**Biology Honors**

**Course Description**

This course is designed to give students a comprehensive introduction to biological concepts in cytology, genetics, botany, zoology, and anatomy as well as an understanding of scientific reasoning, laboratory skills, and objective reporting. Students will learn the scientific method, conduct laboratory experiments, develop the reasoning skills to analyze data and draw conclusions, and communicate their findings clearly and accurately.

This 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.

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**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?

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**Course Curriculum**

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

Focus Questions:

- What is the history of biological inquiry?
- What are the levels of organization in biology?
- 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?
- How is the metric system used in science?

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 each step of the scientific method.
- Explain the characteristics of life shared by all organisms.
- Use the metric system for scientific measurements.

Laboratory:

- Basic laboratory experiment to apply specific steps of the scientific method; mix solutions; gather and analyze data to draw conclusions.

Assessments:

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

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**Unit II - Macromolecules (4 - 5 weeks)**

Focus Questions:

- How is water used for biological systems?
- How does polarity affect how water is used for living organisms?
- What are the four types of macromolecules?
- What are the monomers that make up the four types of macromolecules?
- What polymers make up the four types of macromolecules?

Concepts/Skills:

- Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.
- Describe the composition of macromolecules required by living organisms.
- Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.
- Explain how a change in the subunits of a polymer may lead to changing in the structure or function of the macromolecule.
- Describe the structural similarities and differences between DNA and RNA.

Laboratories:

- Food Label lab
- Drops on a Penny

Assessments:

- Unit Test focused on terminology, concepts and modeling taught in the unit.

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**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 in simple terms.
- 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 terminology, concepts and modeling taught in the unit.

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**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 a virus and how is it different from a cell?
- What can a virus be beneficial to human life?

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. (Connection to previous unit)
- 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.
- 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.

Laboratories:

- Blood Type lab
- Genetic Probability lab

Summative Assessments:

- Formal Laboratory Report
- Unit Test focused on terminology, concepts and modeling taught in the unit.

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**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.
- Explain how allopatric and sympatric speciation are different.
- Demonstrate how species evolve into new species over time.
- Build and explain a cladogram.
- Contrast the  punctuated equilibrium and gradualism models of evolution.
- 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 behavior.

Laboratories:

- Natural Selection lab
- Phylogenetic Trees lab

Summative Assessments:

- Unit Test focused on terminology, concepts and modeling taught in the unit.

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**Unit VI.  Body Systems (5 weeks)**

Focus Questions:

- What are the systems of the human body?
- How do body systems differ among organisms?
- How does reproduction differ among organisms?
- What is homeostasis and how is it maintained in the body?
- How do disorders and diseases occur?

Concepts/Skills:

- Summarize the purpose of each of the body systems and identify associated organs.
- Compare and contrast the internal and external anatomy of different organisms.
- Dissect a worm and a frog and identify specific components of external and internal anatomy.
- Examine the reproductive process in different organisms.
- Understand the human reproductive system and the role of hormones and menstruation.
- Explain how an egg is fertilized and trace the development of the embryo/fetus.
- Explain the digestive process in humans and other organisms.
- Understand the enzymes involved in the digestive system and explain how food is broken down in the digestive system.
- Compare the digestive systems of the frog and human.
- Explain the concept of homeostasis, including negative and positive feedback loops.  Analyze and explain how the body maintains homeostasis in cold temperatures.

Laboratories:

- DIssection Labs: frog, perch, worm

Summative Assessments:

- Unit Test focused on terminology, concepts and modeling taught in the unit.
- Gastro World Map Project

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**Unit VII - Ecology (2-3 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?
- How does energy flow through an ecosystem?
- What shapes a biome?
- What factors affect population size?
- What is meant by biodiversity?
- How is biological classification used to explain relationships among diverse organisms?

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.
- Interpret and create a dichotomous key.
- Explain how biological classification explains the relationship between diverse organisms.

Laboratories:

- Populations lab
- Biomes lab

Assessments:

- Laboratory Report - Populations Lab
- Unit Test focused on terminology, concepts and modeling taught in the unit.
- Biome Project (Research and Powerpoint Presentation)
- Essential Question Discussion

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**Resources**

- *Campbell Biology Concepts and Connections 10th Edition*
- *Current articles related to topics studied*
- *Websites accessed during research*

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**Grading Policy**

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