Biology 1151

Principles of Biological Science

Flexible Learning in the Learning Commons

College of DuPage

Index

Section 1: Syllabus

Catalog Description Including Prerequisites

Course prefix and number: Biology 1151
Course title: Principles of Biological Science

Semester Credit Hours: 5 Lecture Hours: 4 Lab Hours: 3

An introduction to biology for the biological science major and interested students. Topics include the philosophy of science, scientific method, chemical organization of life, cell biology, cellular metabolism, genetics, molecular genetics, molecular biology, evolution, and biodiversity of the Bacteria, Archaea, Protists, and Fungi.
Pre-Enrollment Criteria: Math 0481 (or college equivalent) with a C or better, or qualifying score on the mathematics placement test, or qualifying A.C.T. math score.

Course Goals & Expected Student Outcomes

Upon successful completion of this course, the student should be able to do the following:

- Explain the process of science and the scientific method
- Introduce the chemical connection to life
- Recognize the structures and describe the functions of the basic organic molecules of life
- Describe the structure of cells, the functions of cellular organelles, membrane structure and function
- Describe cellular communication
- Demonstrate understanding regarding the metabolic processes of fermentation, respiration, and photosynthesis
- Describe the cell cycle to include cellular division through mitosis and meiosis
- Demonstrate proficiency in understanding the principles of genetics and their application
- Describe mechanisms involved in gene expression, the regulation of gene expression, and how genes control development
- Demonstrate understanding of the modern synthesis of evolution that combines Darwin's theory with genetics
- Explain the evolution of genomes and developmental mechanisms

- Present an overview of biodiversity from an evolutionary perspective with special attention given to viruses and other nonliving infectious agents, prokaryotes, and protists
- Demonstrate proficiency in utilizing critical thinking, writing, and quantitative skills when conducting experimental research

Course Materials

Campbell BIOLOGY, 9th Edition, by Reece, Urry, Cain, Wasserman, Minorsky, and Jackson Pearson Benjamin Cummings, 2011 (required)

Note: A split version of this text that contains only chapters needed for Biology 1151 is available in the COD bookstore. Students who do not intend to take Biology 1152 may choose to purchase this partial text to save money.

Investigations in the Biology 1151 Laboratory, by Barbara T. Anderson, and Chris E. Petersen, 2011 (required)

Biology Students' Study Guide, 9th Edition, Pearson Benjamin Cummings, 2011 (optional)

Mastering Biology for Campbell Biology, 9th edition, ISBN 10:0-321-67787-0 (optional)

Delivery System

Biology 1151, Principles of Biology, is a self-paced course which is designed to allow the student a flexible learning opportunity. The student is not required to meet for lectures in the traditional classroom setting, but is required to meet for various laboratory exercises. Although the course content remains the same, the course material is provided through a textbook with optional study guide, lab exercises, computer simulations, and examinations. Students may also use the Mastering Biology website for practice questions, animations, and other study aids. An access code for Mastering Biology is provided with new textbooks. Access codes may also be purchased separately at www.masteringbio.com. The course title for this course on the mastering biology web site is CILBio1151. Within the Mastering course, there is an "assignment" for each chapter covered that includes items selected specifically to help students prepare for exams.

To do well in this course, students will need to be self-starters as well as independent learners. Students are encouraged to come in or contact the instructors during scheduled hours of availability. If an instructor is not available during a particular time of convenience for the student, students may leave a message with the instructional assistant or in the instructor's voice mail, and the instructor will respond as soon as possible. Students may also use the campus email system to contact their instructor, and the instructor will reply during their scheduled hours.

How to Succeed in Biology 1151:

- Attend the scheduled orientation during the first week of the semester.
- Set aside a consistent time to study daily.

- Follow the course map. (This will ensure that lab topics correspond to exam material and that you complete the course by the deadline)
- Make sure you read the entire SCM.
- Contact your instructor if you have questions or problems in this course.
- Check Blackboard regularly to monitor your progress in the course.

Orientation

Orientations are offered at the beginning of each term at specified times in a biology laboratory. Check the dates and times listed under Orientation and Deadline Dates on Blackboard. If you cannot attend one of the scheduled orientations, contact the instructor during their scheduled hours; these hours are listed under Contact Information and Availability sheet on Blackboard. It is helpful if you read the syllabus first and then call or email with specific questions.

Exams and Evaluations

There are six objective tests. Each exam consists of multiple choice, matching, or true-false questions. The student may take the exams at the Testing Center (BIC 2405) or at the Off-Campus Learning Commons in Bloomingdale, Naperville, and Westmont. For the first exam only students will be allowed to retake the exam to try for a higher score. The highest of the two exam scores will be used in the final grade calculation. This option is only available for the Unit 1 exam.

Grading Policy

The six, 80 point examinations contribute 70% toward the final grade. The fourteen, 15 point labs contribute 30% to the final grade. Students may earn up to 8 extra credit points for each of the six exams by submitting responses to questions found in Appendix B of this packet.
These questions must be submitted prior to taking each exam in order to receive credit.

Grading Scale

Final grades will be determined on the basis of the following grading scale:
A = 90 - 100%
B = 80 - 89%
C = 70 - 79%
D = 60 - 69%
F = Less than 60%
I = See guidelines for Incomplete Grade

NOTE: All labs and exams must be completed before a final grade is issued. Please refer to your college handbook for other guidelines for incomplete and withdrawal procedures.

Testing Procedures

Tests for this course may be taken at the Testing Center in Glen Ellyn (BIC 2405) or one of the Off-Campus Learning Commons in Bloomingdale, Naperville and Westmont. Students are

required to comply with the Deadline Dates, posted on Blackboard in the Deadline Dates link and comply with specific testing instructions provided by the instructor. Appointments are not required for testing.

When you are ready to take an exam, sign in at the front desk. You will be expected to write in the date, course name and number, the instructor's name, test number, and time the exam is taken. You must present a photo ID as well. You may not use notes or books during the exam. No food, drink, pagers or cell phones are allowed in the testing room.

All tests must be completed in one sitting. All tests will be collected 10 minutes prior to closing. It is important for you to plan sufficient time to complete your test within the Center's hours. No additional time will be given to complete a test. No tests are distributed 30 minutes prior to closing. Tests are graded immediately upon completion and you will be able to see your score. Results will be sent to your instructor who will then post your score on Blackboard. Any extra credit points earned will be included in the score posted on Blackboard. You may discuss your test results with your instructor during their scheduled hours.

Scores of essay exams (if any) are available from the instructor. A progress report may be mailed to the student, or the student may view the test results at the location where registered. You must show a picture ID.

Satisfactory/Fail (S/F) Grade Option

The instructor retains the prerogative to determine whether the "Satisfactory/Fail" option is applicable to the course. It is the responsibility of the instructor to set deadlines for a student's grade option decision and communicate these deadlines to the student during the student's first week of instruction. All students desiring the "Satisfactory/Fail" option must sign an agreement with the instructor confirming the use of the "Satisfactory/Fail" grading option. Grade option forms will be submitted to the Registration office by the instructor no later than 1 week prior to the end of the course. Grade options will not be changed after they have been sent to the Records office. The satisfactory or "S" grade will not be computed in the GPA; the fail or "F" grade will be computed.

Incomplete Policy

Upon the request of a student, the instructor may give an incomplete or "I" grade when a student has been unable to complete the course within the prescribed time for some unavoidable reason. To qualify for an "I" grade, a student must have submitted at least seven of the fourteen labs and completed at least 3 of the 6 exams with 70% grade average. The student is responsible for contacting the instructor regarding course completion. The time period allowed to complete the course will be determined by the instructor. I grades are not granted automatically. The student must sign a "Contract for Incomplete Grade" form with the instructor before an incomplete grade can be issued. Further information concerning the "I" grade may be found in the College catalog.

Withdrawal Policy

Course Withdrawals

Students are encouraged to consult directly with the instructor when considering a course withdrawal. The student may withdraw from a course by contacting the Registration office up to the mid-term date of the class. Thereafter, a grade will be assigned which reflects the student's actual performance in the class. Exceptions require an agreement with the instructor and the student. Written permission to withdraw signed by the instructor must be presented to the Registration office by the student prior to the end of the term.

Medical Withdrawals

Medical Withdrawals: Requests for medical withdrawals should be made to the Dean of Enrollment Services. Send medical forms to Student Registration Services, SSC 2221, (630) 942-2687. Requests should be made in writing and accompanied by documentation from a physician or medical institution to verify the medical condition, date of onset and estimated length of treatment. Request forms for medical withdrawals are reviewed individually. Refunds are issued when appropriate within the guidelines of the College of DuPage refund policy. You will receive written notification of the decision within three (3) weeks from the office of the Student Registration Services.

Plagiarism/Academic Dishonesty Policy

All work submitted for credit must be completed by the student who is registered for the course. Disciplinary action will be pursued in all instances in which it is determined that academic dishonesty has occurred. Academic dishonesty can include the dishonest use of course materials such as student papers and exams.

Library Information

The College of DuPage Library has a wealth of information in both print and online formats. The Library homepage is found at http://www.cod.edu/library. To access the online sources, click on Databases. You may access these databases directly from any COD computer. To access the databases from your home or other computer you will be prompted to enter your library card number. Library cards are free, but you will need to come to the Library to get a card.

The Library is located in the Student Resource Center (SRC) building at the Glen Ellyn campus.

Additional information regarding the current Library hours and services can be obtained by visiting their web site at www.cod.edu/library.

Computer Use

The Library computers may be used for more than accessing the Library Catalog and online sources. You can also use Microsoft Word, Excel, PowerPoint, and Access.

Academic Computing Center (ACC) is located in the Student Resource Center (SRC) room 3600. The Academic Computing Center is open for use by individuals registered at College of DuPage as well as community residents.

Off-Campus Learning Commons at Bloomingdale, Naperville, or Westmont welcome Flexible Learning students to use their computers. Access is granted on a first-come, first serve basis. To use computers at the Off-Campus Learning Commons, the person must be currently enrolled at the College of DuPage and have a photo ID.

At all College of DuPage computer labs, you are expected to work independently and bring your own storage media for your work. No peripheral equipment (e.g. calculators, laptop computers, or mice) may be attached to any computer. Students may NOT install software or programs on any computer in the computer labs.

Section 2: Course Map

Unit	*Required Text*	*Study Guide*	*Activity*	*Exam*
1	BIOLOGY, Ch. 1: Introduction: Themes in the Study of Life BIOLOGY, Ch. 2: The Chemistry of Life BIOLOGY, Ch. 3: Water and Life BIOLOGY, Ch. 4: Carbon and the Molecular Diversity of Life BIOLOGY, Ch. 5: The Structure and Function of Large Biological Molecules	Campbell Study Guide, Ch. 1 Campbell Study Guide, Ch. 2 Campbell Study Guide, Ch. 3 Campbell Study Guide, Ch. 4 Campbell Study Guide, Ch. 5	Lab 4 Lab 5	Exam 1
2	BIOLOGY, Ch. 6: A Tour of the Cell BIOLOGY, Ch. 7: Membrane Structure and Function BIOLOGY, Ch. 8: An Introduction to Metabolism	Campbell Study Guide, Ch. 6 Campbell Study Guide, Ch. 7 Campbell Study Guide, Ch. 8	Lab 7 Lab 9 Lab 11	Exam 2

Unit		*Required Text*	*Study Guide*	*Activity*	*Exam*
3		BIOLOGY, Ch. 9: Cellular Respiration and Fermentation BIOLOGY, Ch. 10: Photosynthesis BIOLOGY, Ch. 12: The Cell Cycle BIOLOGY, Ch. 13: Meiosis and Sexual Life Cycles	Campbell Study Guide, Ch. 9 Campbell Study Guide, Ch. 10 Campbell Study Guide, Ch. 12 Campbell Study Guide, Ch. 13	Lab 14C Lab 16	Exam 3
4		BIOLOGY, Ch. 14: Mendel and the Gene Idea BIOLOGY, Ch. 15: The Chromosomal Basis of Inheritance BIOLOGY, Ch. 22: Descent with Modification: A Darwinian View of Life BIOLOGY, Ch. 23: The Evolution of Populations	Campbell Study Guide, Ch. 14 Campbell Study Guide, Ch. 15 Campbell Study Guide, Ch. 22 Campbell Study Guide, Ch. 23	Lab 19 Lab 21	Exam 4

Unit		***Required Text***	***Study Guide***	***Activity***	***Exam***
5		BIOLOGY, Ch. 16: The Molecular Basis of Inheritance BIOLOGY, Ch. 17: From Gene to Protein BIOLOGY, Ch. 18: Regulation of Gene Expression BIOLOGY, Ch. 19: Viruses BIOLOGY, Ch. 20: Biotechnology	Campbell Study Guide, Ch. 16 Campbell Study Guide, Ch. 17 Campbell Study Guide, Ch. 18 Campbell Study Guide, Ch. 19 Campbell Study Guide, Ch. 20	Lab 22 Lab 3	Exam 5
Unit		***Required Text***	***Study Guide***	***Activity***	***Exam***
6		BIOLOGY, Ch. 24: The Origin of Species BIOLOGY, Ch. 25: The History of Life on Earth BIOLOGY, Ch. 26: Phylogeny and the Tree of Life BIOLOGY, Ch. 27: Bacteria and Archaea BIOLOGY, Ch. 28: Protists BIOLOGY, Ch. 31: Fungi	Campbell Study Guide, Ch. 24 Campbell Study Guide, Ch. 25 Campbell Study Guide, Ch. 26 Campbell Study Guide, Ch. 27 Campbell Study Guide, Ch. 28 Campbell Study Guide, Ch. 31	Lab 23 Lab 24.2 Lab 24.3	Exam 6

Section 3: Study Guide

To prepare for unit exams use the following objectives as a study guide as you read each chapter. Pay particular attention to any figures and/or tables indicated.

Unit 1

Chapter 1: Introduction: Themes in the Study of Life

1. Explain properties of life (Fig. 1.3).
2. Diagram the hierarchy of biological organization and be able to define the terms used for each level (Fig.1.4).
3. Distinguish between prokaryotic and eukaryotic cells.
4. Name for the basic building blocks of DNA.
5. Identify the core theme of biology.
6. Know the correct sequence for the names of the taxonomic groupings shown in Fig. 1.14 from the broadest (Domain) to the most specific (species).
7. Distinguish features of the three domains of life and the kingdoms within them (Fig. 1.15).
8. Distinguish between inductive and deductive reasoning.
9. Explain why hypotheses must be testable and falsifiable, but are not provable (Fig. 1.24).
10. Describe what is meant by a controlled experiment.
11. Distinguish between the everyday meaning of the term *theory* and its meaning to scientists.

Chapter 2: The Chemistry of Life

1. Distinguish between an element and a compound.
2. Identify the four elements that make up 96% of living matter.
3. Define the term trace element and give an example.
4. Draw and label a simplified model of an atom of one of the first 18 elements showing its electron configuration when provided with its atomic number (Figs. 2.5, 2.9).
5. Distinguish between neutrons and protons, and atomic number and atomic mass.
6. Explain how the atomic number and atomic mass of an atom can be used to determine the number of neutrons.
7. Explain how isotopes of an atom are different.
8. Explain why electrons in the first energy shell have less potential energy than electrons in higher energy shells. Define the term *valence electrons* and explain their importance with respect to chemical reactivity (Fig. 2.8).
9. Distinguish among polar covalent, nonpolar covalent, and ionic bonds and give an example of each (Figs. 2.11, 2.13, 2.14).
10. Explain hydrogen bonding and Van der Waals interactions (Fig. 2.16)
11. Explain how a molecule's shape can determine its biological function.
12. Indicate reactants and products in a chemical equation.
13. Explain what is meant by chemical equilibrium.

Chapter 3: Water and Life

1. Explain why water molecules are capable of hydrogen bonding with 4 other water molecules (Fig. 3.2).

2. List 4 characteristics of water that result from hydrogen bonding.
3. Explain how cohesion and adhesion are important to living things (Figs. 3.3, 3.4).
4. Explain how large bodies of water moderate temperature.
5. Define specific heat and evaporative cooling.
6. Describe why ice floats on water. Explain why this is an advantage for life (Fig. 3.6).
7. Distinguish among a solvent, a solute, and a solution (Figs. 3.7, 3.8).
8. Explain the importance of water as the solvent for all life.
9. Name the products of the dissociation of water and give their concentrations in pure water.
10. Define acid and base (Fig. 3.10).
11. Know the mathematical expression for pH and be able to explain how changes in the hydrogen ion concentration affect pH.
12. Explain how acids and bases may directly or indirectly alter the pH of a solution.
13. Explain how buffers work.
14. List causes and effects of acid precipitation and ocean acidification (Fig. 3.11, 3.12).

Chapter 4: Carbon and the Molecular Diversity of Life

1. Explain how carbon's electron configuration accounts for its ability to form large, complex, and diverse organic molecules.
2. Describe how carbon skeletons may vary (Fig. 4.5).
3. Describe the **basic** structure of a hydrocarbon (this does not involve naming or drawing the molecules). Explain why these molecules are hydrophobic.
4. Distinguish among the three types of isomers: structural, geometric, and enantiomer (Fig. 4.7).
5. Name and be able to recognize the major functional groups found in organic molecules. Also be able to give the general name (i.e. alcohol) of compounds that contain each functional group (Fig. 4.9).

Chapter 5: The Structure and Function of Large Biological Molecules

1. List the four major classes of macromolecules.
2. Distinguish between monomers and polymers. Describe dehydration synthesis and condensation reactions (Fig. 5.2).
3. Identify a monosaccharide by its molecular and structural formula (Fig. 5.3).
4. Distinguish among monosaccharides, disaccharides, and polysaccharides. Be able to identify the main function of carbohydrates.
5. Give examples of storage polysaccharides and structural polysaccharides and explain how starch and cellulose differ (Figs. 5.5, 5.6, 5.7).
6. Describe the basic structure and functions of fats, phospholipids and steroids (Figs. 5.10-5.14).
7. Distinguish between saturated and unsaturated fats and the organisms that produce each type of fat (5.11).
8. Describe and be able to recognize (not name or draw) the basic structure of amino acids, the basic building blocks of proteins (Fig. 5.16).
9. Distinguish between a protein and a polypeptide.
10. List some functions of proteins (Table 5.15).
11. Explain the four levels of protein structure and identify the types of bonds that create them (Fig. 5.20).
12. Describe what is meant by the term *denatured*. List four conditions under which proteins may be denatured (Fig. 5.22).

13. Explain the function of chaperonins or chaperone proteins (Fig. 5.23).
14. List the major components of the basic building blocks, nucleotides, found in nucleic acids, including the 4 bases found in each type of nucleic acid (Fig. 5.26).

Unit 2

Chapter 6: A Tour of the Cell

1. Differentiate between magnification and resolution in microscopy.
2. Explain why resolution is enhanced in electron microscopy.
3. Distinguish between prokaryotic and eukaryotic cells. List typical components of a prokaryotic cell (Fig. 6.5).
4. Explain why there are limits to a cell's size (Fig. 6.7).
5. Explain the advantages of compartmentalization in eukaryotic cells.
6. Describe the structure and function of the nucleus, including the nuclear envelope and the nucleolus (Fig. 6.9).
7. Describe the structure and function of eukaryotic ribosomes (Fig. 6.10).
8. Distinguish between free and bound ribosomes in terms of location and function.
9. Compare the structures and functions of the smooth and rough ER (Fig. 6.11).
10. Explain the significance of the *cis* and *trans* sides of the Golgi apparatus (Fig. 6.12).
11. Describe the function of lysosomes (Fig. 6.13).
12. Name and give the function of three different kinds of vacuoles. Describe the role of the central vacuole in plant cells (Fig. 6.14).
13. List the components of the endomembrane system, and describe the structure and function of each component (Fig. 6.15).
14. Explain the endosymbiont theory for the origin of the eukaryotic cell (Fig. 6.16).
15. Describe the structure and function of mitochondria (Fig. 6.17).
16. Describe the structure and function of chloroplasts (Fig. 6.18).
17. Describe three similarities between chloroplasts and mitochondria including the presence of ribosomes and DNA in each.
18. Explain the function of peroxisomes in eukaryotic cells.
19. Describe functions of the cytoskeleton (Table 6.1).
20. Describe the structure, protein subunits, and functions of microtubules and microfilaments (Table 6.1).

Chapter 7: Membrane Structure and Function

1. Describe the fluid mosaic model for membrane structure and be able to identify the components of an animal cell's plasma membrane from a diagram (Fig. 7.5).
2. Describe the fluidity of the components of the cell membrane and explain how membrane fluidity is influenced by temperature and membrane composition.
3. Explain how cholesterol resists changes in fluidity with temperature change (Fig.7.8).
4. Distinguish between peripheral and integral membrane proteins.
5. List six major functions of membrane proteins (Fig. 7.10).
6. Explain the role of membrane carbohydrates in cell-to-cell recognition.
7. Distinguish between molecules that can cross the lipid bilayer and those that can't.
8. Define diffusion. Explain why it is a spontaneous process (Fig. 7.13).
9. Distinguish among hypertonic, hypotonic, and isotonic solutions.
10. Define osmosis and predict the direction of water movement based on solute concentration differences (Fig. 7.14).
11. Describe how cells with and without cell walls regulate water balance (Fig. 7.15).
12. Explain how transport proteins facilitate diffusion (Fig. 7.17).

13. Explain the differences between osmosis, facilitated diffusion, and active transport (Fig. 7.19).
14. Define the term *membrane potential*. Describe the two forces that produce an electrochemical gradient.
15. Explain how an electrogenic pump creates voltage across the cell membrane using the sodium-potassium pump as an example (Fig. 7.18).
16. Define the terms *phagocytosis*, *pinocytosis*, and *receptor-mediated endocytosis* (Fig. 7.22).

Chapter 8: An Introduction to Metabolism

1. Define the term *metabolism* including the roles of catabolic and anabolic pathways and enzymes in cellular metabolism.
2. Distinguish between kinetic and potential energy.
3. Explain the first and second laws of thermodynamics (Fig. 8.2).
4. Explain why highly ordered living organisms do not violate the second law of thermodynamics (Fig. 8.4).
5. Write the equation for free energy change and define each term in the equation.
6. Explain the relationship between free energy and equilibrium in chemical reactions.
7. Distinguish between exergonic and endergonic reactions in terms of free energy change (Fig. 8.6).
8. Describe the structure of ATP and identify the class of macromolecules to which it belongs (Fig. 8.8).
9. Explain how ATP does cellular work (Fig. 8.10).
10. Describe how ATP is regenerated in the ATP cycle (Fig. 8.11).
11. Define *activation energy* (Fig. 8.12).
12. Describe the function of enzymes (Fig. 8.13).
13. Explain how enzyme structure determines enzyme specificity using the terms substrate and active site..
14. Explain the induced-fit model of enzyme action (Fig. 8.14).
15. Describe the mechanisms by which enzymes lower activation energy (Fig. 8.15).
16. Explain how the factors substrate concentration, pH, temperature, cofactors, and enzyme inhibitors can affect enzyme activity (Figs. 8.16, 8.17).
17. Describe what is meant by *allosteric regulation* (Fig. 8.19).

Unit 3

Chapter 9: Cellular Respiration and Fermentation

1. Write the summary equation for cellular respiration. Show how the equation can be seen as a redox process.
2. Define *oxidation* and *reduction*.
3. Explain in general terms how redox reactions are involved in energy conversions.
4. Describe the role of NAD^+ in cellular respiration.
5. Explain the role of electron transport in cellular respiration (Fig. 9.5).
6. Name the three stages of cellular respiration and state the location in the eukaryotic cell where each stage occurs (Fig. 9.6).

7. Distinguish between substrate-level phosphorylation and oxidative phosphorylation. Identify which process is used to make ATP in each of the stages of cellular respiration (Fig. 9.7).
8. List the key starting and ending molecules of glycolysis (Fig. 9.8). Explain why the energy output from glycolysis is low relative to the energy stored in a molecule of glucose.
9. Describe where pyruvate is oxidized to acetyl CoA, what molecules are produced, and how this process links glycolysis and the citric acid (Krebs) cycle (Fig. 9.10).
10. List the products of the citric acid (Krebs) cycle. Explain why it is called a cycle (Fig. 9.11).
11. Explain where and how the respiratory electron transport chain creates a proton gradient.
12. Explain how the transfer of electrons down the electron transport chain is coupled to the production of ATP by chemiosmosis (Fig. 9.15).
13. Summarize the net ATP yield from the oxidation of a glucose molecule. Compare the ATP yield from substrate-level phosphorylation to the yield from oxidative phosphorylation.
14. State the basic function of fermentation (Fig. 9.17).
15. Compare the processes of fermentation and cellular respiration with respect to oxygen requirements, final electron acceptors, and total ATP yield.
16. Discuss evidence that suggests that glycolysis is an ancient metabolic pathway.

Chapter 10: Photosynthesis

1. Distinguish between autotrophic and heterotrophic nutrition. Provide examples of heterotrophic organisms.
2. Define and provide examples of photoautotrophs (fig. 10.2).
3. Describe the structure of a chloroplast, including thylakoids, thylakoid space, and stroma (Fig. 10.4).
4. Write a summary equation for photosynthesis.
5. Describe the two main stages of photosynthesis in terms of reactants, products, and location, and describe how they are linked together (Fig. 10.6, 10.22)
6. Define the term *pigment* and be able to explain why leaves appear green (Fig. 10.8).
7. List the wavelengths of light that are most effective for photosynthesis and briefly describe how Engelmann's experiments demonstrated their effectiveness (Fig. 10.10).
8. Explain what happens when a chlorophyll molecule in a chloroplast absorbs light energy (Fig. 12).
9. List the components of a photosystem and explain the functions of each component.
10. Explain the functions of cyclic and noncyclic electron flow. Explain why water is split during noncyclic electron flow (Figs. 10.14, 10.16, 10.18).
11. Describe the similarities and differences in chemiosmosis between oxidative phosphorylation in mitochondria and photophosphorylation in chloroplasts (Fig. 10.17).
12. Summarize the Calvin cycle including reactants, products, and location (Fig. 10.19).
13. Describe the function of the enzyme rubisco (RuBP).
14. Describe the process of photorespiration including its advantages and disadvantages for C_3 plants.

Chapter 12: The Cell Cycle

1. Discuss functions of cell division.
2. List the phases of the cell cycle and describe the sequence of events that occurs in each phase (Fig. 12.6).
3. List the phases of mitosis and describe the events of each phase particularly the movement of the chromosomes and changes in the spindle apparatus. Be able to recognize the phases of mitosis from cell drawings (Fig. 12.7).
4. Describe the spindle apparatus, including centrosomes, kinetochore microtubules, non kinetochore microtubules, asters, and centrioles in animal cells (Fig. 12.8).
5. Compare cytokinesis in plant cells and animal cells (Fig. 12.10).
6. Describe the process of binary fission in bacteria (Fig. 12.12).
7. Describe the roles of checkpoints, specifically the G_1 checkpoint and how it relates to the G_0 phase (Fig. 12.15, 12.16).

Chapter 13: Meiosis and Sexual Life Cycles

1. Explain in general terms how traits are transmitted from parents to offspring.
2. Distinguish between asexual and sexual reproduction.
3. Define the term *karyotype* and describe how the karyotypes of human males and females differ (Fig. 13.3).
4. Define the terms *somatic cell*, *gamete*, *zygote*, *autosome*, *sex chromosome*, and *homologous chromosome*.
5. Explain how haploid and diploid cells differ from each other. Identify which cells in the human body are haploid and which are diploid. Note the diploid chromosome number for humans (Fig. 13.5).
6. Explain why fertilization and meiosis must alternate in all sexual life cycles (Fig. 13.6).
7. Describe the phases of meiosis I and meiosis II in order. Be able to recognize the phases of meiosis from cell drawings (Fig. 13.8).
8. Describe the process of synapsis during prophase I and explain how genetic recombination occurs.
9. Compare the processes of mitosis and meiosis (Fig. 13.9).
10. Explain how independent assortment, crossing over, and random fertilization contribute to genetic variation in sexually reproducing organisms (Figs. 13.10, 13.11).
11. Explain why heritable variation is crucial to Darwin's theory of evolution by natural selection.

Unit 4

Chapter 14: Mendel and the Gene Idea

1. Explain how Mendel's particulate mechanism differed from the blending theory of inheritance.
2. Define the following terms: *True-breeding, hybridization, monohybrid cross, P generation, F_1 generation, F_2 generation,* and *allele* (Figs. 14.3 and 14.4).
3. Explain the components of Mendel's hypothesis that led him to deduce the law of segregation (Fig. 14.5).
4. Use a Punnett square to predict the results of a monohybrid cross, stating the phenotypic and genotypic ratios of the F_2 generation.

5. Distinguish between the following pairs of terms: *dominant* and *recessive*; *heterozygous* and *homozygous*; *genotype* and *phenotype* (Fig. 14.6).
6. Explain how a test cross can be used to determine if an individual with the dominant phenotype is homozygous or heterozygous (Fig. 14.7).
7. Use a Punnett square to predict the results of a dihybrid cross and state the phenotypic and genotypic ratios of the F_2 generation (Fig. 14.8).
8. State Mendel's law of independent assortment and describe how this law can be explained by the behavior of chromosomes in meiosis.
9. Use the rule of multiplication to calculate probabilities for particular phenotypes in genetic crosses (Fig. 14.9).
10. Explain how phenotypic expression for heterozygotes differs with complete dominance, incomplete dominance, and codominance (Fig. 14.10).
11. Describe the inheritance of the ABO blood system and explain why the I^A and I^B alleles are said to be codominant (Table 14.11).
12. Describe what is meant by the terms *pleiotropy*, *epistasis* and *polygenic inheritance* (Figs. 14.12, 14.13).
13. Explain why studies of human inheritance are not as easily conducted as Mendel's work with pea plants.
14. Given a simple family pedigree, deduce the genotypes of some of the family members (Fig. 14.15).
15. Use the term *carrier* to explain how a lethal allele can be maintained in a population.

Chapter 15: The Chromosomal Basis of Inheritance

1. Explain how the behavior of homologous chromosomes during meiosis accounts for both the segregation and independent assortment of alleles proposed by Mendel (Fig. 15.2).
2. Describe Morgan's fruit fly experiments and how they led to the chromosomal theory of inheritance (Fig. 15.4).
3. Compare the X-Y sex determination system in humans with systems of sex determination in other animals (Fig. 15.6).
4. Explain the importance of the SRY gene in human males.
5. List some examples of sex-linked traits in humans and explain why they are more common in males than in females (Fig. 15.7).
6. Define the term *Barr body* and describe how the formation of Barr bodies effects phenotype in females (Fig. 15.8).
7. Explain why linked genes do not assort independently.
8. Distinguish between parental and recombinant phenotypes. Explain how recombinants are produced (Fig. 15.9, 15.10).
9. Define what is meant by a *map unit* and briefly describe how map units are used to create linkage maps (Fig. 15.11).
10. Define the terms *nondisjunction*, *aneuploidy*, *trisomy* and *polyploidy*.
11. Distinguish among deletions, duplications, inversions, and translocations (Fig. 15.14).
12. Describe the karyotypes responsible for the following human disorders: Down syndrome, Klinefelter syndrome, Turner syndrome, extra Y, and triple-X.

Chapter 22: Descent with Modification- A Darwinian View of Life

1. Define evolution.

2. Describe the classification scheme devised by Linnaeus.
3. Describe Cuvier's theory of catastrophism as an explanation for the various species fossilized in different rock layers.
4. Explain how the principle of gradualism and Lyell's theory of uniformitarianism influenced Darwin's ideas about evolution and the age of the earth.
5. Explain the mechanism for evolutionary change proposed by Jean-Baptiste de Lamarck. Explain why modern biology has rejected Lamarck's ideas.

6. Define adaptation.
7. Explain the evidence that convinced Darwin that species change over time.
8. Explain the mechanism for evolutionary change proposed by Charles Darwin in *On the Origin of Species*.
9. Explain how the classification system of Linnaeus fit Darwn's theory of evolution by natural selection.
10. Describe two inferences Darwin made from his observations that led him to propose natural selection as a mechanism for evolutionary change (Figs. 22.10, 22.11).
11. Distinguish between artificial selection and natural selection.
12. List four types of data that support the theory of evolution.
13. Distinguish between homologous and analogous structures (fig. 22.15, 22.18).

Chapter 23: The Evolution of Populations

1. Explain the statement "It is the population not the individual that evolves."
2. Explain how Mendel's particulate model of inheritance provided support for Darwin's theory of evolution by natural selection.
3. Define the terms *microevolution*, *population* and *gene pool*.
4. Explain why meiosis and random fertilization alone will not alter the frequency of alleles in a population.
5. Write the Hardy-Weinberg equation. Be able to use the equation to calculate allele frequencies in a population (Fig. 23.8).
6. List the five conditions that must be met for a population to remain in Hardy-Weinberg equilibrium.
7. Explain why mutation is the only source of new alleles, yet it usually has little quantitative effect on the allele frequencies in a large population.
8. Define the term *genetic drift*. Explain how population size plays a role in the impact of genetic drift on a population (Fig. 23.9).
9. Distinguish between the bottleneck effect and the founder effect (Fig. 23.10).
10. Describe how gene flow can act to reduce genetic variation between neighboring populations (Fig. 23.12).
11. Distinguish among directional, stabilizing, and disruptive modes of selection. Give an example of each (Fig. 23.13).
12. Explain how diploidy can protect a rare recessive allele from elimination by natural selection.
13. Define the term heterozygote advantage and give an example (Fig. 23.17).
14. Explain why natural selection cannot produce "perfect" organisms.

Unit 5

Chapter 16: The Molecular Basis of Inheritance

1. Explain why researchers originally thought protein was the genetic material.
2. Summarize experiments performed by the following scientists that provided evidence that DNA is the genetic material:
    a. Griffith (Fig. 16.2)
    b. Avery, McCarty, and MacLeod
    c. Hersey and Chase (Fig. 16.4)
    d. Chargoff
3. Describe the Watson and Crick model of DNA structure. Explain the significance of Rosalind Franklin's work to their model (Figs. 16.6, 16.7).
4. Explain the significance of the base-pairing rules (Figs. 16.8, 16.9).
5. Describe the semi-conservative model of replication (Fig. 16.10).
6. Describe the process of DNA replication, including the roles of helicase, topoisomerase, primase, DNA polymerases, and DNA ligase (Figs 16.13-16.17).
7. Define *antiparallel* and explain why continuous synthesis of both DNA strands is not possible.
8. Distinguish between the leading strand and the lagging strand. Explain the significance of Okazaki fragments.
9. Explain the roles of DNA polymerase, mismatch repair enzymes, and nuclease in DNA proofreading and repair (Fig. 16.19).
10. Compare the structure and organization of prokaryotic and eukaryotic genomes.

Chapter 17: From Gene to Protein

1. Briefly describe Beadle and Tatum's experiments with *Neurospora* and explain the contribution they made to our understanding of how genes control metabolism.
2. Distinguish between the "one gene-one enzyme" hypothesis and the "one gene-one polypeptide" hypothesis and explain why the original hypothesis was changed.
3. Explain how RNA differs from DNA.
4. Briefly explain how information in the cell flows from gene to protein.
5. Distinguish between transcription and translation and where they occur in prokaryotic and eukaryotic cells (Fig. 17.3).
6. Define *codon* and explain the relationship between the sequence of codons on mRNA and the sequence of amino acids in a polypeptide (Fig. 17.4).
8. Explain how the genetic code is both redundant and unambiguous (Fig. 17.5).
9. Explain the significance of the reading frame during translation.
10. Explain the evolutionary significance of a nearly universal genetic code.
11. Explain how RNA polymerase recognizes where transcription should begin (Fig. 17.7).
12. Describe the promoter, the terminator, and the transcription unit (Fig. 17.7).
13. Explain the general process of transcription including initiation, elongation, and termination. Note that mRNA synthesis proceeds in the 5` to 3`direction (Fig. 17.9).
14. Describe the processing of eukaryotic mRNA and explain the functions of the 5' cap and poly-A tail (Fig. 17.10).
15. Explain the difference between introns and exons and describe their roles in alternative RNA splicing (Fig. 17.11, 17.13).
16. Define ribozyme.

17. Describe the structure and functions of tRNA including the flexibility in paring with the third base of a codon (Fig. 17.15).
18. Describe the structure and functions of ribosomes (Fig. 17.17).
19. Describe the process of translation including initiation, elongation, and termination. Explain which enzymes are needed for each stage (Figs 17.18-17.20).
20. Describe the significance of polyribosomes (Fig. 17.21).
21. Define *point mutations*. Distinguish between base-pair substitutions and base-pair insertions. Note the significance of the changes (Figs 17.23, 17.24).
22. List several examples mutagens and explain how they cause mutations.

Chapter 18: Regulation of Gene Expression

1. Briefly describe two main strategies cells use to control metabolism (Fig. 18.2).
2. Using the *trp* operon as an example, explain the concept of an operon and the functions of the operator, repressor, and corepressor (Fig. 18.3).
3. Distinguish between repressible and inducible operons.
4, Explain how enzyme synthesis is induced in the lac operon.
5. Describe stages in gene expression that can be regulated in eukaryotic cells (Fig. 18.6).
6. Give an example of histone modification in regulating gene expression.
7. Describe the role of DNA methylation in gene inactivation in a developing embryo.
8. Define epigenetic inheritance.
9. Give some examples of noncoding RNAs in the genome.
10. Describe the generation and function of miRNAs (Fig. 18.15).

Chapter 19: Viruses

1. List some characteristics viruses have in common with living organisms and explain why they do not fit the usual definition of life.
2. Describe the structure of viruses noting the types of molecules common to all viruses (Fig. 19.3).
3. Explain why viruses are intracellular parasites.
4. Explain how a virus identifies its host cell.
5. Describe viroids and prions and explain how each causes disease (Fig. 19.11).

Chapter 20: Biotechnology

1. Explain what is meant by *recombinant DNA*.
2. Describe the natural function of restriction enzymes.
3. Explain how bacterial cells protect their own DNA from restriction enzymes.
4. Explain how restriction enzymes are used in recombinant DNA technology (Fig. 20.3)
5. Describe the polymerase chain reaction (PCR) and explain advantages and limitations of this procedure (Fig. 20.8).
6. Explain how gel electrophoresis is used to analyze restriction fragments and list some possible uses for the procedure (Fig. 20.9, 20.10).
7. Define the terms *totipotent* and *genomic equivalence* (Figs. 20.17).
8. Describe the process by which Dolly the sheep was cloned (Fig. 20.19).
9. Provide some possible explanations for the problems associated with animal cloning.

10. Distinguish between *pluripotent* and *totipotent* stem cells. Explain their significance to medicine (Fig. 20.21).
11. List and briefly describe some medical applications of DNA technology (Fig. 20.23, 20.24).
12. Briefly explain how DNA technology is used in the forensic sciences (Fig. 20.25).
13. Briefly describe practical applications of DNA technology in environmental and agricultural work.
14. Briefly explain how DNA technology can be used to improve the nutritional quality of crops and to develop plants that produce pharmaceutical products.
15. Discuss the safety and ethical questions related to recombinant DNA studies and the biotechnology industry.

Unit 6

Chapter 24: The Origin of Species

1. Define Ernst Mayr's biological species concept (Fig. 24.2).
2. Distinguish between prezygotic and postzygotic isolating mechanisms.
3. Describe five prezygotic isolating mechanisms and give an example of each (Fig. 24.3).
4. Explain a possible cause of reduced hybrid viability (Fig. 24.3).
5. Describe some limitations of the biological species concept.

Chapter 25: The History of Life on Earth

1. Describe the four stages of the hypothesis for the origin of life on Earth by chemical evolution.
2. Describe the experiments of Urey and Miller. Describe the locations and conditions where organic molecules were probably first synthesized on Earth (Fig. 25.2)
3. Describe the evidence that suggests that RNA was the first genetic material. Explain the significance of the discovery of ribozymes.
4. Describe how natural selection may have worked in an early RNA world.
5. List 2 benefits to using DNA instead of RNA as the genetic storage molecule.
6. Examine Fig. 25.4 which shows the major events in Earth's history from its origin until 2 billion years ago. In particular, note when Earth first formed and when life first evolved (the oldest fossils of cells).
7. Explain how index fossils can be used to determine the relative age of fossil-bearing rock strata. Explain how radiometric dating can be used to determine the absolute age of rock strata (Fig. 25.5)
8. Describe the timing and the significance of the evolution of oxygenic photosynthesis. Identify the first organisms to produce O_2 in the process of photosynthesis.
9. Explain the endosymbiotic theory for the evolution of eukaryotic cells indicating how organelles such as chloroplasts and mitochondria evolved (Fig. 25.9).
10. Describe the earliest multicellular eukaryotes. Provide an explanation for their limited size and diversity.
11. Describe the Cambrian explosion.
12. Describe the sequence in which different types of organisms colonized land.

13. Describe in general the mass extinctions of the Permian and Cretaceous periods. Discuss a hypothesis that accounts for each of these mass extinctions.

Chapter 26: Phylogeny and the Tree of Life

1. Distinguish between phylogeny and systematics.
2. Explain the Linnaean systems of binomial nomenclature and hierarchal classification (Fig. 26.3)
3. List the major taxonomic categories from most inclusive to least inclusive.
4. Explain how to read a phylogenetic tree (Fig. 26.5)
5. Explain why it is crucial to distinguish between *homology* and *analogy* before selecting characters to use in the construction of phylogeny.
6. Explain why bird and bat wings are homologous as vertebrate forelimbs, but analogous as wings.
7. Describe how molecular systematics is used to determine evolutionary relationships.
8. Define a *clade*. Distinguish between a monophyletic clade and paraphyletic and polyphyletic groupings of species (Fig. 26.10)
9. Distinguish between shared primitive characters and shared derived characters.
10. Explain how shared derived characters can be used to construct a phylogenetic diagram (Fig. 26.11)
11. Differentiate between an *ingroup* and an *outgroup*. Explain how outgroup comparison can be used to distinguish between shared primitive characters and shared derived characters.
12. Discuss how systematists use the principles of maximum parsimony and maximum likelihood in constructing phylogenies.
13. Explain why any phylogenetic diagram represents a hypothesis about evolutionary relationships among organisms.
14. Explain why the three-domain system was adopted (Fig. 26.21).

Chapter 27: Bacteria and Archaea

1. Describe the structure, composition, and functions of prokaryotic cell walls.
2. Compare the molecular composition of the cell walls of archaea, bacteria, fungi, and plants.
3. Explain how the organization of prokaryotic genomes differs from that of eukaryotic genomes. Distinguish between chromosomal and plasmid DNA (Fig. 27.8).
4. Briefly describe prokaryotic reproduction.
5. Explain why prokaryotes evolve more quickly than more complex organisms.
6. Distinguish among photoautotrophs, chemoautotrophs, photoheterotrophs, and chemoheterotrophs (Table 27.1).
7. Distinguish among obligate aerobes, facultative anaerobes, and obligate anaerobes.
8. Explain the importance of nitrogen fixation to life on Earth.
9. Explain why some archaea are known as extremophiles. Describe the habitats and distinguishing features of methanogens, extreme halophiles, and extreme thermophiles.
10. In general terms, describe the role of chemoheterotrophic and autotrophic prokaryotes in the cycling of chemical elements between biological and chemical components of ecosystems.
11. List several ways we benefit from the metabolism of prokaryotes (Fig. 27.21).

12. Define *bioremediation*. Describe several examples of bioremediation involving prokaryotes.

Chapter 28: Protists

1. Explain why the kingdom Protista is no longer considered a legitimate taxonomic group.
2. Describe the different nutritional strategies of protists (phototroph, heterotroph, and mixotroph) and list habitats where protists are found.
3. Describe the modified mitochondria and other features of diplomonads. Identify the type of environment in which diplomonads are likely to be found.
4. Explain how *Euglena* can be considered both plant-like and animal-like.
5. Identify the organisms involved in "red tides" and describe their effects in ecosystems.
6. Describe the organism that causes malaria and how the disease is transmitted (Fig. 28.10).
7. List distinguishing features of ciliates. Explain how the two types of nuclei differ.
8. Describe the process of conjugation in ciliate life cycles using *Paramecium* as an example. Explain how it differs from reproduction (Fig. 28.11).
9. Describe the mode of nutrition of diatoms as well as the unique structure of their cell walls.
10. Identify the largest and most complex algae and describe its plant-like body.
11. Describe the mode of nutrition of oomycetes and provide a common name for members of the group.
12. Describe how amoeboid protists move and feed.
13. Discuss the pigments found in red algae and the depths at which they can grow.
14. Explain evidence that green algae and plants are related.
15. Briefly compare the life cycles and ecology of plasmodial slime molds, cellular slime molds, and *Entamoebas*.

Chapter 31: Fungi

1. List the characteristics that distinguish fungi from members of other multicellular kingdoms.
2. Explain how fungi acquire their nutrients.
3. Describe the basic body plan of a fungus using the terms *hyphae* and *mycelium*.
4. Explain how the cells walls of fungi differ from those of plants.
5. Describe the function of mycorrhizae. Distinguish between ectomicorrhizae and endomicorrhizae.
6. Describe the generalized life cycle of fungi. Distinguish between *plasmogamy* and *karyogamy* (Fig. 31.5).
7. Define deuteromycetes.
8. Distinguish among the Zygomycetes, Glomeromycetes, Ascomycetes, and Basidiomycetes. Include a description of the sexual structure that characterizes each group and list some common examples of each group.
9. List some of the roles of fungi in ecosystems.
10. Identify the symbiotic partners of a lichen and describe its structure. Explain the roles of the fungal component of the lichen (Fig. 31.24).
11. Describe some practical uses of fungi.

Section 4: Supplemental Lab Packet

Laboratory Instructions

1. Read the Lab Safety guidelines found in *Investigations in the Biology 1151 Laboratory*, Anderson and Petersen prior to coming to the scheduled lab period.

2. Should you have questions, discuss them with your instructor. If not, sign, and print your name, date and course number on the Lab Safety log that will be provided at orientation. This log must be signed before beginning lab experiments.

3. When you arrive in the lab, you must sign in. Students should bring a picture I.D.

4. The instructor will answer any questions and get you started.

5. Students may work with other students (up to four) in the lab provided prior permission is given by the instructor.

REMEMBER: NO EATING OR DRINKING IN THE LAB.

It is required that all students attend the scheduled lab sessions on one of the days designated on the course information sheet. Failure to attend lab may result in failure of this course. The laboratory unit schedule is a guide to give a suggested time line for completion of this course. Students may complete more than one lab per week, but a maximum of 3 labs may be submitted per week. Students can use this schedule or makeup your own.

Laboratory Unit Schedule

Unit	Lab No.	Lab
1	4	Microscope
1	5	Biological Constituents
2	7	Limits to Cell Size – Computer Simulation
2	9	Cell Structure
2	11	Diffusion and Osmosis
3	14C	Investigations in Catabolism
3	16	Mitosis/Meiosis
4	19	Survey of Human Genetics

Unit	Lab No.	Lab
4	21	A Simulation of Evolution
5	22	Computer Simulation of DNA Replication
5	3	The Scientific Paper: DNA Technology
6	23	Developing a Phylogenetic Tree The Scientific Paper: DNA Technology
6	24.2	The Diversity of Life: Protista
6	24.3	The Diversity of Life: Fungi

Laboratory Assignments

Labs must be typed or written legibly. Do Labs in pencil. As soon as a lab unit exercise is completed it should be turned in to the Learning Commons.

All assignments, including lab work data sheets and answers to questions, should contain the following information:

1. Student name
2. Date
3. Instructor's name

Lab assignments are not returned. They become college property. Students will have a folder in the Learning Commons where all graded assignments are placed. You may look at the contents of your folder in the Learning Commons any time the center is open to read instructor comments. Lab grades will be posted on Blackboard.

Additional Laboratory Instructions

The following laboratory exercises are found in *Investigations in the Biology 1151 Laboratory*, Anderson and Petersen. Since the lab exercises in Biology 1151 cover a wide range of activities, the particular style of laboratory report will vary. **Always read labs before coming to class**.

Lab 4 – Microscope Laboratory

1. Read the historical development of the microscope.

2. Review the steps on handling, parts and function of the microscope.

3. Should you have questions, discuss them with the instructor prior to beginning this lab. If not, follow the procedure given in your lab manual.

4. Omit the dissecting microscope section.

5. Complete sections A and B on the data sheet.

Lab 5 – Biological Constituents

1. Read Lab 5 very carefully before coming to class. You must wear goggles throughout this lab!

2. In order to finish during one lab period you will need to perform tests on your unknown chemical (step 1 of Part B) as you complete the standardization procedures described in Part A. This will also allow you to directly compare the results from your unknown with the results from known chemicals. You will be given only one unknown and you will not be testing food items (so you will skip step 2 of Part B and the last data table).

3. Omit the following tests: Solubility test for lipids, Xanthoproteic Test for Aromatic Amino Acids, and Diphenylamine Test for Nitrates.

Lab 7 – Limits to Cell Size-Computer Simulation

1. Go to Academic Computing Center (ACC) and check out the CD-ROM Explorations in Cell Biology and Genetics. Proper I.D. will be required. This lab is only available on computers in the ACC.

2. Select the program Cell Size.

3. Follow procedures outlined in your manual for 4 experiments.

4. For each experiment, state what hypothesis you will be testing, then run the simulation, collect data, graph your results, and make a conclusion that refers back to your hypothesis. For each graph, the value of the experimental variable (i.e. % villi, radius) should be on the x axis. Choose to graph either SA/V or Relative Diffusion Rate on the y axis.

5. You may need to refer to Appendix 2 at the back of your lab manual for general directions on the use of the computer in the ACC.

Lab 9 – Cell Structure

1. Follow the procedures outlined in your manual.

2. All drawings must include all structures/organelles **that are visible** with correct labels.

Lab 11 – Diffusion/Osmosis

1. Follow procedure in your lab manual on diffusion.

Remember:
(1) Do not disturb your experiment once it is set up.
(2) Do not touch potassium permanganate ($KMnO_4$) with your hands. Use the spatula or forceps.

2. Follow procedure for dialysis in your lab manual.

3. Follow procedure for osmosis for setup 1 **or** setup 2. You will not have time to do both.

4. Omit the following:
   Colloid Properties
   1. Brownian Movement
   2. Sol-Gel Reversal

Lab 14– Investigations in Catabolism

1. Complete only part C, *Effects of Activity on Respiration Rates in Humans*.

2. You will be both "subject" and "timekeeper". Follow procedures as indicated.

Lab 16 – Mitosis/Meiosis

1. Follow the procedures outlined in your lab manual.

2. Identify, draw and label all the stages of mitosis for both plants and animals.

3. Draw and label the sperm at various stages of development in a cross section of mammalian testis.

4. Draw and label the oocytes with follicles at various stages of development in a cross section of cat ovary.

5. Slides for this lab and microscopes are available for use in the library. Biology 1151 slides can be checked out at the front desk with proper I.D.

Lab 19 – Survey of Human Genetics

1. Follow the procedures outlined in your lab manual.

2. You can determine your ability to taste the substances listed in Table 19.1 by using the test paper provided in the lab. The rest of this lab can be done at home.

3. If you do not know your blood type just select a blood type and answer the questions assuming you are the blood type you chose.

Lab 21- A Simulation of Evolution

1. Follow the procedures outlined in your lab manual and answer all questions on the data sheet. Use .17 as the starting phenotype frequency for non-tasters. You will need to use the computers in the biology lab for this simulation.

Lab 22 – Computer Simulation of DNA Replication and Expression

1. This simulation is available on the computers in the biology lab as well as on the computers in the Academic Computing Center.

2. Follow the procedures as indicated in your lab manual.

Lab 3 – The Scientific Paper

1. Follow the procedure outlined in your lab manual for assignment number 1.

2. Choose an article that includes an application of DNA technology described in chapter 20 of your text (for example PCR, cloning, RFLP analysis, recombinant DNA). Make sure to select a report of data from an experiment rather than a summary article.

3. The article you chose from a scientific journal must be current (within the last 5 years). You may use the online databases available through the COD library to find an article. If you have a COD library card you can access these databases from any computer. To get started, go to www.cod.edu, click on library, and choose databases. Contact your instructor if you need additional help locating an article for this assignment.

4. A copy of the article must be attached to your critique.

5. The analysis must be typed and two to three pages in length.

Lab 23 – Developing a Phylogenetic Tree

1. Follow the procedures indicated in your lab manual. It is helpful to read about hominin evolution in your text (p.728-733) before coming to lab.

Lab 24 – The Diversity of Life

1. This assignment includes sections 24.2 and 24.3 only. Microscope slides for this lab are available for check-out at the circulation desk in the library as well as in the biology lab.

2. For all sections, follow the procedures as indicated in your lab manual for the *slides*, in most cases *specimens* will not be available. If a particular specimen is not available in the lab you do not need to answer the corresponding question. For each section, you will simply answer the

numbered questions on a separate sheet of paper. You are not required to submit drawings of the slides you observe.

3. Some of the taxonomy has changed with the 9th edition of your text and will be slightly different than the lab manual. For example, some of the phylum names in your lab manual may be used as clade names in your textbook. Common names (i.e. slime molds, water molds, diatoms, etc.) will be consistent between the two books. You should be able to use your text to answer most of the questions. Use internet sources to answer the other questions.

Appendix A

Highlights of Flexible Learning Biology 1151 Orientation

I. The road to follow for successfully completing Biology 1151 Independent Study

A. Create a schedule (calendar).

1. Write on your schedule exactly when you plan to complete each of the chapters.
2. Put test dates on your calendar.
3. Also fill in the dates you plan to do each of the required labs.
4. The course map included in your course handbook may be helpful in scheduling your course requirements.
    a. You will need to cover about one unit every two to three weeks to stay on track.
    b. Give yourself a buffer of time at the end in case you fall behind in your course work.
5. When designing your personal schedule keep in mind the semester deadline dates for exams, labs and extra credit.
    a. Typically all work must be completed one week prior to the end of the semester.
    b. Always check course information sheet for deadline to complete all course work.
6. Post your proposed course calendar in a very visible place such as your refrigerator.
    a. Stick to your schedule.
    b. If for some reason you get off schedule work some extra hours on the course to get back on track.

B. Dedicate approximately fifteen hours a week to Biology 1151.

C. Suggested study habits.

1. While reading a chapter take notes on it **using the study guide that corresponds to the chapter.**

2. Make note cards for terminology with term on one side and definition on the back.
    a. Note cards can easily be taken with you, so when you have extra time you can work on vocabulary.
    b. Biology is comparable to studying a foreign language; therefore terminology is extremely important.
    c. It is very difficult to answer questions on exams when you are not familiar with the terminology.

3. Study your chapter notes.
4. Answer questions in the Student Study Guide for *Biology* that correspond to the objectives listed in the study guide in section 3 of your student course materials.

5. Answer the chapter questions in the text.

6. Try the Mastering Biology activities and questions that correspond to the particular chapter.

D. Do not be shy about asking for help.
1. The instructor's available hours for assistance are listed on Contact and Availability sheet. This information is posted on Blackboard.
2. To avoid phone tag, call the instructor during available hours or leave a message with a number where the instructor can reach you during this period of time.

II. Exams – covered in detail in syllabus.
A. Exams are taken at the Testing Center (BIC 2405) or one of the Off-Campus Learning Commons in Bloomingdale, Naperville, and Westmont.
1. All exams are completed on scantron forms so you will know your test score right away.
2. Exam scores, including extra credit, will be posted on Blackboard.
3. Hours for the Testing Center are posted on Blackboard.
a. Always allow yourself at least 90 minutes for an exam.
b. Keep in mind towards the end of the semester the Testing Lab can get very busy and there may be a wait.
4. Extra credit for exams
a. At the end of each unit there are essay application questions worth one point each.
b. You are allowed to submit answers to eight questions per unit, which means an average of eight points per exam.
c. Answer the questions thoroughly to receive maximum points.
d. These application questions have to be turned in prior to taking an exam – they cannot be turned in after an exam.
e. Doing the application questions also helps prepare you for the unit exams.

III. A suggested lab schedule appears on the course map; always read labs prior to doing the actual experiment.
   A. There is usually a daytime lab and evening lab once a week to attempt to accommodate everyone's varied schedules.
   B. Lab 7 must be done in the Academic Computing Center (ACC). Lab 22 can be done in the ACC, but may also be done during lab hours when an instructor is available to assist you.
   C. Lab 4 and 9 can be done together, and if you read ahead and are really organized other labs could be combined in one session.
   D. A Biology 1151 slide set is available with microscopes for use in the Library for Labs 16 and 24.2-3.
   E. Working with a partner is encouraged.
   F. Make sure you answer all questions thoroughly – check the supplemental lab packet for specific instructions regarding each lab.
   G. It is highly recommended to do labs in pencil.
   H. Labs are each worth a maximum of 15 points – scores for labs will be posted on Blackboard.
   I. Please ask the instructor to explain any questions you might have with your lab reports.

IV. Submit completed work at the Learning Commons in Glen Ellyn (SRC 2102) or off-campus in Bloomingdale, Naperville, and Westmont or directly to your instructor.
   A. Please submit work as you complete it rather than waiting until the deadline.
      1. This avoids, for example, getting docked for a repeated error.

   B. As work is graded the instructor will post your grades on Blackboard.

   C. If you fail to complete the work by the deadline you may be eligible for an Incomplete
      1. To be eligible for an incomplete grade you must have passed with a 70% on three of the six exams and submitted seven of the fourteen labs.
      2. Note that lab hours vary from semester to semester if you need to finish an Incomplete.
      3. Note that you will automatically be dropped from Biology 1152 if you register before completing Biology 1151.

   D. If you decide the course is too much for you to handle, it is your responsibility to withdraw prior to the withdrawal deadline (published in the COD Course Schedule).

V. Last but not least, always stay in contact with your biology instructor.

Appendix B

Extra Credit Questions

Unit 1: The Organization of Life, the Chemical Context of Life (Essay Questions)

Answer any eight of the following questions for Unit 1 and earn an additional point for each question (eight points maximum). In order to earn additional points these application questions **have to be turned in prior to taking an exam – they cannot be turned in after an exam.**

1. Compare living and nonliving things. Point out characteristics unique to living organisms. (ch. 1)

2. Discuss levels of biological organization using yourself as an example. (ch. 1)

3. Contrast the terms *theory* and *hypothesis*. (ch. 1)

4. Distinguish between the different types of chemical bonds found in molecules. (ch. 2)

5. Describe the properties of electrons, protons, and neutrons and their roles in atomic structure. (ch. 2)

6. Discuss properties of water that are important for life. (ch. 3)

7. Explain the four levels of protein structure and the types of bonds important at each structural level. (ch. 5)

8. Discuss several different types of proteins and their biological importance. (ch. 5)

9. Distinguish between different kinds/types of carbohydrates, their characteristics, and their biological importance. (ch. 5)

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Unit 2: The Cell, Energy, and Metabolism (Essay Questions)

Answer any eight of the following questions for Unit 2 and earn an additional point for each question (eight points maximum). In order to earn additional points these application questions **have to be turned in prior to taking an exam – they cannot be turned in after an exam.**

1. What is the value of compartmentalization within the eukaryotic cell? (ch. 6)

2. Describe the interrelationships of the organelles of the endomembrane network by following the path of protein being synthesized in a eukaryotic cell. (ch. 6)

3. What challenges face a cell that undergoes a great increase in size? (ch. 6)

4. Why does putting a collard green leaf in water make the leaf crisper? (ch. 7)

5. Describe the fluid-mosaic model of membrane structure. (ch. 7)

6. Describe at least six ways in which substances are transported into a cell. (ch. 7)

7. How is the action of proteolytic enzymes useful in laundry detergents, stain removers, and meat tenderizers? (ch. 8)

8. Describe the energy changes that occur as an apple first grows on a tree and is then digested by a person who eats it. (ch. 8)

9. In most cases, how does ATP act as a link between exergonic and endergonic reactions? (ch. 8)

Unit 3: Cellular Respiration, Photosynthesis, and Cell Cycles

Answer any eight of the following questions for Unit 3 and earn an additional point for each question (eight points maximum). In order to earn additional points these application questions **have to be turned in prior to taking an exam – they cannot be turned in after an exam.**

1. Describe the energy conversions that occur during the process of chemiosmosis. (ch. 9)

2. Explain how the proton gradient that drives ATP synthesis in mitochondria is created. (ch. 9)

3. Discuss the processes of making beer, wine and bread. What ingredients in these items participate in the fermentation pathways? How are the end products of fermentation utilized? (ch. 9)

4. Compare photosynthesis and cellular respiration with respect to energy transformations. (ch. 9, 10)

5. Compare the chemiosmotic synthesis of ATP in the mitochondrion with its synthesis in chloroplasts. (ch. 9, 10)

6. Discuss why green plants are considered renewable resources. (ch. 10)

7. Which events during interphase prepare eukaryotic cells for mitosis? (ch. 12)

8. Compare and contrast events of mitosis and meiosis. Describe differences and similarities between the two processes. (ch. 12, 13)

9. Describe two sources of variation that arise from the process of meiosis. (ch. 13)

Unit 4: The Basic Principles of Heredity

Answer any eight of the following questions for Unit 4 and earn an additional point for each question (eight points maximum). In order to earn additional points these application questions **have to be turned in prior to taking an exam – they cannot be turned in after an exam.**

1. How is Mendel's Law of Independent Assortment explained by events in meiosis? (ch. 14)

2. Explain why certain diseases such as Tay-Sachs disease and cystic fibrosis are considered recessive at the organismal level but codominant at the molecular level. (ch. 14)

3. Give an example of polygenic inheritance in humans and explain how a continuous range of phenotypes may be observed when there is a set number of possible genotypes for the alleles involved in the trait. (ch. 14)

4. What genetic disorders are currently identifiable through prenatal testing such as CVS and amniocentesis? How are these procedures accomplished? How is the information from test results used? (ch. 14)

5. Give a possible explanation as to why Mendel did not find linkage between seed color and flower color even though these genes are on the same chromosome. (ch. 15)

6. Discuss the incidence, causes, and consequences of aneuploidy of sex chromosomes. (ch. 15)

7. Discuss Darwin's evidence for evolution. Describe contributions from each area. (ch. 22)

8. Lamarck's explanation of evolution as the result of inheritance of acquired characteristics was widely accepted and was invoked by Darwin. Why is it discounted today? (ch. 22)

9. Please answer:
    1) 1/400 babies in the African American population have sickle cell anemia. What percent are heterozygotes?
    2) In the U.S. Jewish population, 1/3600 babies born has Tay-Sachs disease. What is the frequency of heterozygotes?
    3) In PKU tests on newborns only one positive test per 10,000 infants. What percent of individuals are carriers for PKU? (ch. 23)

Unit 5: The Carrier of Genetic Information

Answer any eight of the following questions for Unit 5 and earn an additional point for each question (eight points maximum). In order to earn additional points these application questions **have to be turned in prior to taking an exam – they cannot be turned in after an exam.**

1. Explain why scientists initially suspected that the protein component of the chromosomes, rather than the DNA, was the genetic material. (ch. 16)

2. Discuss the research which led to the "one gene, one polypeptide" hypothesis. (ch. 17)

3. Discuss the effects of various environmental mutagens. What do they do at the molecular level? (ch. 17)

4. This is the base sequence on one strand of a certain DNA molecule:

   C C G G C C A A T G G T T C G C A C

   Give the base sequence on the complementary DNA strand, the base sequence of the mRNA strand that would be synthesized from the original DNA strand, and the amino acid sequence the mRNA would code for. (ch. 17)

5. Describe the varying levels of organization of eukaryotic DNA in the form of chromatin and chromosomes. Relate these varying levels of "packaging" to control of transcription. (ch. 17)

6. Diagram and explain how the trp operon functions. (ch. 18)

7. Explain how a virus is like a living organism and how it is different. (ch. 19)

8. Describe beneficial examples of genetic engineering in agriculture, industry and medicine. (ch. 20)

9. Explain the difference between reproductive cloning and therapeutic cloning. Describe some possible applications of therapeutic cloning. (ch. 20)

Unit 6: Biological Diversity-Systematics, Prokaryotes, Protists, and Fungi

Answer any eight of the following questions for Unit 6 and earn an additional point for each question (eight points maximum). In order to earn additional points these application questions **have to be turned in prior to taking an exam – they cannot be turned in after an exam.**

1. Describe a situation or type of organism to which the biological species concept cannot be applied and explain an alternative species concept that might be applied instead. (ch. 24)

2. Think about the following pairs of structures; (a) a bird's wing and an insect's wing and (b) the spines of a cactus and the quills of a porcupine. Would you describe them as homologous or analogous structures? Explain your reasoning for each pair. (ch. 26)

3. Why might the most parsimonious phylogenetic tree not necessarily be the most accurate in representing evolutionary relationships among a particular group of species? (ch. 26)

4. How is a eukaryotic cell like a chimera? (ch. 25)

5. Explain why all life on earth is dependent upon the metabolism of prokaryotes. (ch. 27)

6. Identify two ways in which you have benefited from prokaryotes today. (ch. 27)

7. Describe two diseases in humans that are caused by protists and explain how the diseases spread. (ch. 28)

8. Describe some beneficial uses of protists. (ch. 28)

9. Describe both a positive and a negative impact of fungi in agriculture. (ch. 31)

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