

AP Biology Big Ideas

BIG IDEA 1: The process of evolution drives the diversity and unity of life.

Enduring Understanding 1.A. Change in the genetic makeup of a population over time is evolution.

- 1.A.1 Natural selection is a major mechanism of evolution.
- 1.A.2 Natural selection acts on phenotypic variations in populations.
- 1.A.3 Evolutionary change is also driven by genetic drift and artificial selection.
- 1.A.4 Biological evolution is supported by evidence from many scientific disciplines.

Enduring Understanding 1.B. Organisms are linked by lines of descent from common ancestry.

- 1.B.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
- 1.B.2 A phylogenetic tree and/or a cladogram is a graphical representation (model) of evolutionary history that can be tested.
- 1.B.3 Non-eukaryotes can transfer genetic information laterally through the mechanisms of transformation, transduction and conjugation; most eukaryotes do not transfer information laterally.

Enduring Understanding 1.C. Life continues to evolve within a changing environment.

- 1.C.1 Speciation and extinction have occurred throughout the Earth's history.
- 1.C.2 Speciation may occur when two populations become reproductively isolated from each other
- 1.C.3 Populations of organisms continue to evolve.

Enduring Understanding 1.D. The origin of living systems is explained by natural processes.

- 1.D.1 There are causal models about the origin of life on Earth.
- 1.D.2 Evidence from many different scientific disciplines supports models of the origin of life.

BIG IDEA 2: Biological systems utilize energy and molecular building blocks to grow, to reproduce, and to maintain homeostasis.

Enduring Understanding 2.A. Growth, reproduction, and maintaining organization of living systems require energy and matter.

- 2.A.1. All living systems require constant input of energy.
- 2.A.2. Organisms capture, use, and store energy in biological processes such as growth, reproduction and maintaining homeostatic processes.
- 2.A.3. Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.
- 2.A.4. Programmed cell death (apoptosis) plays a role in development and differentiation, allows molecules to be reused, and helps maintain homeostasis within a biological system.

Enduring Understanding 2.B. Growth, reproduction, and homeostasis require that cells create and maintain internal environments that are different from their external environments.

- 2.B.1. Cell membranes are selectively permeable due to their structure.
- 2.B.2. Growth and homeostasis is maintained by the constant movement of molecules across membranes.
- 2.B.3. Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.

Enduring Understanding 2.C. Organisms use feedback mechanisms to regulate growth and maintain homeostasis.

- 2.C.1. Positive feedback mechanisms amplify responses and processes in biological organisms.
- 2.C.2. Organisms use negative feedback mechanisms to maintain their internal environments and respond to external environmental changes.
- 2.C.3. Organisms constantly respond to changes in their external environments.

Enduring Understanding 2.D. Growth and homeostasis of a biological system are influenced by changes in the system's environment.

- 2.D.1. All biological systems from cells to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions.
- 2.D.2. Homeostatic mechanisms reflect both continuity due to common ancestry and divergence due to adaptation in different environments.
- 2.D.3. Biological systems are affected by disruptions to their homeostasis.
- 2.D.4. Plants and animals have a variety of chemical defenses against infections that affect homeostasis.

Enduring Understanding 2.E. Many biological processes involved in growth, reproduction, and homeostasis include temporal aspects.

- 2.E.1. Timing and coordination of several events are necessary for the normal development of an organism, and these events require regulation by multiple mechanisms.
- 2.E.2. Timing and coordination of physiological events are regulated by multiple mechanisms
- 2.E.3. Timing and coordination of behavior is regulated by several mechanisms.

BIG IDEA 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.

Enduring Understanding 3.A. Heritable information provides for continuity of life.

- 3.A.1 DNA, and in some cases RNA, is the primary source of heritable information.
- 3.A.2 In most eukaryotes, heritable information is passed to the next generation through mitosis or meiosis plus fertilization.
- 3.A.3 Mendelian genetics provides a basic understanding of the underlying causes of the pattern traits from parent to offspring.
- 3.A.4 The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.

Enduring Understanding 3.B. Expression of genetic information involves cellular and molecular mechanisms.

- 3.B.1 Cells can be activated, produce new products, and retain their activated state through gene regulation
- 3.B.2 A variety of intercellular and intracellular signal transmissions mediate gene expression.

Enduring Understanding 3.C. Transfer of genetic information may produce variation.

- 3.C.1 Changes in genotype can result in changes in phenotype.
- 3.C.2 Biological systems possess multiple mechanisms that increase genetic variation.
- 3.C.3 Viruses reproduce and can introduce genetic variation into their hosts.

Enduring Understanding 3.D Cells communicate by generating, transmitting, and receiving chemical signals.

- 3.D.1 Cell communication involves processes resulting from evolution that are shared common features.
- 3.D.2. Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.
- 3.D.3. Signal transduction pathways link signal reception with cellular response.
- 3.D.4. Errors in normal signal transduction may alter cellular response.

Enduring Understanding 3.E. Transmission of non-heritable information results in changes within and between biological systems.

3.E.1. Organisms exchange information with each other in response to internal changes and external cues, which may change behavior.

3.E.2. Multi-cellular animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.

3.E.3. Individuals can act on information and communicate it to others.

BIG IDEA 4: Biological systems interact, and these interactions possess complex properties.

Enduring Understanding 4.A. Interactions within biological systems lead to complex properties.

4.A.1. The subcomponents of a biological polymer and their sequence determine the properties of that polymer.

4.A.2. Interactions of subcellular structures, including a repertory of eukaryotic organelles possessing specialized functions, provide essential cellular functions and activities.

4.A.3. Interactions between external stimuli and gene expression result in specialization of cells, tissues, and organs.

4.A.4. Organisms exhibit complex properties due to interactions between their constituent parts.

4.A.5. Communities are composed of populations of organisms that interact in complex ways.

4.A.6. Interactions among living systems and with their environment result in the movement of matter and energy.

Enduring Understanding 4.B. Competition and cooperation are important aspects of biological systems.

4.B.1. Interactions between molecules affect their structure and function.

4.B.2. Interactions between cells affect the fitness of the organism.

4.B.3. Cooperative interactions within organisms increase efficiency in the use of energy and matter.

4.B.4. Interactions between and within populations influence patterns of species distribution and abundance

4.B.5. Global distribution of ecosystems changes substantially over time.

Enduring Understanding 4.C. Variation within biological systems affects interactions with the environment.

4.C.1. Variation in molecular units provides cells with a wider range of functions.

4.C.2. Environmental factors influence the expression of the genotype in an organism.

4.C.3. The level of variation in a population affects population dynamics.

4.C.4. Diversity of species within an ecosystem may influence the stability of the ecosystem.

Science Practices (SP)

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 within the context of the AP course.

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.