

## Masconomet Regional High School Curriculum Guide

Course Title: Biology CP

Course Number: 3331

Department: Science/Technology

Grade Level and Phase: 9

Length of Course: 1 year

### Course Description:

Biology Honors includes a survey of all the major topics in biology and prepares students for the future honors courses in science and the MCAS Biology exam in June. Biology Honors requires advanced reading and writing skills and a strong work ethic. Investigative laboratory experiences are emphasized, and students are required to complete an independent a science project.

### Objectives:

*As a result of this course, students will understand and/or be able to demonstrate proficiency in the identified learning standards of the Massachusetts Biology Framework. (These standards are identified by unit in the section labeled Materials and Activities.)*

*As a result of this course, students will:*

- Engage in regular laboratory and fieldwork experiences.
- Develop greater independence in designing and carrying out experiments, most often working alone or in small groups.
- Formulate questions and hypotheses that build on what they have learned from secondary sources.
- Learn to critique and defend their findings, and to revise their explanations of phenomena as new findings emerge.
- Use a variety of physical and conceptual models.

These objectives support the following **Academic Expectations from the Masconomet High School Mission Statement:**

1. Students will communicate effectively.
2. Students will use problem solving skills.
3. Students will use a variety of technological and informational resources to gather, analyze, and synthesize facts, results, ideas and concepts.
4. Students will participate in decision making and team building activities
5. Students will demonstrate and practice an understanding of the rights and responsibilities of citizenship.

### Materials and Activities:

Materials used in this course include a textbook (*Biology: Exploring Life*), a variety of print and electronic media, and a wide range of laboratory equipment.

The units of study for the course and learning standards that align with each unit follow.

### Unit 1: Ecology

#### MA Biology Learning Standards:

**6.1** Explain how birth, death, immigration, and emigration influence population size.

**6.2** Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.

**6.3** Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, and mutualism) add to the complexity of biological communities.

**6.4** Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem and how oxygen cycles through photosynthesis and respiration.

## **Unit 2: Basic Chemistry and Biochemistry**

### **MA Biology Learning Standards:**

**1.1** Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, S.

**1.2** Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).

**1.3** Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, which have an effect on enzymes.

## **Unit 3: Cell Structure**

### **MA Biology Learning Standards:**

**2.1** Relate cell parts/organelles (plasma membrane, nuclear envelope, nucleus, nucleolus, cytoplasm, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, vacuole, cell wall, chloroplast, cytoskeleton, centriole, cilium, flagellum, pseudopod) to their functions. Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, facilitated diffusion, and active transport).

**2.2** Compare and contrast, at the cellular level, prokaryotes and eukaryotes (general structures and degrees of complexity).

**2.3** Use cellular evidence (such as cell structure, cell number, and cell reproduction) and modes of nutrition to describe six kingdoms (Archaeobacteria, Eubacteria, Protista, Fungi, Plantae, Animalia).

**2.8** Compare and contrast a virus and a cell in terms of genetic material and reproduction.

## **Unit 4: Cell Energy (Cellular Respiration and Photosynthesis)**

### **MA Biology Learning Standards:**

**2.4** Identify the reactants, products, and basic purposes of photosynthesis and cellular respiration. Explain the interrelated nature of photosynthesis and cellular respiration in the cells of photosynthetic organisms.

**2.5** Explain the important role that ATP serves in metabolism.

## **Unit 5: Cellular Reproduction (Mitosis and Meiosis)**

**2.6** Describe the cell cycle and the process of mitosis. Explain the role of mitosis in the formation of new cells, and its importance in maintaining chromosome number during asexual reproduction.

**2.7** Describe how the process of meiosis results in the formation of haploid cells. Explain the importance of this process in sexual reproduction, and how gametes form diploid zygotes in the process of fertilization.

## **Unit 6: Mendelian Genetics**

### **MA Biology Learning Standards:**

**3.4** Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, incomplete dominance, codominant, sex-linked, polygenic, and multiple alleles).

**3.5** Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance (such as dihybrid crosses).

**3.6** Use a Punnett Square to determine the probabilities for genotype and phenotype combinations in monohybrid crosses.

## **Unit 7: Molecular Genetics**

### **MA Biology Learning Standards:**

**3.1** Describe the basic structure (double helix, sugar/phosphate backbone, linked by complementary nucleotide pairs) of DNA, and describe its function in genetic inheritance.

**3.2** Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic code. Explain the basic processes of transcription and translation, and how they result in the expression of genes. Distinguish among the end products of replication, transcription, and translation.

**3.3** Explain how mutations in the DNA sequence of a gene may or may not result in phenotypic change in an organism. Explain how mutations in gametes may result in phenotypic changes in offspring.

## **Unit 8: Evolution and Biodiversity**

### **MA Biology Learning Standards:**

**5.1** Explain how evolution is demonstrated by evidence from the fossil record, comparative anatomy, genetics, molecular biology, and examples of natural selection.

**5.2** Describe species as reproductively distinct groups of organisms. Recognize that species are further classified into a hierarchical taxonomic system (kingdom, phylum, class, order, family, genus, species) based on morphological, behavioral, and molecular similarities. Describe the role that geographic isolation can play in speciation.

**5.3** Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.

## **Unit 9: Anatomy & Physiology**

### **MA Biology Learning Standards:**

**4.1** Explain generally how the digestive system (mouth, pharynx, esophagus, stomach, small and large intestines, rectum) converts macromolecules from food into smaller molecules that can be used by cells for energy and for repair and growth.

**4.2** Explain how the circulatory system (heart, arteries, veins, capillaries, red blood cells) transports nutrients and oxygen to cells and removes cell wastes. Describe how the kidneys and the liver are closely associated with the circulatory system as they perform the excretory function of removing waste from the blood. Recognize that kidneys remove nitrogenous wastes, and the liver removes many toxic compounds from blood.

**4.3** Explain how the respiratory system (nose, pharynx, larynx, trachea, lungs, alveoli) provides exchange of oxygen and carbon dioxide.

**4.4** Explain how the nervous system (brain, spinal cord, sensory neurons, motor neurons) mediates communication between different parts of the body and the body's interactions with the environment. Identify the basic unit of the nervous system, the neuron, and explain generally how it works.

**4.5** Explain how the muscular/skeletal system (skeletal, smooth and cardiac muscle, bones, cartilage, ligaments, tendons) works with other systems to support and allow for movement. Recognize that bones produce both red and white blood cells.

**4.6** Recognize that the sexual reproductive system allows organisms to produce offspring that receive half of their genetic information from their mother and half from their father and that sexually produced offspring resemble, but are not identical to, either of their parents.

**4.7** Recognize that communication between cells is required for coordination of body functions. The nerves communicate with electrochemical signals, hormones circulate through the blood, and some cells produce signals to communicate only with nearby cells.

**4.8** Recognize that the body's systems interact to maintain homeostasis. Describe the basic function of a physiological feedback loop.

## **Unit 10: Biotechnology**

### **MA Biology Learning Standards:**

Biotechnology is a rapidly expanding field of biology that uses a growing set of techniques to derive valuable products from organisms and their cells. Biotechnology is already commonly used to identify potential suspects or exonerate persons wrongly accused of crimes, determine paternity, diagnose diseases, make high-yield pest-resistant crops, and treat genetic ailments. Educators should recognize the importance of introducing students to biotechnology so that they may better understand the molecular basis of heredity and critically evaluate the benefits and risks of this technology.

### **Assessment:**

Assessments for this course include tests, quizzes, homework, formal laboratory reports, and projects. A science fair project is required, but students are not required to participate in the fair.