COURSE: 421/422 BIOLOGY

GRADE: 9

LEVEL: I AND II

CREDITS: 10

RECOMMENDATION: Determined by 8th grade science teacher and guidance counselor.

BASIC TEXT: Biology, Glencoe Science (2007)

REQUIRED MATERIALS: Notebook, calculator and writing materials.

COURSE DESCRIPTION:

The full year freshman biology class has several goals for the student. One goal is to give students a foundation in the biological sciences on which to build content knowledge from other topics, in courses available to upperclassmen, such as environmental science, forensics, human anatomy and physiology or AP biology. A second goal is to prepare students for success on the MCAS assessment in biology which will be administered in June of their freshman year. A third goal is to guide students as they develop academic skills necessary to achieve success in a high school setting.

This course is aligned with the learning standards detailed in the Massachusetts State Curriculum Frameworks. In the first semester, students will study living systems. They will begin with the characteristics of life and continue with the study of ecology, which includes the relationships of living organisms in ecosystems. They will explore the chemistry of biology, including the organic compounds that make up living systems. They will study the cell and its structure and functions, including photosynthesis and cellular respiration. They will also explore the cell cycle including mitosis.

In the second semester students will continue their exploration of cell processes as they begin an in-depth study of genetics starting with the formation of gametes through meiosis. They will spend time reviewing Mendels' laws of segregation and independent assortment, expanding upon this information in a review of complex human inheritance patterns. They will examine the structure of the DNA molecule and the processes of replication and gene expression through protein synthesis. They will look at genetic mutation and its influence on natural selection in the process of evolution. They will explore the relationship between evolution and the diversity of life on planet Earth. They will examine how this great variety of life is organized by scientists into related groups sharing common characteristics. They will explore levels of organizations in living systems, especially the structure and function of organs within body systems. Finally, they will develop an understanding of how human body systems work together to maintain the steady-state condition known as homeostasis.

Throughout the year, MCAS Biology questions from previous tests will be reviewed in an effort to reinforce course content as well as introduce students to the variety and complexity of typical test questions. Students will receive exposure to standardized test-taking strategies as well as practice with the open-response question format using actual test scoring rubrics to assess and improve upon their own work.

MISSION RELATED GOALS:

This course promotes intellectual curiosity through student-guided scientific investigations and discussion of biological science current events. Academic excellence is emphasized through critical assessment of higher order thinking skills, application of broad scientific principles in lab activities and responses to homework/discussion questions.

STUDENT EXPECTATIONS FOR LEARNING ADDRESSED:

The course will reinforce the application of problem-solving skills through a variety of laboratory investigations. Students learn to communicate effectively by conducting oral presentations and producing written lab reports. Students will learn to work toward a common goal during cooperative group and laboratory activities. As individual members of lab groups, students will learn to respect the rights of others, as they are encouraged to accept other group members' right to express differing opinions/views. The course promotes personal growth and accepting responsibility, as individuals are held accountable for their contributions to the group. The combined accomplishment of these expectations will effectively result in the acquisition of life skills necessary for students to become successful contributing members of society.

GENERAL PERFORMANCE OBJECTIVES:

1. Apply the scientific method to laboratory investigations. Design an experiment.
2. Demonstrate proper care and procedural use of the microscope during laboratory investigations.
3. Analyze / interpret experimental data using graphs.
4. Describe form and function in prokaryotic and eukaryotic cells.
5. Interpret basic molecular structure and be able to identify four categories of organic compounds.
6. Describe energy transfer at the ecosystem, cellular and molecular levels through exploration of interactions between organisms and selected metabolic chemical reactions.
7. Compare and contrast mitotic and meiotic cell division.
8. Describe the structure of DNA and the processes of replication, transcription, and translation.
9. Apply principles of genetics to predict hereditary outcomes.
10. Classify and compare organisms. Describe evolutionary relationships as depicted by cladistic diagrams.
11. Explore natural selection to explain the theory of evolution and the diversity of life.
12. Describe the structure, function and interaction of organ systems. Identify selected systems through observations of lab specimens and interactive visual media.

MASSACHUSETTS CURRICULUM FRAMEWORK STRANDS: High School Biology

1. The Chemistry of Life
2. Structure and function of cells

3. Genetics
4. Human Anatomy and Physiology
5. Evolution and Biodiversity
6. Ecology

CURRICULUM FRAMEWORK LEARNING STANDARDS: High School Biology

1. **The Chemistry of Life**

Broad Concept: Living things are made of atoms bonded together to form organic molecules.

1.1. Explain the significance of carbon in organic molecules.
1.2. Recognize the six most common elements in organic molecules (C, H, N, O, P, S).
1.3. Describe the composition and functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).*
1.5. Explain the role of enzymes in biochemical reactions.

2. **Structure and Function of Cells**

Broad Concept: All living things are composed of cells. Life processes in a cell are based on molecular interactions.

2.1. Relate cell parts/organelles to their functions.*
2.2. Differentiate between prokaryotic cells and eukaryotic cells, in terms of their general structures and degrees of complexity.*
2.3. Distinguish between plant and animal cells.*
2.4. Describe how cells function in a narrow range of physical conditions, such as temperature and pH, to perform life functions that help to maintain homeostasis.
2.5. Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, and active transport).*
2.6. Identify the reactants and products in the general reaction of photosynthesis. Describe the use of isotopes in this identification.
2.7. Provide evidence that the organic compounds produced by plants are the primary source of energy and nutrients for most living things.*
2.8. Identify how cellular respiration is important for the production of ATP.
2.9. Explain the interrelated nature of photosynthesis and cellular respiration.*
2.10. Describe and compare the process of mitosis and meiosis, and their roll in the cell cycle.*

3. **Genetics**

Broad Concept: Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.

3.1. Describe the structure and function of DNA, and distinguish among replication, transcription, and translation.*
3.2. Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology.
3.3. Describe the general pathway by which ribosomes synthesize proteins by using tRNAs to translate genetic information encoded in mRNAs.
3.4. Explain how mutations in the DNA sequence of a gene may be silent or result in phenotypic change in an organism and in its offspring.
3.5. Differentiate between dominant, recessive, codominant, polygenic, and

sex-linked traits.

3.6. State Mendel's laws of segregation and independent assortment.

3.7. Use a Punnett Square to determine the genotype and phenotype of monohybrid crosses.*

3.8. Explain how zygotes are produced in the fertilization process.

4. **Human Anatomy and Physiology**

Broad Concept: There is a relationship between structure and function in organ systems of humans.

4.1 Explain how major organ systems in humans (e.g., kidney, muscle, lung) have the function of that organ system.

4.2 Describe how the function of individual systems within humans are integrated to maintain a homeostatic balance in the body.

5. **Evolution and Biodiversity**

Broad Concept: Evolution and biodiversity are the result of genetic changes that occur in constantly changing environments.

5.1. Explain how the fossil record, comparative anatomy, and other evidence support the theory of evolution.

5.2. Illustrate how genetic variation is preserved or eliminated from a population through Darwinian natural selection (evolution) resulting in biodiversity.

5.3. Describe the taxonomic system classifies living things into domains (eubacteria, archaebacateria, and eukaryotes) and kingdoms (animals, plants, fungi, etc.).* [Note: there is an ongoing scientific debate about the number of kingdoms and which organisms should be included in each. The following websites provide more information: Brave New Biosphere Tree of Life Project Root Page phylogeny Arizona edu/tree/life.html.]

6. **Ecology**

Broad Concept: Ecology is the interaction between living organisms and their environment.

6.1 Explain how biotic and abiotic factors cycle in an ecosystem (water, carbon, oxygen, and nitrogen).*

6.2 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels.*

6.3 Identify the factors in an ecosystem that influence fluctuations in population size.

6.4 Analyze changes in an ecosystem resulting from natural causes, changes in climate, human activity, or introduction of non-native species.

6.5 Explain how symbiotic behavior produces interactions within ecosystems.

UNITS AND THEMES:

The Science of Biology/ Inquiry methods/ Characteristics of Life	2 weeks
The Biosphere/ Ecology/ Energy Flow	4 weeks
Strands: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6	
The Chemistry of Life	4 weeks
Strands: 1.1, 1.2, 1.3, 1.4, 1.5	
Structure and Function of Cells/ Transport/ Microscopy	2 weeks

Strands: 2.1, 2.2, 2.3, 2.4, 2.5	
Photosynthesis/ Autotrophy/ Energy Transfer	2 weeks
Strands: 2.6, 2.7	
Cellular Respiration/ Chemical Pathways/ Metabolism	2 weeks
Strands: 2.8, 2.9	
Cell Growth and Division/ Cell Cycle	2 weeks
Strands: 2.10, 2.5	
Mendelian Genetics/ Heredity/ Meiosis	5 weeks
Strands: 3.5, 3.6, 3.7, 3.8, 3.9, 2.10	
DNA Replication/ Protein Synthesis/ Mutations	4 weeks
Strands: 3.1, 3.2, 3.3, 3.4	
Theory of Evolution/ Genes and Variation	1 week
Strands: 5.2	
Evidence of Evolution/ Patterns of Evolution	2 week
Strands: 5.1	
Classification/ Diversity	2 week
Strands: 5.3	
Human Anatomy and Physiology/ Organ Systems	4 weeks
Strands: 4.1, 4.2	

COURSE OUTLINE:

I. The Science of Biology
   a. What is science?
   b. How scientists work.
   c. Studying Life and Bioethics.
   d. Tools and procedures. (Safety and lab equipment use)

II. The Biosphere
   a. What is ecology?
   b. Energy flow
   c. Cycles of Matter

III. Ecosystems and Communities
   a. The role of climate
   b. What shapes an ecosystem?

V. Cells Structure and Function
   a. The cellular level of organization.
   b. Cell structures.
   c. Movement through the membrane.
   d. The diversity of cellular life.

III. The Chemistry of Life
   a. The nature of matter.
   b. Properties of water.
   c. Carbon compounds
   d. Chemical reactions and enzymes.

VI. Photosynthesis
   a. Energy and life.
   b. The reactions of Photosynthesis.

VII. Cellular Respiration
  a. Chemical pathways
  b. The Krebs cycle and electron transport.
VIII. Cell Growth and Division
  a. Cell growth limitations.
  b. Cell division.
  c. Regulating the cell cycle.
IX. Introduction to Genetics
  a. The work of Gregor Mendel
  b. Probability and Punnett squares
  c. Exploring Mendelian genetics
  d. Meiosis
  e. Linkage and gene maps
X. DNA and RNA
  a. DNA
  b. Chromosomes and DNA replication
  c. RNA and protein synthesis
  d. Mutations
  e. Gene regulation
XI. Darwin's Theory of Evolution
  a. The principles of Darwin's Theory of Evolution
  b. Genes and Variation
  c. Evolution as genetic change
  d. The process of speciation
  e. Evidence of evolution.
XII. Classification
  a. Modern evolutionary classification
  b. Kingdoms and domains
XIII. The Human Body
  a. Human Body Systems
  b. Homeostasis

SUGGESTED INSTRUCTIONAL STRATEGIES:

1. Assign Labs that reinforce measuring techniques
2. Assign labs that improve graphing skills
3. Assign labs that use the scientific method to solve a problem and design an experiment
4. Use the John Collins Method to write an essay which critically evaluates a "scientific"claim.
5. Use Think-Pair Share Strategies to do prelab exercises
6. Use cooperative groups of 2, 3 or 4 for Lab experiments and projects
7. Use a peer evaluation form/rubric to assess cooperative group's vs individual credit on projects
8. Maximize on task work by assigning students to work in pairs when doing microscope labs
9. Students are required to maintain notebooks. Note taking is assessed.
10. Give students cooperative roles when working in groups and require a written product. Example: butcher paper with bullets of major discussion points presented to class..

11. Students collect specimens from campus during ecology, taxonomy or microscopy units.
12. Students produce a Video or Powerpoint presentation that is presented to the class to teach concepts related to a course objective.

SUGGESTED INTEGRATED ACTIVITIES:
Possible for Biology 9 include:
1. Current Events Presentations in the Field of Biological Science.
2. Debating Bioethical Issues, charting conflicts between goals and responsibilities
3. Have students act the role of historical figures in Biology.
4. Students Design Experiments and Conduct Lab Investigations.
5. Use Scientific Problem Solving methods to analyze problems and develop solutions to problems/ issues affecting the community.
6. Invite guest speakers in fields of biotechnology to share career advice and describe.
7. Applications of biological science in the workplace.
8. Students write a children's storybook that explains a complex biological concept in the form of an allegory and visual presentation.

USE OF TECHNOLOGY:
Use of microscopes to observe identify phases of meiosis, use microscope video adapter to show the class active transport in microorganisms, use internet webquests to efficiently guide students through a set of genetic probability demonstrations and problems, gel electrophoresis, digital cameras, digital projector videos (organic molecules, genetics studies, evolution), overhead projector visual aids, models, preserved specimens, internet/computer lab, microscope (1 per 2 students), microscope camera, campus exploration (pond, field, forest)

ASSESSMENTS:
All assessments follow the school wide rubric.
Unit Quizzes
Laboratory Reports
Projects
Short Essay
Oral Presentations
Homework and Participation is 20% of grade
Standardized Departmental Final Exam is 20% of grade