**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.

**Essential knowledge 1.A.1**: Natural selection is a major mechanism of evolution.

**Essential knowledge 1.A.2**: Natural selection acts on phenotypic variations in populations.

**Essential knowledge 1.A.3**: Evolutionary change is also driven by random processes.

**Essential knowledge 1.A.4**: Biological evolution is supported by scientific evidence from many disciplines,

including mathematics.

**Enduring understanding 1.B**: Organisms are linked by lines of descent from common ancestry.

**Essential knowledge 1.B.1**: Organisms share many conserved core processes and features that evolved and are

widely distributed among organisms today.

**Essential knowledge 1.B.2**: Phylogenetic trees and cladograms are graphical representations (models) of

evolutionary history that can be tested.

**Enduring understanding 1.C**: Life continues to evolve within a changing environment.

**Essential knowledge 1.C.1**: Speciation and extinction have occurred throughout the Earth’s history.

**Essential knowledge 1.C.2**: Speciation may occur when two populations become reproductively isolated from each

other.

**Essential knowledge 1.C.3**: Populations of organisms continue to evolve.

**Enduring understanding 1.D**: The origin of living systems is explained by natural processes.

**Essential knowledge 1.D.1**: There are several hypotheses about the natural origin of life on Earth, each with

supporting scientific evidence.

**Essential knowledge 1.D.2**: Scientific evidence from many different disciplines supports models of the origin of life.

**Big Idea 2: Biological systems utilize free energy and molecular building blocks**

**to grow, to reproduce, and to maintain dynamic homeostasis.**

**Enduring understanding 2.A**: Growth, reproduction and maintenance of the organization of living systems require

free energy and matter.

**Essential knowledge 2.A.1:** All living systems require constant input of free energy.

**Essential knowledge 2.A.2**: Organisms capture and store free energy for use in biological processes.

**Essential knowledge 2.A.3**: Organisms must exchange matter with the environment to grow, reproduce and

maintain organization.

**Enduring understanding 2.B**: Growth, reproduction and dynamic homeostasis require that cells create

and maintain internal environments that are different from their external environments.

**Essential knowledge 2.B.1**: Cell membranes are selectively permeable due to their structure.

**Essential knowledge 2.B.2**: Growth and dynamic homeostasis are maintained by the constant movement of

molecules across membranes.

**Essential knowledge 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 reproduction,

and to maintain dynamic homeostasis.

**Essential knowledge 2.C.1**: Organisms use feedback mechanisms to maintain their internal environments and

respond to external environmental changes.

**Essential knowledge 2.C.2**: Organisms respond to changes in their external environments.

**Enduring understanding 2.D**: Growth and dynamic homeostasis of a biological system are influenced by

changes in the system’s environment.

**Essential knowledge 2.D.1**: 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.

**Essential knowledge 2.D.2**: Homeostatic mechanisms reflect both common ancestry and divergence due to

adaptation in different environments.

**Essential knowledge 2.D.3**: Biological systems are affected by disruptions to their dynamic homeostasis.

**Essential knowledge 2.D.4**: Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.

**Enduring understanding 2.E**: Many biological processes involved in growth, reproduction and dynamic

homeostasis include temporal regulation and coordination.

**Essential knowledge 2.E.1**: Timing and coordination of specific events are necessary for the normal development

of an organism, and these events are regulated by a variety of mechanisms.

**Essential knowledge 2.E.2**: Timing and coordination of physiological events are regulated by multiple mechanisms.

**Essential knowledge 2.E.3**: Timing and coordination of behavior are regulated by various mechanisms and are

important in natural selection.

**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.

**Essential knowledge 3.A.1:** DNA, and in some cases RNA, is the primary source of heritable information.

**Essential knowledge 3.A.2**: In eukaryotes, heritable information is passed to the next generation via processes

that include the cell cycle and mitosis or meiosis plus fertilization.

**Essential knowledge 3.A.3**: The chromosomal basis of inheritance provides an understanding of the pattern of

passage (transmission) of genes from parent to offspring.

**Essential knowledge 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.

**Essential knowledge 3.B.1**: Gene regulation results in differential gene expression, leading to cell specialization.

**Essential knowledge 3.B.2**: A variety of intercellular and intracellular signal transmissions mediate gene expression.

**Enduring understanding 3.C**: The processing of genetic information is imperfect and is a source of genetic

variation.

**Essential knowledge 3.C.1**: Changes in genotype can result in changes in phenotype.

**Essential knowledge 3.C.2**: Biological systems have multiple processes that increase genetic variation.

**Essential knowledge 3.C.3**: Viral replication results in genetic variation, and viral infection can introduce genetic

variation into the hosts.

**Enduring understanding 3.D**: Cells communicate by generating, transmitting and receiving chemical signals.

**Essential knowledge 3.D.1**: Cell communication processes share common features that reflect a shared evolutionary history.

**Essential knowledge 3.D.2**: Cells communicate with each other through direct contact with other cells or from a

distance via chemical signaling.

**Essential knowledge 3.D.3**: Signal transduction pathways link signal reception with cellular response.

**Essential knowledge 3.D.4**: Changes in signal transduction pathways can alter cellular response.

**Enduring understanding 3.E**: Transmission of information results in changes within and between

biological systems.

**Essential knowledge 3.E.1**: Individuals can act on information and communicate it to others.

**Essential knowledge 3.E.2**: Animals have nervous systems that detect external and internal signals, transmit and

integrate information, and produce responses.

**Big Idea 4: Biological systems interact, and these systems and their**

**interactions possess complex properties.**

**Enduring understanding 4.A**: Interactions within biological systems lead to complex properties.

**Essential knowledge 4.A.1:** The subcomponents of biological molecules and their sequence determine the

properties of that molecule.

**Essential knowledge 4.A.2**: The structure and function of subcellular components, and their interactions, provide

essential cellular processes.

**Essential knowledge 4.A.3**: Interactions between external stimuli and regulated gene expression result in

specialization of cells, tissues and organs.

**Essential knowledge 4.A.4**: Organisms exhibit complex properties due to interactions between their constituent

parts.

**Essential knowledge 4.A.5**: Communities are composed of populations of organisms that interact in complex ways.

**Essential knowledge 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.

**Essential knowledge 4.B.1**: Interactions between molecules affect their structure and function.

**Essential knowledge 4.B.2**: Cooperative interactions within organisms promote efficiency in the use of energy and

matter.

**Essential knowledge 4.B.3**: Interactions between and within populations influence patterns of species distribution and abundance.

**Essential knowledge 4.B.4**: Distribution of local and global ecosystems changes over time.

**Enduring understanding 4.C**: Naturally occurring diversity among and between components within biological

systems affects interactions with the environment.

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

**Essential knowledge 4.C.2**: Environmental factors influence the expression of the genotype in an organism.

**Essential knowledge 4.C.3**: The level of variation in a population affects population dynamics.

**Essential knowledge 4.C.4**: The diversity of species within an ecosystem may influence the stability of the ecosystem.