Biology Enrichment
Energy & Metabolism

Competencies

Resources

Standards

HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-7: 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.
HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Vocab

Content: chloroplast, chlorophyll, stroma, grana, thylakoid stack, ATP, glucose, light-dependent, light-independent, carbon dioxide, oxygen, photosynthesis equation, plant type (C3, C4, CAM)
glycolysis, Krebs cycle, Calvin cycle,, electron transport chain (ETC), fermentation, aerobic, anaerobic, enzyme, ATP, mitochondria, cytoplasm, lactic acid, alcohol
carbohydrate, protein, lipid, nucleic acid, carbon dioxide, amino acid, fatty acid, saturated, unsaturated, organic chemistry, peptide bonds, cellular respiration, enzyme, hydrolysis reaction, dehydration synthesis, monomer, polymer, polysaccharide
transcription, translation, DNA, transfer-RNA, messenger-RNA, ribosomal-RNA, double helix, Okazaki fragment, codon, anti-codon, enzyme, nucleotides, nucleic acids, anti-parallel (five prime, three prime), Central Dogma Theory, amino acid, protein

Academic: State, Differentiate, Measure, Model, Calculate, Create, Test, Build, Design, Explain, Construct, Compare

Biology Enrichment
Energy & Metabolism

I can

I can state the photosynthesis equation.
I can list the common characteristics of a C3, C4, and CAM plant.
I can differentiate between the types of photosynthesis based on the plant type.
I can measure the amount of oxygen produced via photosynthesis by a plant given the amount of carbon dioxide in the system.
I can create a model of the process of photosynthesis in a C3 plant.
I can identify the steps involved in converting a food source into ATP.
I can balance a chemical equation representing cellular respiration.
I can differentiate between aerobic and anaerobic processes carried out in a cell.
I can compare photosynthesis and cellular respiration.
I can measure the products of cellular respiration in a controlled environment.
I can create a model that represents cellular respiration in a cell and the associated transfer of energy.
I can identify the components of the major macromolecules.
I can identify the parts of a glucose molecule.
I can explain the role of carbon, hydrogen and oxygen in the formation of macromolecules.
I can combine monomers to produce polymers (e.g. simple sugars to polysaccharides)
I can test for the presence of macromolecules in a variety of organic samples.
I can model a dehydration synthesis reaction or a hydrolysis reaction.
I can build a model of the major macromolecules with ball-and-stick model kits.
I can list the steps of the Central Dogma Theory.
I can define essential vocabulary including transcription, translation, etc.
I can construct an amino acid from a DNA sequence.
I can compare and contrast RNA and DNA for structure and function.
I can synthesize a complementary strand of DNA given a parent strand.
I can create a model of the steps involved in generating a protein molecule.

Biology Enrichment
Cellular Structures & Genetics

Competencies

Resources

Standards

HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS3-2: 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/or (3) mutations caused by environmental factors
HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Vocab

Content: homeostasis, positive feedback, negative feedback, feedback loops, stimulus response
Multicellular organism, tissue, organ system, enzyme, capillary action, diffusion, active transport, passive transport, stimulus, reproduction, osmosis
mitosis, spindle fiber, cell cycle, centriole, daughter cell, centromere, cytokinesis, interphase, sister chromatid, nuclear membrane, cleavage furrow
meiosis, trait, gamete, crossing over, allele, chromosome, independent assortment, fertilization, sex-linked trait
meiosis, mutation, genetic variation, genotype, phenotype, Law of Independent Assortment, non-disjunction
gametogenesis
Law of Probability, Mendel Laws, phenotype, genotype, phenotypic frequency, genotypic frequency, allelic frequency, di-hybrid, mono-hybrid, incomplete dominance, complete dominance

Academic: State, Differentiate, Measure, Model, Calculate, Create, Test, Build, Design, Explain, Construct, Compare

Biology Enrichment
Cellular Structures & Genetics

I can

II can define homeostasis.
I can list examples of responses that exhibit positive and negative feedback.
I can evaluate environmental conditions and determine if those conditions will disrupt homeostasis for the organism.
I can evaluate an organism's response and identify that response as positive or negative.
I can design and conduct an experiment to study an organism's response to a stimuli to maintain homeostasis.
I can list the sequence of the hierarchical organization of interacting systems within a multicellular organism.
I can list the properties of life for an organism.
I can differentiate between unicellular and multicellular organisms.
I can design and conduct an experiment that demonstrates diffusion across a membrane.
I can design and conduct an experiment that demonstrates an organism's response to stimuli.
I can list the steps of the cell cycle.
I can identify the structures necessary to carry out mitosis.
I can predict the rate of cell division based upon the type of cell involved.
I can compare and contrast two cells at varying points of the cell cycle.
I can compare and contrast cell division for prokaryote and eukaryote cells.
I can determine which stage a cell is in based on a slide, diagram, or other visual representation.
I can construct a model that represents the cell cycle.
I can define a gene.
I can identify the components of a chromosome.
I can determine if a trait is sex-linked or multiple allele.
I can predict a trait passed from parent to offspring.
I can construct a representation that connects the process of meiosis to trait passage from parent to offspring.

Biology Enrichment
Evolution & Natural Selection

Competencies

Resources

Standards

HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
HS-LS4-2: 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.
HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
HS-LS4-3: Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5: Evaluate the evidence supporting 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 (3) the extinction of other species.

Vocab

Content: biochemical, DNA sequence, fossils, embryological development, vestigial structures, ancestral trait, derived trait, dichotomous key Reproductive advantage, survival of the fittest, variation, heritability, overproduction, carrying capacity, r-strategist, k-strategist, fossil records, speciation, allopatric speciation, sympatric speciation, competition, predation Directional selection, disruptive selection, stabilizing selection, relative fitness natural selection, analogous structure, homologous structure, vestigial structure, speciation plate tectonics, oceanic crust, continental crust, mid-ocean ridges Meteors, meteorites, geological time-scale hydrosphere, atmosphere, geosphere, biosphere, carbon cycle natural selection, adaptation, succession, background extinction

Academic: State, Differentiate, Measure, Model, Calculate, Create, Test, Build, Design, Explain, Construct, Compare

Biology Enrichment
Evolution & Natural Selection

I can

I can identify an ancestral trait and a derived trait.
I can describe the content of a cladogram.
I can differentiate between analogous and homologous structures.
I can cite evidence of relationships between specimens based on observed derived traits and ancestral traits.
I can draw a cladogram and explain its parts.
I can link a current specimen with a historical specimen given key data.
I can explain the differences between oceanic crust and continental crust.
I can predict the relative age of a section of Earth's crust based on its location on the planet.
I can compare characteristics of oceanic and continental crust.
I can develop a logical argument to support the theory of plate tectonics.
I can classify given examples as biotic or abiotic.
I can identify patterns of change in biosystems based on geosystem changes.
I can develop a logical argument for the linkages between biotic and abiotic Earth systems
I can identify the four primary factors that affect evolution.
I can explain sources of evidence for evolution.
I can compare and contrast between allopatric and sympatric speciation.
I can construct and explanation of the process of evolution based on geologic evidence and comparative anatomy.
I can identify the components of the major macromolecules.
I can identify the parts of a glucose molecule.
I can explain the role of carbon, hydrogen and oxygen in the formation of macromolecules.
I can combine monomers to produce polymers (e.g. simple sugars to polysaccharides)
I can test for the presence of macromolecules in a variety of organic samples.
I can model a dehydration synthesis reaction or a hydrolysis reaction.
I can build a model of the major macromolecules with ball-and-stick model kits.
I can define directional selection, disruptive selection, and stabilizing selection.
I can compare and contrast directional selection, disruptive selection, and stabilizing selection.
I can determine, from a graph, if a population is displaying direction, disruptive, or stabilizing selection.
I can identify stressors that might influence a population to change or adapt.
I can justify the importance of a structure modification or adaptation to the population's survival.
I can develop a logical argument about the effect of an introduced species on a native species.
I can create a model showing the impact of climate change on a population. Key factors may include geographic barriers, natural disasters, and human impacts.
I can identify environmental conditions that may affect species survival.
I can collect and display evidence that will support environmental changes leading to speciation.
I can draw a conclusion that catastrophic disasters lead to extinction of species due to limiting resources.

Biology Enrichment
Ecology & Environmental Factors

Competencies

Resources

Standards

HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Vocab

Content: limiting factors, abiotic factors, biotic factors, population density, density-dependent, density-independent, species, population, community, ecosystem, biome, biosphere, aerobic, anaerobic, decomposer, detritivore, consumer, producer, food web, 10% rule, trophic level, biotic, abiotic, limiting factors, abiotic factors, biotic factors, population density, density-dependent, density-independent, species, population, community, ecosystem, biome, biosphere, succession, invasive species, non-native species, urbanization, pollution, habitat destruction, climate change, secondary succession, bioremediation, reclamation, surface temperature, precipitation pattern, sea level, closed system, open system, glacial ice level, biosphere distribution, sea level rock cycle, hydrologic cycle, solubility, frost wedging, recrystallization, hydrosphere, atmosphere, geosphere, biosphere, carbon cycle, Fresh water, fertile soils, natural hazards, natural resources, mass migration

Academic:

Biology Enrichment
Ecology & Environmental Factors

I can

I can define photosynthesis and cellular respiration.
I can identify the components of the carbon cycle.
I can differentiate between the biosphere, atmosphere, hydrosphere, and the geosphere.
I can recall the differences between chemical and mechanical processes.
I can recognize the steps of the rock cycle.
I can use a chart of melting points to determine the composition of a rock sample.
I can estimate the stage of stream transportation and deposition based on various rock samples.
I can classify the solubility of different materials
I can define the following terms: detritivore, consumer, producer, and decomposer.
I can differentiate between aerobic and anaerobic respiration.
I can investigate the flow of energy within a system such as a landfill or compost pile.
I can interpret the results of an experiment that models the cycling of matter between aerobic and anaerobic conditions.
I can list the components of a biogeochemical cycle
I can determine the source (reservoir) of a biogeochemical cycle.
I can determine the living and non-living components of a biogeochemical cycle.
I can calculate the amount of energy that is transferred from one trophic level to the next.
I can create a food web and identify the trophic levels for a given ecosystem.
I can create a model of a biogeochemical cycle.
I can identify causes of climate change based on time scale (sudden and long-term).
I can classify a cause of climate change as sudden or long-term.
I can develop a logical argument to support a model of climate change.
I can create a model that represents the flow of energy through the climate.
I can define biodiversity.
I can list the components of an ecosystem.
I can graph the relationship between a population and a limiting factor.
I can predict the changes in a given population based on experimental evidence.
I can compare and contrast abiotic and biotic factors that affect biodiversity
I can calculate the number of populations present in an environment depending upon a given set of available resources.
I can interpret a graph or other data set to determine if there is a change in population caused by an environmental factor.
I can list factors that might limit the carrying capacity of a population
I can graph the relationship between a population and a limiting factor.
I can calculate the number of organisms an environment can support given a set of available resources.
I can identify examples of Earth's systems, such as hydrosphere, atmosphere, cryosphere, geosphere, and biosphere.
I can use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
I can recognize the components of the biosphere, geosphere, and hydrosphere.
I can investigate the interactions and influences of one Earth system or other systems.
I can hypothesize the impact of a change in one Earth system on other systems.
I can list factors that could affect a population in a given ecosystem.
I can identify the components of a given ecosystem.
I can differentiate between a biotic and an abiotic factor in a population.
I can differentiate between a density-dependent and a density-independent factor.
I can compare and contrast primary and secondary succession.
I can research and evaluate claims and evidence of an environmental issue (climate change, habitat loss, pollution, etc.).
I can identify group behaviors.
I can identify patterns of population distribution.
I can differentiate between individual and group behaviors of a species.
I can compare and contrast innate behavior with learned behavior.
I can critique case study evidence on the actions of group behavior on a population or community's survival, i.e. elephant herds, salmon runs, bee hives.
I can list human activities that might negatively impact biodiversity
I can differentiate between a native and an invasive species.
I can compare and contrast the impact of an invasive species on the native population and environment.
I can evaluate a cases study of a historical attempt to bio-remediate a location negatively affected by human actions.
I can synthesize a plan to reduce, remediate or prevent a given pollutant or human impact on an environment.
I can identify factors that influence human activity.
I can compare and contrast factors that could influence human activity.
I can cite evidence from a case study for the influence of resource availability, existence of natural hazard, and changes in climate on human activities.
I can evaluate technological solutions that reduce the impact of human activities on natural systems.
I can identify aspects of human activity that might impact biodiversity.
I can create a simulation that tests the impact of human activity on biodiversity. Possible topics include fish ladders, turtle highways, man-made reefs.