

## Worcester Public Schools

### High School Course Syllabus – District

**Course Title:** Biology II (1 credit)

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#### **Course Description:**

Biology II: In this lab-based science course, students will study selected topics in Biology to develop greater understanding of biological concepts. Students will conduct lab investigations, collect and analyze data, and explore content information from a variety of text and media sources. Exploration of careers in Life Sciences and new technologies used in research, environmental protection, or health care will be associated with each unit of study. Ethical and legal implications will be addressed as students explore the application of biological knowledge in today's society.

In an honors level course, content will be covered at an accelerated pace. Students will study topics at a deeper level and will be expected to complete more independent coursework and assignments.

#### **Essential Understandings:**

- ◆ An understanding of concepts in Biology is essential for living in society today.
- ◆ There are social, ethical and legal issues associated with different aspects of Biology.
- ◆ Many new technologies used in Biology have both positive and negative attributes.
- ◆ Cells have organized structures and systems necessary to support chemical reactions needed to maintain the living condition.
- ◆ Through a variety of mechanisms, organisms seek to maintain a biological balance between their internal and external environments.
- ◆ Organisms obtain and use energy to carry out their life processes.
- ◆ Hereditary information in genes is inherited and expressed.
- ◆ DNA segments contain information for the production of proteins necessary for growth and function of cells.
- ◆ Evolution is the result of many random processes selecting for the survival and reproduction of a population.
- ◆ Organisms on Earth interact and depend in a variety of ways on other living and nonliving things in their environments.

#### **Essential Questions:**

- ◆ How does life result from cellular structure and function?
- ◆ How do organisms maintain a biological balance between their internal and external environments?
- ◆ How do different organisms obtain and use energy to survive in their environment?
- ◆ How is the hereditary information in genes inherited and expressed in different species?
- ◆ How does DNA control growth and function of cells?
- ◆ How do we scientifically explain the evidence and mechanisms for biological evolution?
- ◆ How do organisms interact and depend on each other and their environment for survival?
- ◆ What are the advantages of multicellularity?
- ◆ Why is DNA called the “blueprint of life?”
- ◆ How can individuals of the same species and even siblings have different characteristics?

## **Instructional Materials:**

Approved Text: Modern Biology

Publisher - Holt, Reinhart, Winston

Website <http://go.hrw.com/>

Supporting Materials: WPS MOODLE Sites

**In Biology II, students will study the Massachusetts State Standards at a deeper level of understanding. Exploration of careers and new technologies will be associated with each standard. Ethical and legal implications will be addressed as students explore the application of biological knowledge in today's society.**

## **Content and Literacy Standards:**

### **I. Content Standards-Massachusetts Curriculum Frameworks 2006 High School Biology**

#### **1. The Chemistry of Life**

*Central Concept:* Chemical elements form organic molecules that interact to perform the basic functions of life.

- 1.1 Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, and S.
- 1.2 Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, 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, that have an effect on enzymes.

#### **2. Cell Biology**

*Central Concepts:* Cells have specific structures and functions that make them distinctive. Processes in a cell can be classified broadly as growth, maintenance, and reproduction.

- 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, active transport).
- 2.2 Compare and contrast, at the cellular level, the general structures and degrees of complexity of prokaryotes and eukaryotes.
- 2.3 Use cellular evidence (e.g., cell structure, cell number, cell reproduction) and modes of nutrition to describe the six kingdoms (Archaeobacteria, Eubacteria, Protista, Fungi, Plantae, Animalia).
- 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.
- 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.
- 2.8 Compare and contrast a virus and a cell in terms of genetic material and reproduction.

### **3. Genetics**

*Central Concepts:* Genes allow for the storage and transmission of genetic information. They are a set of instructions encoded in the nucleotide sequence of each organism. Genes code for the specific sequences of amino acids that comprise the proteins characteristic to that organism.

- 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.
- 3.4 Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, codominant, sex-linked, polygenic, incomplete dominance, multiple alleles).
- 3.5 Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance (e.g., dihybrid crosses).
- 3.6 Use a Punnett Square to determine the probabilities for genotype and phenotype combinations in monohybrid crosses.

### **4. Anatomy and Physiology**

*Central Concepts:* There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism. Homeostasis allows the body to perform its normal functions.

- 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 among different parts of the body and mediates 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 muscles, bones, cartilage, ligaments, tendons) works with other systems to support the body and allow for movement. Recognize that bones produce 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 among 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.

### **5. Evolution and Biodiversity**

*Central Concepts:* Evolution is the result of genetic changes that occur in constantly changing environments. Over many generations, changes in the genetic make-up of populations may affect biodiversity through speciation and extinction.

- 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.

### **6. Ecology**

*Central Concept:* Ecology is the interaction among organisms and between organisms and their environment.

- 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, 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.

## **Massachusetts Standards for Literacy in Science and Technical Subjects (Gr 6 - 12) 2011**

### **Reading Standards**

#### *Key Ideas and Details*

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the

text.

#### *Craft and Structure*

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.

#### *Integration of Knowledge and Ideas*

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

#### *Range of Reading and Level of Text Complexity*

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

## **Writing Standards**

#### *Text Types and Purposes*

1. Write arguments focused on *discipline-specific content*.
  - a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
  - b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns.
  - c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
  - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
  - e. Provide a concluding statement or section that follows from or supports the argument presented.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
  - a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
  - b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience’s knowledge of the topic.
  - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
  - d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
  - e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
  - f. Provide a concluding statement or section that follows from and supports the information or

explanation presented (e.g., articulating implications or the significance of the topic).

3. N/A

*Production and Distribution of Writing*

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

*Research to Build and Present Knowledge*

9. Draw evidence from informational texts to support analysis, reflection, and research.

This document was updated May 2014