GRADE EIGHT

Theme: Cause and Effect

Since causes of complex phenomena and systems are not always immediately or physically visible to students, the need to develop abstract thinking skills is a significant outcome for Grade 8. Explaining patterns and making predictions based on an understanding of cause and effect allows students to conceptualize and describe the relationships among natural phenomena. In Grade 8, some examples of the relationships include the role of genetics in reproduction and heredity, the biology that explains unity and diversity, the transfer of energy, the result of dynamic changes to the Earth's surface, and human impact on the biosphere.

GRADE EIGHT: Life Science

L.8.2 Reproduction and Heredity

Conceptual Understanding: Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. The process of passing genetic information to offspring is inheritance. During sexual reproduction, genetic information is passed to offspring resulting in similarities and differences between parental organisms and their offspring. There are advantages and disadvantages of the two types of reproduction.

L.8.2A **Students will demonstrate an understanding of how sexual reproduction results in offspring with genetic variation while asexual reproduction results in offspring with identical genetic information.**

L.8.2A.1 *Obtain and communicate information about the relationship of genes, chromosomes, and DNA, and construct explanations comparing their relationship to inherited characteristics.*

L.8.2A.2 *Create a diagram of mitosis and explain its role in asexual reproduction, which results in offspring with identical genetic information.*

L.8.2A.3 *Construct explanations of how genetic information is transferred during meiosis.*

L.8.2A.4 *Engage in discussion using models and evidence to explain that sexual reproduction produces offspring that have a new combination of genetic information different from either parent.*

L.8.2A.5 *Compare and contrast advantages and disadvantages of asexual and sexual reproduction.*

Conceptual Understanding: Inheritance is the key process causing similarities between parental organisms and their offspring. Organisms that reproduce sexually transfer genetic information (DNA) to their offspring. This transfer of genetic information through inheritance leads to greater similarity among individuals within a population than between populations. Genetic changes can accumulate through natural selection or mutation that can lead to the evolution of species. Humans can manipulate genetic information using technology.

L.8.2B **Students will demonstrate an understanding of the differences in inherited and acquired characteristics and how environmental factors (natural selection) and the use of technologies (selective breeding, genetic engineering) influence the transfer of genetic information.**

L.8.2B.1 *Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms.*

L.8.2B.2 *Use various scientific resources to research and support the historical findings of Gregor Mendel to explain the basic principles of heredity.*

L.8.2B.3 *Use mathematical and computational thinking to analyze data and make predictions about the outcome of specific genetic crosses (monohybrid Punnett Squares) involving simple dominant/recessive traits.*

L.8.2B.4 *Debate the ethics of artificial selection (selective breeding, genetic engineering) and the societal impacts of humans changing the inheritance of desired traits in organisms.*

Conceptual Understanding: Genes are located on the chromosomes of cells, with each chromosome pair containing two variations of each distinct gene. Each distinct gene chiefly controls the production of a specific protein, which in turn affects the traits of the individual. Changes (mutations) in genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.

L.8.2C Students will demonstrate an understanding that chromosomes contain many distinct genes and that each gene holds the instructions for the production of a specific protein, which in turn affects the traits of an individual.

L.8.2C.1 *Communicate through diagrams that chromosomes contain many distinct genes and that each gene holds the instructions for the production of specific proteins, which in turn affects the traits of the individual (not to include transcription or translation).*

L.8.2C.2 *Construct scientific arguments from evidence to support claims about the potentially harmful, beneficial, or neutral effects of genetic mutations on organisms.*

GRADE EIGHT: Life Science

L.8.4 Adaptation and Diversity

Conceptual Understanding: The scientific theory of evolution underlies the study of biology and provides an explanation for both the diversity of life on Earth and similarities of all organisms at the chemical, cellular, and molecular level. Multiple forms of scientific evidence support the theory of evolution. Adaptations are physical or behavioral changes that are inherited and enhance the ability of an organism to survive and reproduce in a particular environment.

L.8.4A Students will demonstrate an understanding of the process of natural selection, in which variations in a population increase some individuals' likelihood of surviving and reproducing in a changing environment.

L.8.4A.1 *Use various scientific resources to analyze the historical findings of Charles Darwin to explain basic principles of natural selection.*

L.8.4A.2 *Investigate to construct explanations about natural selection that connect growth, survival, and reproduction to genetic factors, environmental factors, food intake, and interactions with other organisms.*

Conceptual Understanding: Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. The traits of organisms that survive a change in the environment are inherited by offspring and become more common in the population. The traits of organisms that cannot survive a change in the environment are not passed to offspring and become less common. In separated populations, the changes can be large enough that the populations evolve to become separate species. Extinction occurs when the environment changes and the adaptive characteristics of a species, including its behaviors, are insufficient to allow its survival.

L.8.4B **Students will demonstrate an understanding of how similarities and differences among living and extinct species provide evidence that changes have occurred in organisms over time and that similarity of characteristics provides evidence of common ancestry.**

L.8.4B.1 *Analyze and interpret data (e.g. pictures, graphs) to explain how natural selection may lead to increases and decreases of specific traits in populations over time.*

L.8.4B.2 *Construct written and verbal explanations to describe how genetic variations of traits in a population increase some organisms' probability of surviving and reproducing in a specific environment.*

L.8.4B.3 *Obtain and evaluate scientific information to explain that separated populations, that remain separated, can evolve through mutations to become a new species (speciation).*

L.8.4B.4 *Analyze displays of pictorial data to compare and contrast embryological and homologous/analogous structures across multiple species to identify evolutionary relationships.*

GRADE EIGHT: Physical Science

P.8.6 Motions, Forces, and Energy

Conceptual Understanding: Waves have energy that is transferred when they interact with various types of matter. A repeating pattern of motion allows the transfer of energy from place to place without overall displacement of matter. All types of waves have some features in common. When waves interact, they affect each other resulting in changes to the resonance. Many modern technologies are based on waves and their interactions with matter.

P.8.6 **Students will demonstrate an understanding of the properties, behaviors, and application of waves.**

P.8.6.1 *Collect, organize, and interpret data about the characteristics of sound and light waves to construct explanations about the relationship between matter and energy.*

P.8.6.2 *Investigate research-based mechanisms for capturing and converting wave energy (frequency, amplitude, wavelength, and speed) into electrical energy.*

P.8.6.3 *Conduct simple investigations about the performance of waves to describe their behavior (e.g., refraction, reflection, transmission, and absorption) as they interact with various materials (e.g., lenses, mirrors, and prisms).*

P.8.6.4 *Use scientific processes to plan and conduct controlled investigations to conclude sound is a wave phenomenon that is characterized by amplitude and frequency.*

P.8.6.5 *Conduct scientific investigations that describe the behavior of sound when resonance changes (e.g., waves in a stretched string and design of musical instruments).*

P.8.6.6 *Obtain and evaluate scientific information to explain the relationship between seeing color and the transmission, absorption, or reflection of light waves by various materials.*

P.8.6.7 *Research the historical significance of wave technology to explain how digitized tools have evolved to encode and transmit information (e.g., telegraph, cell phones, and wireless computer networks).*

P.8.6.8 *Compare and contrast the behavior of sound and light waves to determine which types of waves need a medium for transmission.*

GRADE EIGHT: Earth and Space Science

E.8.7 Earth's Structure and History

Conceptual Understanding: Fossils are preserved remains or traces of organisms that lived in the past. Thousands of layers of sedimentary rock not only provide evidence of the history of Earth itself but also of changes in organisms whose fossil remains have been found in those layers. The collection of fossils and their placement in chronological order (e.g., through the location of rock layers or through radioactive dating) is collectively known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.

E.8.7 Students will demonstrate an understanding of geological evidence to analyze patterns in Earth's major events, processes, and evolution in history.

E.8.7.1 *Use scientific evidence to create a timeline of Earth's history that depicts relative dates from index fossil records and layers of rock (strata).*

E.8.7.2 *Create a model of the processes involved in the rock cycle and relate it to the fossil record.*

E.8.7.3 *Construct and analyze scientific arguments to support claims that most fossil evidence is an indication of the diversity of life that was present on Earth and that relationships exist between past and current life forms.*

E.8.7.4 *Use research and evidence to document how evolution has been shaped both gradually and through mass extinction by Earth's varying geological conditions (e.g., climate change, meteor impacts, and volcanic eruptions).*

GRADE EIGHT: Earth and Space Science

E.8.9 Earth's Systems and Cycles

Conceptual Understanding: Earth systems and cycles are characterized by cause and effect relationships. All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. Landforms and water distribution result from constructive and destructive processes. Physical and chemical interactions among rocks, sediments, water, air, and organisms produce soil. Water's movements—both on the land and underground—cause weathering and erosion. Plate tectonics is the unifying theory that explains the past and current crustal movements at the surface. This theory provides a framework for understanding geological history. Mapping land and water patterns based on investigations of rocks and fossils can help forecast the proximity and probability of future events.

E.8.9A Students will demonstrate an understanding that physical processes and major geological events (e.g., plate movement, volcanic activity, mountain building, weathering, erosion) are powered by the Sun and the Earth's internal heat and have occurred over millions of years.

E.8.9A.1 *Investigate and explain how the flow of Earth's internal energy drives the cycling of matter through convection currents between Earth's surface and the deep interior causing plate movements.*

E.8.9A.2 *Explore and debate theories of plate tectonics to form conclusions about past and current movements of rocks at Earth's surface throughout history.*

E.8.9A.3 *Map land and water patterns from various time periods and use rocks and fossils to report evidence of how Earth's plates have moved great distances, collided, and spread apart.*

E.8.9A.4 *Research and assess the credibility of scientific ideas to debate and discuss how Earth's constructive and destructive processes have changed Earth's surface at varying time and spatial scales.*

E.8.9A.5 *Use models that demonstrate convergent and divergent plate movements that are responsible for most landforms and the distribution of most rocks and minerals within Earth's crust.*

E.8.9A.6 *Design and conduct investigations to evaluate the chemical and physical processes involved in the formation of soils.*

E.8.9A.7 *Explain the interconnected relationship between surface water and groundwater*.

Conceptual Understanding: Natural processes can cause sudden or gradual changes to Earth's systems. Some may adversely affect humans such as volcanic eruptions or earthquakes. Mapping the history of natural hazards in a region, combined with an understanding of related geological forces can help forecast the locations and likelihoods of future events.

E.8.9B Students will demonstrate an understanding of natural hazards (volcanic eruptions, severe weather, earthquakes) and construct explanations for why some hazards are predictable and others are not.

E.8.9B.1 *Research and map various types of natural hazards to determine their impact on society.*

E.8.9B.2 *Compare and contrast technologies that predict natural hazards to identify which types of technologies are most effective.*

E.8.9B.3 *Using an engineering design process, create mechanisms to improve community resilience, which safeguard against natural hazards (e.g., building restrictions in flood or tidal zones, regional watershed management, Firewise construction).**

GRADE EIGHT: Earth and Space Science

E.8.10 Earth's Resources

Conceptual Understanding: Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources, both renewable and nonrenewable. Human activities have significantly altered the biosphere, sometimes damaging, or destroying natural habitats that could cause extinction or the threat of extinction of many species. Past and present geological events have distributed resources unevenly around the planet; therefore, there has been an increase in, and continued need for, technology to harness available resources and develop alternatives.

E.8.10 Students will demonstrate an understanding that a decrease in natural resources is directly related to the increase in human population on Earth and must be conserved.

E.8.10.1 *Read and evaluate scientific information about advancements in renewable and nonrenewable resources. Propose and defend ways to decrease national and global dependency on nonrenewable resources.*

E.8.10.2 *Create and defend a proposal for reducing the environmental effects humans have on Earth (e.g., population increases, consumer demands, chemical pollution, deforestation, and change in average annual temperature).*

E.8.10.3 *Using scientific data, debate the societal advantages and disadvantages of technological advancements in renewable energy sources.*

E.8.10.4 *Using an engineering design process, develop a system to capture and distribute thermal energy that makes renewable energy more readily available and reduces human impact on the environment (e.g., building solar water heaters, conserving home energy).**