malnourishment,
4. Define *essential nutrients* and describe the four classes of essential nutrients.
5. Distinguish between water-soluble and fat-soluble vitamins.
6. Describe the general functions minerals in an animal’s diet.
7. Distinguish between intracellular with extracellular digestion.
8. Compare the incomplete digestive systems of a Cnidarian with those of animals having complete digestive systems.
9. Describe the common processes and structural components of the mammalian digestive system.
10. Compare where and how the major types of macromolecules are digested and absorbed within the mammalian (human) digestive system.
11. Explain how the small intestine is specialized for digestion and absorption.
12. Describe the major functions of the large intestine.
12. Describe the roles of symbiotic microorganisms in vertebrate digestion.

04/02 - 04/09. Chapter 42. Circulation and Gas Exchange.
1. Describe the need for circulatory and respiratory systems due to increasing animal body size.
2. Distinguish between open and dosed circulatory systems.
3. List the structural components of a vertebrate circulatory system and relate their structure to their functions.
4. Using diagrams, compare and contrast the circulatory systems of fish, amphibians, reptiles, and mammals or birds.
5. Distinguish between pulmonary and systemic circuits and explain the functions of each.
6. Define a cardiac cycle, distinguish between systole and diastole, and explain what causes the first and second heart sounds.
7. List the four heart valves, describe their location, and explain their functions.
8. Define sinoatrial (SA) node and describe its location in the heart.
9. Relate the structures of capillaries, arteries, and veins to their functions.
10. Explain how blood flow through capillary beds is regulated.
11. Describe the composition of lymph and explain how the lymphatic system helps the normal functioning of the circulatory system.
12. Describe the composition and functions of plasma.
13. Generalize as to the structure and function of the cellular components of blood.
14. Define gas exchange and distinguish between a respiratory medium and a respiratory surface.
15. Describe respiratory adaptations of aquatic animals.
16. Describe respiratory adaptations of terrestrial animals.
17. Describe the respiratory structures of human beings.
18. Explain how the respiratory systems of birds and mammals differ.
19. Explain how breathing is controlled in human beings.
20. Define partial pressure and explain how it influences diffusion across respiratory surfaces.
21. Describe how carbon dioxide is picked up at the tissues and deposited in the lungs.
04/11. Major Test III.

04/14 - 04/16. Chapter 43. The Immune System.
1. Explain what is meant by nonspecific defense against pathogens and give some examples.
2. Describe the structure of the human lymphatic system and describe how lymph moves through the system.
3. Define phagocytosis.
4. Explain how interferon limits cell-to-cell spread of viruses.
5. Distinguish humoral and cell mediated immunity.
6. Distinguish between active and passive immunity and describe examples of each.
7. Define anaphylactic shock.
8. Give examples of human autoimmune diseases.

04/18. Chapter 44. Osmoregulation and Excretion.
1. Define osmoregulation and excretion.
2. Define osmolarity and distinguish among isosmotic, hyperosmotic, and hypoosmotic solutions.
3. Explain how the osmoregulatory problems of freshwater animals differ from those of marine animals.
4. Compare the strategies to eliminate waste as ammonia, urea, or uric acid. Note which animal groups are associated with each process and why a particular strategy is most adaptive for a particular group.
5. Compare the excretory systems of flatworms (planarians), annelids (earthworms), and insects.
6. Describe the structure of the mammalian (human) excretory system.
7. Describe the structure and function of a nephron from a human kidney.

1. Compare the response times of the two major systems of internal communication: the nervous system and the endocrine system.
2. Describe an example of a negative feedback loop in an endocrine pathway involved in maintaining homeostasis.
3. List the three major classes of molecules that function as hormones in vertebrates.
4. Explain how the hypothalamus and pituitary glands interact and how they coordinate the endocrine system.
5. Describe the location of the pituitary. List and explain the functions of the hormones released from the anterior and posterior lobes.
6. Explain the role of tropic hormones in coordinating endocrine signaling throughout the body.
7. List the hormones of the thyroid gland and explain their roles in development and metabolism. Explain the causes and symptoms of hyperthyroidism, hypothyroidism, and goiter.
8. Note the location of the parathyroid glands and describe the hormonal control of calcium homeostasis.
9. Distinguish between alpha and beta cells in the pancreas and explain how their antagonistic hormones (insulin and glucagon) regulate carbohydrate metabolism.

10. Distinguish between type I diabetes mellitus and type II diabetes mellitus.

11. List the hormones of the adrenal medulla, describe their functions, and explain how their secretions are controlled.

12. List the hormones of the adrenal cortex and describe their functions.

13. List the hormones of three categories of steroid hormones produced by the gonads. Describe variations in their production between the sexes. Note the functions of each category of steroid and explain how secretions are controlled.


1. Compare and contrast the nervous systems of the following animals: hydra, sea star, planarian, insect, squid, and vertebrate.

2. Distinguish among sensory neurons, interneurons, and motor neurons.

3. Describe the major parts of a neuron.

4. Define membrane potential and resting potential. Also describe the factors that contribute to a membrane potential.

5. Explain the role of the sodium-potassium pump in maintaining the resting potential.

6. Describe the characteristics of an action potential, also describe saltatory conduction.

7. Compare the structures and functions of the mammal (human) central nervous system and the peripheral nervous system.

8. Distinguish between the functions of the autonomic nervous system and the somatic nervous system.

05/02  Major Test IV.

05/07  Final Examination: 8:00 A.M.