Course Outline
Fall 2008 Semester

COURSE NAME: Biological Principles I
COURSE NUMBER: BIOL 121-04
INSTRUCTOR: Mr. Marc Simmons
OFFICE: S114
OFFICE HOURS: Monday, Thursday, Friday 9:00-10:00, Tuesday 2:00-3:00 and by appointment
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COURSE DESCRIPTION: This course introduces basic principles of biology. Topics include scientific method, evolution, cellular and subcellular structure, basic cell chemistry, transport across cell membranes, mitosis, meiosis, metabolism, photosynthesis, DNA structure and replication, protein synthesis, and patterns of inheritance. This course is required as a prerequisite for most other four-credit Biology courses.
Lecture: 3 hours Laboratory: 2 hours

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PREREQUISITE: One unit of high school science, preferably Biology, and Preparing for College Reading II (ENGL092), Introductory Writing (ENGL099), and Fundamentals of Mathematics (MATH010), or waiver by placement testing results, or Departmental Approval.

REQUIRED TEXTS:

Text: Campbell and Reece et al. 2008. Biology. 8th edition. Custom Version. San Francisco: Benjamin Cummings Publisher.
(The full version text is also acceptable.)

Laboratory Manual: Massasoit Community College Biology Department Laboratory Exercises available on class website

COURSE OBJECTIVES: At the successful completion of this course each student will have an understanding of the principles of biology with an emphasis on the scientific process, evolution, cell chemistry, the structure and function of the cell, metabolism, cell reproduction, and Mendelian and molecular genetics. The specific learning objectives for each topic are listed on the chapter reading guides. Each student will also develop the following laboratory skills: lab safety procedure as outlined in the biology department guidelines, understanding the scientific method as a problem solving technique, and use of the compound light microscope as an observational tool. Course outcomes are listed at the end of this syllabus.

CLASS FORMAT: We will use a lecture/discussion approach. You are encouraged to contribute relevant information whenever appropriate and upon recognition by the instructor. However, private comments and conversations are not allowed. To succeed in this class, you should attend each lecture. Tape recording is permitted and encouraged. Good note taking is very important. Questions about the material are encouraged at any time during or after class.

How to Prepare for Lecture and Laboratory

The student should spend a minimum of two hours preparing for each class by pre-reading the assigned pages from the text and laboratory exercises. Reading assignments on the syllabus are general and refer to the chapter(s) in the text that related to the material covered in lecture. Use the guide given to you in class to direct your reading in the text. It is helpful to look over the material related to the topic before coming to class as this preparation will allow you to become a more active participant in the learning process. Class discussion will be augmented by use of handouts, PowerPoint, DVD, and computer simulations. I will be using a tablet PC and all board notes will be uploaded to the course site on CE6 (WebCT). You can then use the text to enhance the explanation of the material covered in class. Quiz and test questions will come from material covered in lecture and lab.

During laboratory sessions students will work individually or in small groups to complete the assigned tasks. Procedures are outlined in the laboratory exercises. The student should carefully read over each procedure before coming to lab. The instructor will demonstrate all new procedures.

Students are encouraged to meet frequently with the instructor for additional help with the course material, study skills, test taking skills, and writing skills. Office hours are posted outside my office door, on my CE6 site and on this syllabus. If these hours are not convenient, please see me about scheduling an appointment. Students are also strongly encouraged to use the ARC for individual and small group tutoring. The ARC also has a wide variety of review materials that many students have found very useful. Students are also encouraged to use the interactive study guide that is packaged with your text.

ATTENDANCE POLICY: You are expected to attend all meetings of the course each week. An outgoing spirit of active participation is your best assurance of success. If extenuating circumstances force you to miss a class, please inform me in advance (if possible) or upon your return to class. You are responsible for making up any material missed.

You are expected to be present in the classroom at the **BEGINNING** of the class period. **LATE ARRIVALS** disturb the class and will **NOT** be tolerated.

GRADING: Your final grade will be determined by a series of announced quizzes, one-hour lecture exams, final exam, laboratory exams, laboratory reports, and writing assignments according to the following point system:

Weekly Quizzes =	10 points each =	120 points
3 Lecture Exams =	100 points each =	300 points
1 Comprehensive Final Exam =		200 points
Weekly Lab Reports =	20 points each =	280 points
Total =		900 points

Final grades will be determined as follows:

A	=	92.5% or higher	=	833 points or greater
A-	=	90.0% - 92.4%	=	806-832 points
B+	=	87.5% - 89.9%	=	788-805 points
B	=	82.5% - 67.4%	=	743-787 points
B-	=	80.0% - 82.4%	=	716-742 points
C+	=	77.5% - 79.9%	=	698-715 points
C	=	72.5% - 77.4%	=	653-697 points
C-	=	70.0% - 72.4%	=	626-652 points
D+	=	67.5% - 69.9%	=	608-625 points
D	=	62.5% - 67.4%	=	563-607 points
D-	=	60.0% - 62.4%	=	536-562 points
F	=	0.0% - 59.9%	=	0-535 points

Chapter quizzes will consist of a short series of questions and will be given the first ten minutes of class. **DO NOT ARRIVE LATE!!** There will be **NO** make up of chapter quizzes, so a missed quiz will be assigned a zero grade. However, the lowest lecture quiz grade will be dropped.

For each week, a reading guide and set of objectives will be handed out. Exams are based on the reading objectives, so these should be used as study guides. Note that while these reading guides will not be collected, they are intended as study guides and you are responsible for understanding the information they contain.

There will be a total of three lecture exams throughout the semester. Exams may consist of a mixture of multiple choice, true/false, figures, fill-in-the-blank, matching, short answer, and essay questions. You will not be allowed to make up an exam during the semester, so a missed exam will be assigned a zero grade. Exceptions will be made only under extraordinary circumstances **and** when the proper documentation is provided.

The final exam will have the same format as a lecture exam. It will be a comprehensive exam on the major concepts discussed throughout the semester. A missed final exam will not be made up or an Incomplete grade given except under extraordinary circumstances and by prior arrangement, when the proper documentation is provided. The final exam date and time will be arranged by the Registrar.

Note: While Extra Credit has its places, it has been overused and distorted. There are no extra credit opportunities in this course. Much extra credit is done at the expense of other work. If you wish to improve your grade, read, study, attend class, study harder. And *smarter*.

HELPFUL HINTS: When having difficulties, seek help from the instructor at the first indication of a problem. Set up study groups with other students in lecture and laboratory. Prepare for each class by completing objectives and reading guides. There are several resources available if extra help is needed.

DISABILITY: SERVICES The Biology department embraces the position of the disability service providers at the college. "Students with disabilities who believe that they may need accommodations in the classroom are encouraged to contact a disability counselor as soon as possible. Students with learning disabilities should contact Andrea Henry, at extension 1805. Students with physical disabilities should contact Mary Berg, at extension 1425. Students at the Canton Campus should contact Stan Oliver at extension 2114 or 2117."

STUDENT RESPONSIBILITIES: Freedom to teach and freedom to learn are inseparable facets of academic freedom. The freedom to learn depends upon appropriate opportunities and conditions in the classroom, on the campus, and in the larger community. The responsibility to secure and respect general conditions conducive to the freedom to learn is shared by all members of the academic community - students, faculty, and staff members.

The orderly operation of the college or classroom would suggest that students:

- Be prepared academically for each class.
- Attend class regularly.
- Turn off all cell phones, PDA's and iPods before coming to class. During an exam or quiz, if a device in your possession makes any type of audible noise you will earn a zero.
- Arrive at class on time and remain until the end of the class.
- Consult with their instructor prior to class if it is necessary to leave class early.
- Adhere to the college policy prohibiting food, drink, smoking, and the use of tobacco in the classroom.
- Treat all college property with respect.
- Leave the classrooms and laboratories neat and tidy.
- Respect the rights of others to an education and not disturb the learning process in any way.
- Obtain a copy of the student handbook and become familiar with college policies and policies and procedures.

Academic integrity from the college catalog: Students are responsible for maintaining the highest standards of academic honesty and integrity in this course. Violations of academic honesty will usually fall in one of two categories: cheating or plagiarism. Cheating includes, for example, copying or buying the work of others; hiring or persuading others to do work under a false

name; concealing notes or other helpful materials during an exam; communicating with your classmates during an exam. Plagiarism is the use of another person's work or ideas as one's own without giving appropriate credit. In short, plagiarism is intellectual theft and is, therefore, taken seriously; consequently, using the ideas or language of others in an oral, written, technical, or artistic work must be properly acknowledged and documented. Students are responsible for understanding what constitutes plagiarism in their classes and should note that these offenses are often very easy for the instructor to catch. In this class, the penalty for cheating and plagiarism will be a grade of zero for the work in question and possibly a failing grade for the course.

DATE	TOPIC	TEXT ASSIGNMENT	LABORATORY ASSIGNMENT
SEPT 2, 4	*Introduction: Themes in the Study of Life*	Chapter 1	Lab Safety, The Metric System, and Measurements
SEPT 9, 11	*Introduction: Themes in the Study of Life* *The Chemical Context of Life*	Chapter 1 Chapter 2	Scientific Investigation
SEPT 16, 18	*Water and the Fitness of the Environment* *Carbon and the Molecular Diversity of Life*	Chapter 3 Chapter 4	Molecular Models
SEPT 23, 25	*The Structure and Function of Large Biological Molecules*	Chapter 5	The Microscope
SEPT 30	**EXAM 1**	**CH 1-5**	
OCT 2	*A Tour of the Cell*	Chapter 6	Cell Diversity
OCT 7, 9	*A Tour of the Cell* *Membrane Structure and Function*	Chapter 6 Chapter 7	Diffusion and Osmosis
OCT 14, 16	*An Introduction to Metabolism*	Chapter 8	Enzymes
OCT 21, 23	*Cellular Respiration: Harvesting Chemical Energy*	Chapter 9	Fermentation
OCT 28, 30	*Cellular Respiration: Harvesting Chemical Energy* *Photosynthesis*	Chapter 9 Chapter 10	Respiration
NOV 4	**EXAM 2**	**CH 6-10**	
NOV 6	*The Cell Cycle*	Chapter 12	The Cell Cycle and Mitosis
NOV 11	**VETERANS' DAY**	**NO CLASSES**	
NOV 13	*Meiosis and Sexual Life Cycles*	Chapter 13	Meiosis
NOV 18, 20	*Mendel and the Gene Idea* *The Chromosomal Basis of Inheritance*	Chapter 14 Chapter 15	Human Variation
NOV 25	**PRE-REGISTRATION DAY - BROCKTON**	**NO CLASSES**	
NOV 27	**THANKSGIVING BREAK**	**NO CLASSES**	
DEC 2	**EXAM 3**	**CH 12-15**	
DEC 4	*The Molecular Basis of Inheritance*	Chapter 16	Electrophoresis and DNA Profiling
DEC 9, 11	*From Gene to Protein* *Regulation of Gene Expression*	Chapter 17 Chapter 18	Protein Synthesis
DEC 16	*Biotechnology*	Chapter 20	
DEC 17	**FINAL EXAM – TIME TBA**		

Note: Schedule is subject to change. Pay attention in class for changes.

Learning Outcomes for Biological Principles

1. **Scientific Method/Science**:

   Students will be able to describe the general steps of the scientific method and use these steps in solving problems, in order to understand how scientists think and describe the natural world, to distinguish between pseudoscience and real science, and to critically evaluate scientific information in the popular press.

   To this end, students must be able to:

   - Demonstrate an understanding of the ethical component of experimental design and data interpretation, and be able to apply them in both a classroom and laboratory setting;
   - Explain concepts, hypotheses and experimental results in their own words and using appropriate terminology;
   - Conduct an experiment, collect and analyze data and draft a scientific research paper;
   - Demonstrate the ability to perform rudimentary data analysis, including calculation of means and graphing of datasets; and
   - Explain how scientists choose and use model organisms in order to appreciate the research process.

2. **Evolution:**

   Students will be able to:

   - Explain why evolution is the central theme in biology in order to understand the unity and diversity of life
   - Explain *natural selection* and *descent from a common ancestor* in order to understand why organisms have certain characteristics in common.

3. **Chemistry:**

   Students will be able to demonstrate knowledge of basic chemistry including the properties of atoms, ions, chemical bonding and chemical reactions in order to understand biologically important molecules and processes.

   To this end, students must be able to:

   - Diagram and discuss important features of the following:
     - Functional groups: amino, hydroxyl, carboxyl, carbonyl, phosphate and sulfhydryl
     - Monosaccharide (preferably glucose), including numbering scheme
     - Generalized amino acid (or glycine)
   - Describe the role of biologically important molecules in order to understand the correlation between cell structure and function.
   - Diagram the structure of water and explain how water's polar nature is the basis for many of its special properties.

- Demonstrate an understanding of the theory and practical application of acids, bases and the pH scale.
- Identify and provide chemical properties of the following functional groups:
    - amino, hydroxyl, carboxyl, carbonyl, phosphate and sulfhydryl
- Demonstrate a rigorous understanding of the four major classes of organic molecules used by living systems (see below):

  I. Carbohydrates
    - Describe the general structure and functions of monosaccharides, disaccharides, oligosaccharides and polysaccharides, including examples of each (see suggested examples below):
    - Monosaccharides: glucose, ribose, deoxyribose, fructose, galactose
    - Disaccharides: sucrose, maltose, lactose
    - Oligosaccharides: blood group sugars
    - Polysaccharides: starch, glycogen, cellulose, chitin

  II. Lipids
    - Describe the general structure and functions of triglycerides, steroids and phospholipids
    - Be able to classify molecules as hydrophilic or hydrophobic based on chemical structures

  III. Proteins:
    - Analyze the structures of the twenty amino acid side chains and provide an explanation of the side chain's behavior in an aqueous solution
    - List the four levels of protein structure and describe the chemical interactions that are responsible for each of these levels of structure
    - Discuss the roles of proteins in membrane transport and as enzymes
    - Discuss examples of protein regulation (phosphorylation, GTP hydrolysis, glycosylation, *etc*.)

  IV. Nucleic acids:
    - Nucleotide structure and function (building blocks of nucleic acid AND energy molecules – ATP and GTP)
    - Compare and contrast the structural and functional differences between DNA and RNA
- Explain how chemical reactions occur and describe/diagram dehydration syntheses/condensations and hydrolysis reactions.

4. Cell Structure

Students will be able to distinguish between eukaryotic and prokaryotic cells, and identify and describe the structure and function of plant and animal cells and their organelles, in order to appreciate the fundamental role that the cell plays as the foundation of living organisms.

To this end, students must be able to:

- Provide both a structural and functional survey of:
    - Organelles involved in protein synthesis (nucleus, nucleolus, bound and free ribosomes);

    - Organelles involved in endomembrane system (a.k.a. secretory pathway) (smooth & rough endoplasmic reticulum, Golgi apparatus, lysosomes, and transport & secretory vesicles);
    - Organelles involved in metabolism (mitochondria and plastids);
- Describe the Endosymbiotic Theory, its supporting data, and its implication for the origin of eukaryotic cells;
- Discuss cell surface area-to-volume ratios and their importance in placing upper limits on cell size; and
- Understand the various roles that the cytoskeleton plays in the cell, that the cytoskeleton is a dynamic structure, and its role in the integrity of tissues in multicellular organisms.

5. Membrane Structure and Function

Students will be able to describe the structure of the plasma membrane and relate it to its functions in permeability, transport, metabolism, and cell-cell interactions.

To this end, students must be able to:

- Discuss and diagram the phospholipid bilayer's structure;
- Describe the membrane's role as a semi-permeable barrier;
- Describe the role of cholesterol in membrane fluidity;
- Discuss how membranes compartmentalize intracellular activities;
- List and explain the types and functions of membrane proteins (enzymes, transport proteins, CAMs and receptors);
- Define and explain the importance of the glycocalyx and the extracellular matrix (incl. the plant cell wall)
- Describe the concept of self/non-self recognition as it pertains to cell surface markers and recognition;
- Passive mechanisms of transport
    - passive/simple diffusion
    - facilitated diffusion
- Active mechanisms of transport
    - active transport
    - vesicular transport
- Use of membranes in maintaining gradients

6. Metabolism

Students will be able to explain the principles of cellular respiration and photosynthesis so that the students understand energy flow in living systems.

6A. Bioenergetics:

Students must be able to:

- Provide a general overview of the concept of energy and basic thermodynamic principles

- Articulate what is meant by the "work" of the cell.
- Explain the role and structure of nucleotide triphosphates (ATP, GTP, *etc*.)
- Discuss the importance of and constituents of redox and phosphorylation reactions.

6B. Metabolic pathways:

Students must be able to:

- Define and identify reactants and products
- Identify redox vs. phosphorylation reactions in glycolysis and the citric acid cycle, using chemical structures
- Discuss the organization of the electron transport chain, its role in ATP production, and its reliance on oxygen (or other terminal electron acceptor)
- Discriminate between aerobic and anaerobic respiration and fermentation
- Compare and contrast mechanisms, reactants and products of alcoholic and lactic acid fermentation

7. Cell Division

Students will be able to compare and contrast mitosis and meiosis in order to understand the process of growth, reproduction and the importance of sexual reproduction to the evolution of the species.

To this end, students must be able to:

- Compare and contrast the eukaryotic cell cycle and binary fission in prokaryotes
- Describe and diagram the steps in DNA replication, including a discussion of the following:
    - the roles of DNA polymerase, DNA ligase , and primase
    - antiparallelism of double-stranded DNA and its effect on discontinuous replication (lagging vs. leading strands)
    - the semi-conservative nature of DNA replication
- Describe and diagram the phases of the eukaryotic cell cycle, including a discussion of the following:
    - mechanisms of cytokinesis
    - roles of cell cycle regulatory proteins (cyclins, Cdks)
    - the importance of the G_0 phase/senescence.
    - the antagonistic relationship between oncogenes and tumor-suppressor genes, and their role in cancer
    - mechanisms of cell death (necrosis/apoptosis)
- Describe and diagram the phases of meiosis I and II, with emphasis on comparing and contrasting with the mitotic phases.
- Explain the difference between haploid and diploid cells, and the role that meiosis plays in genetic diversity.
- Discuss what is meant by homologous chromosomes.

8. Molecular Biology

Students will be able to describe the role of DNA in RNA and protein synthesis in order to understand the chemical basis of genetics and the use of DNA in genetic engineering and biotechnology.

To this end, students must be able to:

- Chromosome structure
- Parts of a gene (promotors, enhancers, introns, exons)
- Transcription
    - Role of polymerase
    - Sense vs antisense strands and the use of templates
    - Coding vs noncoding RNAs
- mRNA processing/export
    - Functions of caps and tails
    - Splicing
- Translation
    - Ribosome structure
    - tRNA structure and function
    - Steps of translation
    - Mutation
    - Types and causes
    - Alleles
- Provide examples and mechanisms for gene regulation via:
    - transcriptional controls
    - posttranscriptional controls
    - translational controls
    - posttranslational controls

9. Transmission Genetics

Students will be able to demonstrate understanding of basic concepts in inheritance in order to solve simple genetic problems and recognize common misconceptions regarding human heredity.

To this end, students must be able to:

- Dominant vs recessive traits
- Genotype vs Phenotype
- Compare and contrast autosomal vs sex-linked inheritance
- Compare and contrast simple (Mendelian) inheritance and codominance
- Differentiate between expression at the cell vs at the organismal level
- Demonstrate an understanding of Punnett squares and probabilities to predict outcomes of monohybrid and dihybrid crosses

10. Laboratory Skills

Students will be able to:

- Work safely in the laboratory and follow simple laboratory protocols in order to work cooperatively to complete laboratory exercises and conduct experiments using the scientific method.
- Use the microscope to observe cell structure in order to develop good technique in preparation for more advanced courses.
- Perform simple mathematical calculations and construct and interpret graphs in order to record and communicate the results of experiments.
- Use technology in order to collect and analyze data.
- Use the Metric System
- Understand the role of modeling in science
- Write a scientific laboratory report

11. Study Skills

Students will be able to:

- Apply a study skills method to learning biology in order to improve success in an academically rigorous course.
- Use technology
- Use concept mapping
- Use of self testing to assess understanding
- Use of roots, prefixes, and suffixes in order to understand terminology

12. Strengthen Core Competencies in order to increase success in college courses and other courses in the workplace