Biology Unit 2: Structure and Function

Unit #:	APSDO-00018791	Duration:	10.0 Week(s)	Date(s):	11-10-2014 to 01-12-2015

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Grades:
10
Subjects:
Science

Unit Focus

In this unit, students can investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. Furthermore, students demonstrate how homeostasis is maintained through passive and active transport, and feedback mechanisms. Students demonstrate understanding of how systems of cells function together utilizing information processing mechanisms to support life processes. Summative assessments may include: analysis of data, modeling interactions within and between cells in response to their environment, application problems, laboratory practice, experimental design, and communication of cellular roles within systems and organisms when attempting to maintain homeostasis. Primary instructional materials may include: course textbook (Biology by Miller and Levine), supplemental print and online resources (e.g., Howard Hughes Medical Institute, Learn Genetics, and POGILs (process oriented guided inquiry learning activities)), and related equipment and materials.

Stage 1: Desired Results - Key Understandings

Established Goals

Next Generation Science Standards (DCI)
Science: 10

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *LS1.9.A2*
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process

Transfer

T1 (T3) Collect, analyze, and evaluate the quality of evidence in relation to a question.
T2 (T5) Communicate scientific information clearly, thoroughly, and accurately.
T3 (T2) Design an investigation or model using appropriate scientific tools, resources, and methods.
T4 (T4) Develop a valid scientific conclusion, assess its validity and limitations, and determine future course of actions to inspire further questions.
T5 (T1) Integrate knowledge from a variety of disciplines and apply it to new situations to make sense of information, formulate insightful questions, and/or solve problems.
T6 (T6) Use mathematics to represent physical variables and their relationships, to make quantitative predictions, and to solve problems.

Meaning

in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. *LS1.9.C4* • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. *LS1.9.C3* • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *ETS1.9.C1* • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species'' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. *LS3.9.A1* • Feedback mechanisms maintain a living system''s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. *LS1.9.A4*	**Understandings** **U1** LS1-D Cells respond to environmental stimuli and communicate to other cells using signaling molecules and feedback mechanisms for survival **U2** (U355) Although each cell has the same genetic information, each cell can vary in structure and function as different genes are expressed. **U3** (U310) All organisms have feedback mechanisms which allow them to remain alive and function even as conditions change. **U4** (U311) Cellular growth, division, and differentiation produce and maintain a complex organism. **U5** (U300) All animals need food, obtained from plants or other animals, in order to live and grow. Plants need water and light to live and grow. **U6** (U305) All cells contain genetic information that provide instructions for the functioning of a cell. **U7** (U306) All cells contain specific structures that interact with each other to carry out a variety of functions. **U8** (U308) Multicellular organisms have a hierarchical structural organization in which any one system is made up of numerous parts and is itself a component of the next level. **U9** (U309) Photosynthesis provides a mechanism for converting light energy into chemical energy (sugars) while cellular respiration breaks down sugar to create a usable form of chemical energy. **U10** (U307) Systems of specialized cells within organisms help them perform the essential functions of life.	**Essential Questions** **Q1** LS1-A How does a cells genetic information enable differentiation and specialization during growth and development? **Q2** LS1-D How do specialized cells respond to environmental stimuli and communicate with each other to maintain homeostasis through the implementation of feedback mechanisms? **Q3** (Q355) How can cells function differently when they have the same genetic information? **Q4** (Q312) How are the processes of photosynthesis and cellular respiration connected in the cycling of matter and transfer of energy through different organizational levels of living system? **Q5** (Q311) How does mitosis and cell differentiation enable organismal growth and development? **Q6** (Q310) How do feedback mechanisms help organisms respond to their environments to achieve survival? **Q7** (Q305) How does a cell`s structure enable it to carry out a variety of functions in response to its environment? **Q8** (Q304) How does DNA provide instructions for a cell`s functioning?

- In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. *LS1.9.B1*
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. *LS1.9.A3*
- Systems of specialized cells within organisms help them perform the essential functions of life. *LS1.9.A1*
- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. *LS1.9.C1*
- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. *LS1.9.C2*

U11 (U311) Cellular growth, division, and differentiation produce and maintain a complex organism.

Acquisition of Knowledge and Skill

Knowledge

K1

Cell differentiation and specialization

K2

Cell structure and function

K3

Plasma membrane structure, selective permeability, and transport mechanisms

K4

Relationship between photosynthesis and cellular respiration in the cycling of matter and energy

K5

Influence of surface area to volume ratio on cell size and function

K6

Enzyme catalysis and environmental factors influencing them as applied to the digestive system for example

K7

Process of cellular communication in the regulation of positive and negative feedback mechanisms present in endocrine and immune systems for example

Skills

S1

Modeling plasma membrane structure and fluidity

S2

Simulating diffusion and osmosis across a semipermeable membrane

S3

Comparing and contrasting environmental factors that affect the movement of matter and energy in photosynthesis and cellular respiration processes

S4

Investigating actions of enzymes under various environmental conditions; applied to enzymes of digestive system

S5

Modeling cell signaling mechanisms from the cellular to organism level and its relationship to feedback mechanisms

S6

Describe how organelles of a cell work together in the production and transportation of organic compounds and give examples