Advanced Biology

Course Description

This course offers a comprehensive study of biological concepts, including cytology, genetics, botany, zoology, and anatomy as well as an understanding of scientific reasoning, laboratory skills, and objective reporting. Students will apply the scientific method, conduct laboratory experiments, and develop the reasoning skills to analyze data and draw conclusions.

This biology course teaches and reinforces skills and dispositions aligned with the ***Portrait of the Crusader,*** including thinking critically about information presented, solving problems through innovation, and communicating effectively. Laboratory investigations and in-class activities promote fostering relationships, collaboration, team work, and respect for other student's ideas.

Course Essential Questions

- How do scientists test their hypotheses?
- What are the characteristics of life?
- How are form and function related in biological systems?
- How do biological systems utilize energy and molecular building blocks to grow, reproduce, and maintain homeostasis?
- How do living systems store, retrieve, transmit, and respond to information essential to life processes?
- How do biological systems interact? What complex properties do those systems and their interactions have?
- How does the process of evolution drive the unity and diversity of life?
- How can a knowledge of biology be applied to maintaining health?

Course Curriculum

Unit I - Introduction to Biology (2 -3 weeks)

Focus Questions:

- What is the scientific method and how can we use it to learn about the living world?
- What are the tools, procedures and measuring systems used in science and biology?
- How can we better understand the vocabulary of science?
- What are the characteristics of living organisms?
- What are the four macromolecules?

Concepts/Skills:

- Understand and discuss key events in the history of biological inquiry.
- Use a microscope, metric measuring devices, and appropriate safety equipment.
- Understand common prefixes used in science vocabulary.
- Define and explain the purpose for each step of the scientific method.
- Explain the characteristics of life shared by all organisms.
- Explain the difference between the four types of macromolecules.

Laboratory:

- Basic laboratory experiment to apply specific steps of the scientific method; mix solutions; gather and analyze data to draw conclusions, and write a well-structured report.

Assessments:

- Laboratory Report
- Unit Test focused on the terminology, concepts and skills learned in the unit.

Unit II - Ecology (4 -5 weeks)

Focus Questions:

- How do living things take in the energy they need to survive?
- What is a food chain and how does energy flow through a food chain? A food web?
- What is an ecosystem and how is it structured?
- How do energy and matter flow through an ecosystem?
- What shapes a biome?
- What factors affect population size?

Concepts/Skills:

- Interpret/model food chains and food webs and explain energy flow.
- Explain trophic levels and trophic cascade in a food web.
- Explain the overall structure of an ecosystem.
- Analyze why an ecosystem with food webs is a healthier system than one with simple food chains.
- Interpret and analyze an ecological pyramid to explain energy flow and productivity in an ecosystem.
- Define the different biomes, including abiotic and biotic characteristics. Analyze the factors that shape a biome.
- Explain the study of population ecology.
- Analyze specific human impacts on the environment.

Laboratories:

- Populations lab
- Biomes lab

Assessments:

- Laboratory Report - Populations Lab
- Biome Project (Research and Powerpoint Presentation)
- Unit Test focused on the terminology, concepts and skills learned in the unit.

Unit III. Cells (5 weeks)

Focus Questions:

- What is cell theory?
- What do all cells need to carry on life processes?
- How do cells grow and reproduce?
- How do proteins underlie the structure and function of all living things?
- How do cells work together in a multicellular organism?
- Why is cell specialization important to multicellular organisms?

Concepts/Skills:

- Summarize cell theory.
- Model cell structure and describe the function of organelles.
- Compare/contrast structures and functions in prokaryotic and eukaryotic cells.
- Define the processes of metabolism, respiration, diffusion, osmosis, and active transport.
- Define *selectively permeability*; explain the role that the cell membrane plays in maintaining homeostasis and harvesting energy.
- Compare the basic transformation of energy during photosynthesis and cellular respiration.
- Describe the structure and function of DNA.
- Interpret models to explain protein synthesis including transcription and translation.
- Explain the major events of the cell cycle.
- Explain/model mitosis.
- Illustrate/explain the role of mitosis and differentiation in producing and maintaining complex organisms.
- Discuss what happens when mitosis goes unchecked.

Laboratories:

- Microscope identification of cells and organelles
- Mitosis Lab
- Osmosis Lab (evaluate how cells react to different osmotic solutions in the laboratory setting)
- Photosynthesis Chromatography

Summative Assessments:

- Formal Laboratory Report - Osmosis lab
- Unit Test focused on the terminology, concepts and skills learned in the unit.

Unit IV. Genetics (5 weeks)

Focus Questions:

- What shapes the characteristics of all living things?
- How are inherited traits passed from parent to offspring?
- What is the genetic relationship between siblings?
- What causes genetic diversity?
- How are the expressions and activity of genes controlled?

- How do genetic mutations occur?
- What is genetic engineering? What are some potential problems associated with genetic engineering?

Concepts/Skills:

- Define the essential terms needed to understand the fundamentals of genetics.
- Model meiosis.
- Describe the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring
- Analyze how meiosis creates genetic diversity.
- Create and use Punnett Squares to determine the probability of different genotypes and phenotypes in a population
- Interpret models which explain how gene expression is controlled and regulated.
- Determine how genetic mutations occur and the three types of genetic mutation.
- Use a pedigree to determine how a genetic disease is passed on.
- Calculate the probability of a genetic trait being passed on.
- Summarize Mendel's contribution to genetics.
- Research/discuss some potential problems associated with genetic engineering?

Laboratories:

- Blood Type lab
- Genetic Probability lab

Summative Assessments:

- Formal Laboratory Report based on one lab completed during the unit
- Unit Test focused on the terminology, concepts and skills learned in the unit.

Unit V. Evolution (5 weeks)

Focus Questions:

- What is natural selection?
- What evidence is there for evolution?
- Why is evolution considered the unifying concept of biology?
- How has the current theory of evolution led to more biodiversity?
- What role do genetics play in evolution?
- How do the concepts of "natural selection" fit together in terms of evolution?

Concepts/Skills:

- Explain the concept of natural selection. Trace the development of Darwin's theory of natural selection.
- Research examples of natural selection; describe why the adaptation occurred and the time frame involved (i.e.,Galapagos finches, peacock females, peppered moths,deer mice, moray eels, warrior ants).
- Describe how natural selection can lead to speciation. Analyze how speciation creates biodiversity.
- Explain how scientists know when speciation events occurred.
- Explain the role that genetics plays in evolution.

- Explain the four forces involved in evolution: mutation, genetic drift, gene flow or migration, and natural selection. Analyze how these forces can account for all the genotypic variation observed in the world today.
- Build and explain a cladogram.
- Contrast the punctuated equilibrium and gradualism models of evolution.

Laboratories:

- Natural Selection lab
- Phylogenetic Trees lab

Summative Assessments:

- Unit Test focused on the terminology, concepts and skills learned in the unit.

VI. Diversity of Life (5 weeks)

Focus Questions:

- What is meant by biodiversity?
- What is the difference between an animal, plant, and fungus?
- How is biological classification used to explain relationships among diverse organisms?
- What role does the classification of organisms play in the study of the earth's diverse life forms?
- Why do organisms behave the way they do?
- How is behavior related to evolution?
- How do environmental changes affect animal behavior?
- What is a virus and how are they beneficial/harmful to human life?
- What are the threats to biodiversity and how can we better preserve it?

Concepts/Skills:

- Define biodiversity as it relates to genetic variation, ecosystem variation, and species variation.
- Describe the classification system developed by Linnaeus.
- Explain how biological classification explains the relationship between diverse organisms.
- Compare different organisms' internal and external anatomy.
- Interpret and create a dichotomous key.
- Determine factors that impact the behavior of an organism.
- Analyze the connection between behavior and evolution.
- Investigate the connection between changes in the environment and animal behavior.
- Compare a virus to a cell.
- Analyze the structure of a virus, how it replicates in the body.
- Analyze how a virus can be beneficial to human life.
- Define genetic splicing and summarize how a genetically modified virus can be used in medicine.(Advanced Bio only)
- Analyze why it is easier to treat tuberculosis or anthrax than it is to cure malaria.

Laboratories:

- DIssection Labs: frog, perch, worm
- Virus model

Summative Assessments:

- Unit Test focused on the terminology, concepts and skills learned in the unit.

Resources

- *Miller and Levine Biology 2019*
- *Current articles related to topics studied*
- *Websites accessed during research*

Grading Policy

- Tests: 35 - 45 %
- Quizzes: 15 - 25 %
- Labs: 15 - 25 %
- Classwork: 10 - 20 %
- Student Preparation: 15 - 25 %