Sparta Area School District

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Course Outcome Summary

Course Information: (SCADBI) AP Biology

Description: This course is designed based on the three overarching topics of Molecules and Cells, Heredity and Evolution, and Organisms and Populations. The recurring thread throughout the text is evolution as the foundation of modern biological models and thought. The course is taught to constantly review the themes and relate the biological concepts to real world examples and explanations to the students and society. Advanced Biology is designed to actively engage students in the process of science through class assignments and discussions which inform their laboratory experiences. This course is equivalent of an introductory college-level biology course, and it is designed to prepare students for the second year Biology course.

Instruction Level: 11-12

Total Credits: 2

Prerequisites: Successful completion of Biology/Chemistry/Physics

Textbooks: Biology, Concepts and Connections, Reece, Campbell, 978-0321696816)

Course Standards:

Content-

1. The process of evolution drives the diversity and unity of life.
2. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
3. Living systems store, retrieve, transmit and respond to information essential to life processes.
4. Biological systems interact, and these systems and their interactions possess complex properties.

Science Practices-

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations with the context of AP Biology.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.

6. The student can work with scientific explanations and theories.
7. The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

Unit

1. **Biological and Chemical Basis of Life**
2. **Cells and Cellular Energy**
3. **Genetics**
4. **Molecular Genetics**
5. **Evolution**
6. **Homeostasis and Organization of Life**
7. **Ecology**

Unit Outlines

1. Biological and Chemical Basis of Life

Standards:

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
- Biological systems interact, and these systems and their interactions possess complex properties.

Essential Question:

Students will be able to answer the following question(s):

- How are the characteristics of life manifested by the cell?
- How is free energy used in biological systems to facilitate growth, reproduction, and homeostasis sustainability?
- How do living things use energy and matter to survive in an ecosystem?
- How do structures of biologically important molecules account for their functions?

Essential Knowledge:

<u>Water and Chemistry of Life</u>

- All living systems require constant input of free energy.
- The subcomponents of biological molecules and their sequence determine the properties of that molecule.
- Interactions between molecules affect their structure and function.
- Analyze data to identify how molecular interactions affect structure and function.
- The structure and function of subcellular components, and their interactions, provide essential cellular processes.

Carbon

- There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.
- Scientific evidence from many different disciplines supports models of origin of life.
- Biological evolution is supported by scientific evidence from many disciplines, including mathematics.
- The structure and function of subcellular components, and their interactions, provide essential cellular processes.
- Interactions between molecules affect their structure and function.

Macromolecules

- Biological evolution is supported by scientific evidence from many disciplines, including mathematics.
- The structure and function of subcellular components, and their interactions, provide essential cellular processes.
- Interactions between molecules affect their structure and function.
- The subcomponents of biological molecules and their sequence determine the properties of that molecule.
- Organisms capture and store free energy for use in biological processes.
- DNA, and in some cases RNA, is the primary source of heritable information.
- Use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule

2. Cells and Cellular Energy

Standards:

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
- Living systems store, retrieve, transmit and respond to information essential to life processes.
- Biological systems interact, and these systems and their interactions possess complex properties.

Essential Question:

Students will be able to answer the following question(s):

- How does cell structure and function help to maintain dynamic homeostasis in living organism?
- Why do growth, reproduction and maintenance of the organization of living systems require free energy and matter?
- What mechanism and structural features of cells allow organisms to capture, store, and use free energy?

Essential Knowledge:

Cellular Anatomy

- Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.

- Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.
- The structure and function of subcellular components, and their interactions, provide essential cellular processes.
- Variation in molecular units provides cells with a wider range of functions.
- Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.
- Cooperative interactions within organisms promote efficiency in the use of energy and matter.

Cell Membrane Homeostasis

- Cell membranes are selectively permeable due to their structure.
- Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.

Cellular Respiration and Photosynthesis

- All living systems require constant input of free energy.
- Organisms capture and store free energy for us in biological processes.
- Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.
- Conserved core biological processes and features shared by all domains or within one domain of life, and how these shared, conserved core processes and features support the concept of common ancestry for all organisms

3. Genetics

Standards:

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
- Living systems store, retrieve, transmit and respond to information essential to life processes.
- Biological systems interact, and these systems and their interactions possess complex properties.

Essential Question:

Students will be able to answer the following question(s):

- How is heritable information passed to the next generation via processes that include the cell cycle and mitosis and meiosis plus fertilization?
- How does the chromosomal basis of inheritance provide an understanding of the pattern passage (transmission) of genes from parent to offspring?
- What is the primary source of heritable information, and how are cellular and molecular mechanisms involved in the expression of this heritable information?

Essential Knowledge:

- In eukaryotes, heritable information is passed to next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.
- The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.
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- The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.
- Changes in genotype can result in changes in phenotype.

4. Molecular Basis of Inheritance

Standards:

- The process of evolution drives the diversity and unity of life.
- Living systems store, retrieve, transmit and respond to information essential to life processes.

Essential Question:

Students will be able to answer the following question(s):

- How are external signals converted into cellular responses?
- How does gene expression control the cell and determine its metabolism?
- How does genotype affect phenotype?
- How are genotype and human disorder related?

Essential Knowledge:

- DNA, and in some cases RNA, is the primary source of heritable information.
- Gene regulation results in differential gene expression, leading to cell specialization.
- A variety of intercellular and intracellular signal transmissions mediate gene expression.
- Changes in genotype can result in changes in phenotype.
- Biological systems have multiple processes that increase genetic variation.
- Viral replication results in genetic variation, viral infection can introduce genetic variation into hosts.
- Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues, and organs.
- Variation in molecular units provides cells with a wider range of functions.
- Environmental factors influence the expression of the genotype in an organism.

5. Mechanisms of Evolution

Standards:

- The process of evolution drives the diversity and unity of life.
- Living systems store, retrieve, transmit and respond to information essential to life processes.

Essential Question:

Students will be able to answer the following question(s):

- How is natural selection a major mechanism of evolution?
- How is biological evolution supported by scientific evidence from many disciplines, including mathematics?
- How is the origin of living systems explained by natural processes?
- How do phylogenetic trees graphically model evolutionary history?

Essential Knowledge:

- Natural selection is a major mechanism of evolution.
- Natural selection acts on phenotypic variations in populations.
- Evolutionary change is also driven by random processes.
- Biological evolution is supported by scientific evidence from many disciplines, including mathematics.
- Organisms are linked by lines of descent from common ancestry.
- Phylogenetic tress and cladograms are graphical representations (models) of evolutionary history that can be tested.
- Speciation and extinction have occurred throughout the Earth's history.
- Speciation may occur when two populations become reproductively isolated from each other.
- Populations of organisms continue to evolve.
- Scientific evidence from many different disciplines supports models of the origin of life.
- There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.

6. Homeostasis and Organization of Life

Standards:

- The process of evolution drives the diversity and unity of life.

Essential Question:

Students will be able to answer the following question(s):

- How do homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments?
- How do cell-to-cell signaling pathways regulate important complex responses in living systems?
- How are signaling pathways involved in the functioning of the nervous and immune systems?
- What important mechanisms are responsible for normal development of an organism?

Essential Knowledge:

- Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.

- Organisms respond to changes in their external environments.
- Homeostatic mechanisms reflect both common ancestry and divergence due to adaption in different environments.
- Biological systems are affected by disruptions to their dynamic homeostasis.
- Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.
- Cell communication processes share common features that reflect a shared evolutionary history.
- Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.
- Signal transduction pathways link signal reception with cellular response.
- Changes in signal transduction pathways can alter cellular responses.
- Individuals can act on information and communicate it to others.
- Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.
- Organisms exhibit complex properties due to interactions between their constituent parts.

7. Ecology

Standards:

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
- Biological systems interact, and these systems and their interactions possess complex properties.

Essential Question:

Students will be able to answer the following question(s):

- What mechanisms regulate the timing and coordination of behavioral events in animals?
- What results from the interactions of populations within a community?
- What factors govern energy capture, allocation, storage, and transfer between producers and consumers in a terrestrial ecosystem?
- What are the consequences of human actions on both local and global ecosystems?

Essential Knowledge:

- All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.
- Communities are composed of populations of organisms that interact in complex ways.
- Interactions among living systems and with their environment result in the movement of matter and energy.
- Interactions between and within populations influence patterns of species distribution and abundance.
- Distribution of local and global ecosystems changes over time.
- The level of variation in a population affects population dynamics.

- The diversity of species within an ecosystem may influence the stability of the ecosystem.