Biology
East Chicago Central High School

Biology

Units of Study

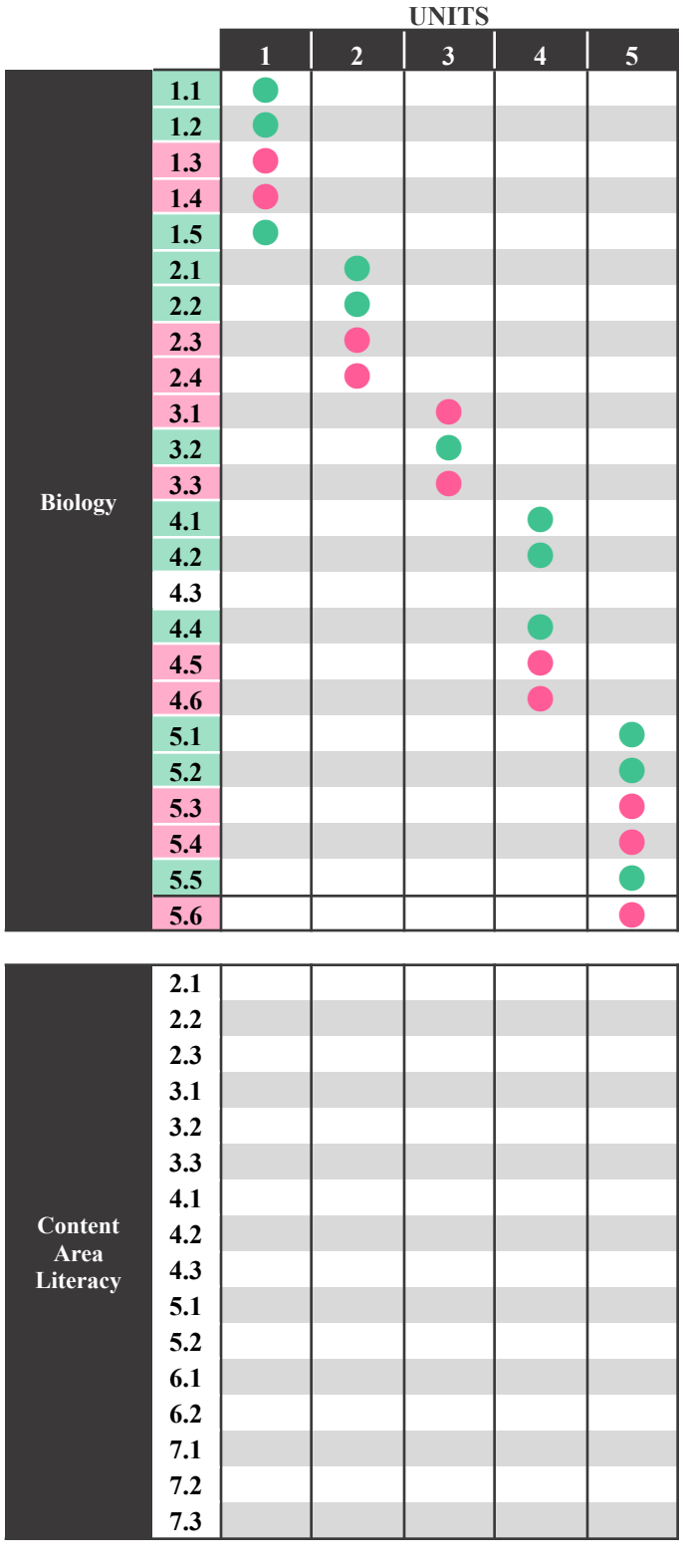
Unit 1:	Cellular Structure and Function	🕓 25 Days
Unit 2:	Matter Cycles and Energy Transfer	🕓 30 Days
Unit 3:	Interdependence	🕓 15 Days
Unit 4:	Inheritance and Variation in Traits	🕓 35 Days
Unit 5:	Evolution	🕓 40 Days

Appendices

Appendix A: Curriculum Refinement Form

Standards Breakdown

Green: Priority Standards **Pink:** Supporting Standards **Gray:** Additional Standards



General Description of the Unit

Literacy Assessments:
Macromolecules & Nutrition Teacher Document
Macromolecules & Nutrition Student Document

Molecules & Cellular Processes Teacher Document
Molecules & Cellular Processes Student Document

Priority Standards

- **B.1.1:** Compare and contrast the shape and function of the essential biological macromolecules (i.e. carbohydrates, lipids, proteins, and nucleic acids), as well as, how chemical elements (i.e. carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur) can combine to form these biomolecules.
- **B.1.2:** Analyze how the shape of a molecule determines its role in the many different types of cellular processes (e.g., metabolism, homeostasis, growth and development, and heredity) and understand that the majority of these processes involve proteins that act as enzymes.
- **B.1.5:** Develop and use a model to illustrate the hierarchical organization of interacting systems (cell, tissue, organ, organ system) that provide specific functions within multicellular organisms.

Supporting Standards

- **B.1.3:** Develop and use models that illustrate how a cell membrane regulates the uptake of materials essential for growth and survival while removing or preventing harmful waste materials from accumulating through the processes of active and passive transport.
- **B.1.4:** Develop and use models to illustrate how specialized structures within cells (i.e. nuclei, ribosomes, Golgi, endoplasmic reticulum) interact to produce, modify, and transport proteins.

Content Area Literacy Standards

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Enduring Understandings

- Atoms are the foundation of biological chemistry and the building blocks of all living organisms
- Cells are the structural and functional units of all living organisms

Essential Questions

How do we know if something is alive?
Why do we need to know how

How do cells work together to keep organisms alive.

How does our understanding of cell function save peoples lives?

How does a cell function like a factory?
How would you explain cellular function to a first grader?

Explain how the study of biology helps promote human welfare.

- What are atoms?
- How are the particles that make up atoms diagrammed?
- How are Van Der Waal forces described?

- What are the parts of a chemical reaction?
- How can energy changes be related to chemical reactions?

	● What is the importance of enzymes in living organisms? ● What are the differences and similarities between solutions and suspensions? ● How does the structure of water make it a good solvent? ● What are the differences between acids and bases? ● What is the role of carbon in living organisms? ● What are the four major families of biological macromolecules? ● What are the functions of each group of macromolecules? ● How are the advances in microscope technology related to discoveries about cells? ● What are the similarities and differences between compound light microscopes and electron microscopes? ● What are the principles of cell theory? ● What are the differences between a prokaryotic and eukaryotic cell? ● How does a cell's plasma membrane function? ● What are the roles of proteins, carbohydrates and cholesterol in the plasma membrane? ● What are the structures of a typical eukaryotic cell, and what are their functions? ● What are the similarities and differences between plant and animal cells? ● What are the processes of diffusion, facilitated diffusion and active transport? ● What is the effect of a hypotonic, hypertonic and isotonic solution on a cell? ● How do large particles enter and exit cells?
Key Concepts ● I can compare and contrast the shape of carbohydrates, lipids, proteins, and nucleic acids. (B.1.1) ● I can compare and contrast the function of carbohydrates, lipids, proteins, and nucleic acids. (B.1.1) ● I can compare and contrast how chemical elements combine to form carbohydrates, lipids, proteins, and nucleic acids. (B.1.1) ● I can analyze how the shape of a molecule determines its function in different cellular processes. (B.1.2) ● I can explain that cellular processes involve proteins that act as enzymes. (B.1.2) ● I can develop and use a model to illustrate the higher levels of organization of interacting systems that provide specific functions within multicellular organisms. (B.1.5)	**Related Concepts** ● I can develop and use a model to illustrate how a cell membrane regulates materials that enter and leave a cell through passive transport. (B.1.3) ● I can develop and use a model to illustrate how a cell membrane regulates materials that enter and leave a cell through active transport. (B.1.3) ● I can develop and use a model to illustrate how specialized structures within cells produce proteins. (B.1.4) ● I can develop and use a model to illustrate how specialized structures within cells modify proteins. (B.1.4) ● I can develop and use a model to illustrate how specialized structures within cells transport proteins. (B.1.4)
Science and Engineering Process Standards ● SEPS 1: Asking questions and defining problems ● SEPS 2: Developing and Using Models ● SEPS 8: Obtaining, Evaluating, and Communicating Information	**Vocabulary** ● Activation Energy ● Active Transport ● Amino acid ● Amino Acids ● Biomolecule

		● Carbohydrates ● Catalysis ● Cell ● Covalent bond ● Dehydration synthesis ● Denature ● Diffusion ● Disaccharide ● DNA ● Endocytosis ● Energy ● Enzyme ● Eukaryote ● Exocytosis ● Fatty acid ● Glycerol ● Glycoprotein ● Golgi Apparatus ● Heredity ● Homeostasis ● Hydrogen bond ● Hydrolysis ● Hypertonic ● Hypotonic ● Ionic bond ● Isotonic ● Lipids ● Membrane ● Metabolism ● Monomer ● Monosaccharide ● mRNA ● Multicellular Organism ● Nuclei ● Nucleic acids ● Nucleotide ● Organ ● Organ system ● Organism ● Osmosis ● Passive Transport ● Phagocytosis ● Phospholipid Bilayer ● Polymer ● Polysaccharide ● Prokaryote ● Protein ● Ribosomes ● Rough Endoplasmic Reticulum ● rRNA ● Tissue ● Transcription ● Translation ● Transport Proteins ● tRNA ● Unicellular Organism ● Vesicle
Supplemental Resources		
Resources & Materials	**Texts & Articles**	**Videos & Media**

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School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

Literacy Assessments:
Biogeochemical Cycles Teacher Document
Biogeochemical Cycles Student Document

Cellular Respiration Teacher Document
Cellular Respiration Student Document

Priority Standards
- **B.2.1:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- **B.2.2:** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Supporting Standards
- **B.2.3:** Use mathematical and/or computational representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- **B.2.4:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Content Area Literacy Standards
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Enduring Understandings
- Photosynthesis converts the Sun's energy into chemical energy, while cellular respiration uses chemical energy to carry out life functions.
- Energy is required to cycle materials through living and nonliving systems.

Essential Questions

How do cells work together like a community?

How does the cell function like a factory?

How do living organisms use energy to live?
How do we use energy from food to live?
How does our body use energy to live and grow?

Key Concepts
- I can use a model to illustrate how photosynthesis can transform light energy into stored chemical energy. (B.2.1)
- I can use a model to illustrate how cellular respiration uses glucose obtained from food, and oxygen in a series of chemical reactions to produce ATP in a net transfer of energy. (B.2.2)

Related Concepts
- I can use a mathematical and/or computational representation to support claims for the flow of energy among organisms in an ecosystem. (B.2.3)
- I can use schematic representations to support claims for the cycling of matter among organisms in an ecosystem. (B.2.3)
- I can develop a model to illustrate the role of photosynthesis in the cycling of carbon between the biosphere, atmosphere, hydrosphere and geosphere. (B.2.4)
- I can develop a model to illustrate the role of cellular respiration in the cycling of carbon between the biosphere, atmosphere, hydrosphere and geosphere. (B.2.4)

Science and Engineering Process Standards
- SEPS 1: Asking questions and defining problems
- SEPS 2: Developing and Using Models
- SEPS 3: Planning and Carrying Out Investigations
- SEPS 4: Analyzing and Interpreting Data
- SEPS 5: Using Mathematics and Computational Thinking
- SEPS 8: Obtaining, Evaluating, and Communicating Information

Vocabulary
- Acetyl Coa
- Aerobic Respiration
- Atp
- Autotroph
- Carbohydrate
- Carbon Cycle
- Chemical Bond
- Chemical Energy

		● Chlorophyll ● Chloroplast ● Decomposer ● Detritivore ● Ecological Pyramids ● Electron Carrier ● Electron Transport Chain ● Energy ● Fermentation ● Food Chain ● Food Web ● Global Warming ● Glucose ● Glycolysis ● Heterotroph ● Krebs Cycle ● Light Dependent Reactions ● Light Energy ● Light Independent Reactions ● Mitochondria ● Nitrogen Cycle ● Photosystems ● Pigment ● Primary Consumer ● Producer ● Scavenger ● Secondary Consumer ● Ten Percent Rule ● Tertiary Consumer ● Trophic Level ● Water Cycle

Supplemental Resources

Resources & Materials	Texts & Articles	Videos & Media
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School Resources

Textbook	Formative Assessments
	● What are the two laws of thermodynamics? ● What is the difference between anabolic and catabolic pathways? ● How does ATP work in a cell?

General Description of the Unit

Literacy Assessment:
Benefits of Biodiversity Teacher Document
Benefits of Biodiversity Student Document

Priority Standards	**Supporting Standards**
● **B.3.2:** Design, evaluate, and refine a model which shows how human activities and natural phenomena can change the flow of matter and energy in an ecosystem and how those changes impact the environment and biodiversity of populations in ecosystems of different scales, as well as, how these human impacts can be reduced.	● **B.3.1:** Use mathematical and/or computational representation to explain why the carrying capacity ecosystems can support is limited by the available energy, water, oxygen, and minerals and by the ability of ecosystems to recycle the remains of dead organisms. ● **B.3.3:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, and identify the impact of changing conditions or introducing non-native species into that ecosystem.

Content Area Literacy Standards

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Enduring Understandings	**Essential Questions**
● .Population growth is a critical factor in a species' ability to maintain homeostasis within its environment. ● Community and ecosystem homeostasis depend on a complex set of interactions among biologically diverse individuals. ● Energy is required to cycle materials through living and non-living systems	● What is the difference between abiotic factors and biotic factors? ● What are the interactions between the levels of biological communities? ● What is the difference between an organism's habitat and niche? ● What are the characteristics of populations and how they are distributed? ● What are the similarities between the different models used to quantify the growth of population? ● How does carrying capacity affect reproductive rates? ● What aspects affect human population growth? ● What are the age structures of representative nongrowing, slowly growing and rapidly growing countries? ● What might be the consequence of continued population growth? ● What are three types of biodiversity?Why is biodiversity important? ● What are the direct and indirect values of biodiversity? ● What are the threats to biodiversity? ● How is the current extinction rate different from the background extinction rate? ● How can the decline of a single species affect an entire ecosystem? ● What are the two classes of natural resources? ● What are the methods used to conserve biodiversity? ● What are two techniques used to restore biodiversity?
Key Concepts	**Related Concepts**
● I can design, evaluate, and refine a model to show how human activities and natural phenomena can change the flow of matter and energy in ecosystems. (B.3.2)	● I can use mathematical representations to explain why the carrying capacity ecosystems can support is limited by the available energy, water, oxygen, and minerals

● I can design, evaluate, and refine a model to show how human and natural changes impact the environment and biodiversity in ecosystems. (B.3.2) ● I can design, evaluate and refine a model to show how human impacts can be reduced. (B.3.2)	and by the ability of ecosystems to recycle the remains of dead organisms. (B.3.1) ● I can use computational representations to explain why the carrying capacity ecosystems can support is limited by the available energy, water, oxygen, and minerals and by the ability of ecosystems to recycle the remains of dead organisms. (B.3.1) ● I can evaluate the claims, evidence and reasoning that complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable condition. (B.3.3) ● I can identify the impact of changing conditions on and ecosystem. (B.3.3) ● I can identify the impact of introducing non-native species into ecosystems. (B.3.3)

Science and Engineering Process Standards	**Vocabulary**
● SEPS 2: Developing and Using Models ● SEPS 3: Planning and carrying out investigations ● SEPS 3: Planning and carrying out investigations. ● SEPS 4: Analyzing and Interpreting Data ● SEPS 5: Using Mathematics and Computational Thinking	● Abiotic ● Biodiversity ● Biotic ● Carrying Capacity ● Climate Change ● Competition ● Decomposers ● Deforestation ● Density Dependent Factors ● Density Independent Factors ● Ecosystems ● Exponential Growth ● Fossil Fuels ● Interspecific Competition ● Intraspecific Competition ● Invasive Species ● Keystone Species ● Limiting Factors ● Logistic Growth ● Niche ● Nonrenewable Resources ● Pollution ● Population ● Predation ● Recycling ● Renewable Resources ● Succession ● Symbiosis

Supplemental Resources

Resources & Materials	**Texts & Articles**	**Videos & Media**
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School Resources

Textbook	**Formative Assessments**

General Description of the Unit

Literacy Assessments:
DNA & Protein Structures Teacher Document
DNA & Protein Structures Student Document

Cellular Division Teacher Document
Cellular Division Teacher Document

Priority Standards	**Supporting Standards**
● **B.4.1:** Develop and revise a model that clarifies the relationship between DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. ● **B.4.2:** Construct an explanation for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. ● **B.4.4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	● **B.4.5:** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and (3) mutations caused by environmental factors. ● **B.4.6:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
Content Area Literacy Standards ●	
Enduring Understandings ● Cells go through a life cycle that includes interphase, mitosis, cytokinesis. ● Reproductive cells, which pass on genetic traits from the parent to the child, are produced by the process of meiosis. ● Human inheritance does not always follow Mendel's Law. ● DNA is the genetic material that contains a code for proteins. ●	**Essential Questions** **How does the cell cycle ensure survival?** **How do mistakes in the cell cycle cause problems for the organism?** ● Why are cells relatively small? ● What are the primary stages of the cell cycle? ● What are the stages of interphase? ● What are the events of each stage of mitosis? ● What is the process of cytokinesis?What is the role of cyclin proteins in controlling the cell cycle? ● What does cancer relate to the cell cycle? ● What are the two types of stem cells and what are their potential use? ● How does the reduction in chromosomes occur in meiosis? ● What are the stages of meiosis? ● What is the importance of meiosis in providing genetic variation? ● What is the significance to Mendel's experiments to the study of genetics? ● What is the Law of Segregation? ● What is the Law of Independent Assortment? ● What are the possible offsprings from a cross using a Punnett Square? ● What are the possible offspring using a Punnett Square
Key Concepts ● I can develop and revise a model that clarifies the relationship between DNA and chromosomes. (B.4.1) ● I can develop and revise a model that describes how DNA codes for the instructions that result in an organism's traits. (B.4.1)	**Related Concepts** ● I can use evidence to describe how meiotic events can produce inheritable genetic variations. (B.4.5) ● I can use evidence to describe how gene mutations during replication can produce inheritable genetic variations. (B.4.5)

● I can develop and revise a model that explains how DNA is passed from parents to offspring. (B.4.1) ● I can explain how the structure of DNA determines the structure of proteins. (B.4.2) ● I can explain that proteins carry out the essential functions of life through systems of specialized cells. (B.4.2) ● I can use a model to illustrate the role of cell division in producing and maintaining multicellular organisms. (B.4.4) ● I can use a model to illustrate the role of cell differentiation in producing and maintaining multicellular organisms. (B.4.4)	● I can use evidence to describe how environmental mutagens can produce inheritable genetic variations. (B.4.5) ● I can use probability techniques to explain the variation of expressed traits in a population. (B.4.6) ● I can use probability techniques to explain the distribution of expressed traits in a population. (B.4.6)

Science and Engineering Process Standards

- SEPS 1: Asking questions and defining problems
- SEPS 2: Developing and Using Models
- SEPS 3: Planning and Carrying Out Investigations
- SEPS 4: Analyzing and Interpreting Data
- SEPS 5: Using Mathematics and Computational Thinking
- SEPS 6: Construction explanations and designing solutions
- SEPS 7: Engaging in Argument from Evidence
- SEPS 8: Obtaining, Evaluating, and Communicating Information

Vocabulary

- Adenine
- Alleles
- Aneuploidy
- Asexual Reproduction
- Cancer
- Cell Cycle
- Central dogma
- Centrioles
- Centromere
- Checkpoints
- Chromatids
- Chromosomal Mutations
- Chromosomes
- Co-Dominance
- Complete Dominance
- Crossing Over
- Cytosine
- Daughter Cells
- Deoxyribose
- Differentiation
- DNA
- DNA Replication
- Dominant
- Frameshift Mutation
- Gametes
- Gene Expression
- Genes
- Genetic Variation
- Genotype
- Guanine
- Heterozygous
- Homologous Chromosomes
- Homozygous
- Incomplete Dominance
- Independent Assortment
- Interphase
- Meiosis
- Mendelian Genetics
- Mitosis
- Monosomy
- Multiple Allelic
- Mutagens
- Mutations
- Nondisjunction
- Nucleotide
- Pedigree Analysis

		● Phenotype ● Point Mutation/Substitution ● Polygenic ● Probability ● Proteins ● Punnett Square ● Purine ● Pyrimidines ● Random Fertilization ● Recessive ● RNA ● Sex-linked ● Sexual Reproduction ● Sister Chromatids ● Spindle Fibers ● Stem Cells ● Thymine ● Transcription ● Translation ● Trisomy ● Uracil

Supplemental Resources		
Resources & Materials	**Texts & Articles**	**Videos & Media**
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School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

Literacy Assessment:
Ancestry & Evolution Teacher Document
Ancestry & Evolution Student Document

Priority Standards

- **B.5.1:** Evaluate anatomical and molecular evidence to provide an explanation of how organisms are classified and named based on their evolutionary relationships into taxonomic categories.
- **B.5.2:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence including both anatomical and molecular evidence.
- **B.5.5:** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Supporting Standards

- **B.5.3:** Apply concepts of statistics and probability to support a claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- **B.5.4:** Evaluate evidence to explain the role of natural selection as an evolutionary mechanism that leads to the adaptation of species, and to support claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and/or (3) the extinction of other species.
- **B.5.6:** Analyze and interpret data for patterns in the fossil record and molecular data that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Content Area Literacy Standards

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Enduring Understandings

- Fossils provide key evidence for understanding the origin and the history of life on Earth.
- The theory of evolution is supported by natural selection and explains the diversity of life.
- Evolution underlies the classification of life's diversity.

Essential Questions

- What are the differences and similarities of Earth's early environment and Earth's current environment?
- What is a typical sequence of events in fossilization?
- How are the different techniques of dating fossils used?
- What are the major events on the geologic time scale?
- What are the differences between spontaneous generation and biogenesis?
- What may have been the sequence of events that led to cellular life?
- What is the endosymbiont theory?
- What evidence convinced Darwin that species could change over time?
- What are the four principles of natural selection?
- How can natural selection change a population?
- How do fossils provide evidence of evolution?
- How does morphology provide evidence of evolution?
- How does biochemistry provide evidence of evolution?
    - What are the conditions of the Hardy-Weinberg principle?
    - What patterns can be observed in evolution? What factors influence speciation?
    - organisms classified at the kingdom level?
    - What are the similarities and differences between Aristotle's and Linneaus methods of classification?
    - What are the categories

	● What are the similarities and differences between the species concept used in biological classification? ● How is a cladogram constructed? ● What are the major characteristics of the three domains? ● What are the differences between the six kingdoms?
Key Concepts ● I can evaluate anatomical evidence to explain how organisms are classified and named based on their evolutionary relationships. (B.5.1) ● I can evaluate molecular evidence to explain how organisms are classified and named based on their evolutionary relationships. (B.5.1) ● I can explain how anatomical evidence can be used to establish phylogeny. (B.5.2) ● I can explain how molecular evidence can be used to establish phylogeny. (B.5.2) ● I can describe how every species has the potential to increase in number. (B.5.5) ● I can describe the major sources of inheritable genetic variation. (B.5.5) ● I can describe the competition that exists within and between populations for access to resources. (B.5.5) ● I can describe how organisms better suited to the environment are more likely to survive and reproduce. (B.5.5)	**Related Concepts** ● I can use statistics and probability to explain why advantageous traits tend to be inherited more frequently in a population. (B.5.3) ● I can explain how natural selection is a mechanism of evolution. (B.5.4) ● I can explain how natural selection can cause some species to increase in population size. (B.5.4) ● I can explain how natural selection can lead to the emergence of new species. (B.5.4) ● I can explain how natural selection can lead to the extinction of a species. (B.5.4) ● I can explain how changes in environmental conditions can cause some species to increase in population size, the emergence of new species over time, and the extinction of other species. (B.5.4) ● I can analyze and explain how the fossil record provides evidence of the existence, diversity, extinction and change of life forms throughout the history of Earth. (B.5.6) ● I can analyze and explain how molecular data provides evidence of the existence, diversity, extinction and change of life forms throughout the history of Earth. (B.5.6) ● I can explain how the concepts of uniformitarianism and punctuated equilibrium can be demonstrated using the fossil record and molecular data. (B.5.6)
Science and Engineering Process Standards ● SEPS 1: Asking Questions and Defining Problems ● SEPS 3: Planning and Carrying Out Investigations ● SEPS 4: Analyzing and Interpreting Data ● SEPS 5: Using Mathematics and Computational Thinking ● SEPS 6: Constructing Explanations and Designing Solutions ● SEPS 8: Obtaining, Evaluating, and Communicating Information	**Vocabulary** ● Adaptation ● Adaptive Radiation ● Allele Frequency ● Anatomical ● Artificial Selection ● Bottleneck Effect ● Cladogram ● Darwin ● DNA ● DNA Sequence ● Embryology ● Empirical ● Extinction ● Fitness ● Fossil Record ● Founder Effect ● Genetic Drift ● Genetic Variation ● Genus ● Hardy Weinberg ● Homologous Structures ● K Strategy ● Molecular Evidence ● Natural Selection

		● Phylogeny ● Probability ● Proteins ● R Strategy ● Scientific Name ● Speciation ● Species ● Survival Of The Fittest ● Taxonomy ● Vestigial Structures ● Fossil Record ● Extinction ● Uniformitarianism ● Punctuated Equilibrium ● Radioactive Decay ● Relative Dating

Supplemental Resources		
Resources & Materials ●	**Texts & Articles** ●	**Videos & Media** ●

School Resources	
Textbook	**Formative Assessments**