Labs And Activities

Unit #1

HS-LS 1-3 Go to: http://www.resa.net/curriculum/curriculum/science/professionaldevelopment/ngss-pd/lesson-plans-exploring-ngss/ and click on the link for "Fish Homeostasis Metabolism"
HS-LS 1-2 For an overview of human body systems, go to:
https://www.sophia.org/tutorials/organ-system?pathway=ngss-standard-hs-ls1-2
HS-LS 1-3 For a brief overview of Feedback Mechanisms and Homeostasis go to:
https://www.sophia.org/tutorials/homeostasis--5?pathway=ngss-standard-hs-ls1-3
HS-LS 1-2 and HS-LS 1-3 A laboratory activity that examines the factors that affect heart rate:
http://serendip.brynmawr.edu/sci_edu/waldron/pdf/HeartRateTeachPrep.pdf

Unit #2

HS-LS 1-7 For an online activity explaining Cellular Respiration go to: http://concord.org/stem-resources/cellular-respiration
HS-LS 1-5 and HS-LS 1-6 For an online model of photosynthesis that allows students to manipulate variables and observe the results, go to: http://concord.org/stem-resources/leaf-photosynthesis
HS-LS 1-6 For an online activity that focuses on molecule formation, go to:
http://concord.org/stem-resources/molecular-self-assembly
HS-LS 1-5 For an online summary of Photosynthesis, go to:
https://www.sophia.org/tutorials/overview-of-photosynthesis--2?pathway=ngss-standard-hs-ls1-5
HS-LS 1-6 An in-class laboratory activity that involves using macromolecule identification procedures to solve a theft mystery: http://serendip.brynmawr.edu/sci_edu/waldron/pdf/WhoTookJerellsIpodTeachPrep.pdf
HS-LS 1-7 A laboratory experiment that quantifies alcoholic fementation in yeast:
http://serendip.brynmawr.edu/sci_edu/waldron/pdf/YeastTeachPrep.pdf
HS-LS 1-5 A laboratory experimant that allows students to measure the rate of photosynthesis:
http://www.biologycorner.com/worksheets/photosynthesis_rate.html

Unit #3

HS-LS 2-3 A laboratory experiment that quantifies alcoholic fementation in yeast:
http://serendip.brynmawr.edu/sci_edu/waldron/pdf/YeastTeachPrep.pdf
HS-LS 2-4 A virtual lab activity that shows the movment of biomass and energy in a variety of different ecosystems:
http://http://www.mhhe.com/biosci/genbio/virtual_labs/BL_02/BL_02.html
HS-LS 2-5 A role-playing activity demonstrating how carbon moves throughout the biotic and abioitc systems of an ecosystem. https://www.calacademy.org/educators/lesson-plans/carbon-cycle-role-play

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DRAFT

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Biology • First Quarter

Pacing Guide

Science

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Biology — Science — First Quarter

Unit #1
Homeostasis and Body Systems

Standard HS LS1.2

☐ **I CAN** develop and use models to show how multicellular organism's systems carry out their functions.

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Clarification: Emphasis on functions at organ system level (nutrient uptake, water delivery, response to stimuli, etc.). Assessment should not include interactions and functions at the chemical or molecular level.

Standard HS LS1.3

☐ **I CAN** design and implement a procedure that shows how homeostasis is maintained.

Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Clarification: Investigations into homeostasis could include heart rate response to exercise, stomate response to moisture, or any similar biological feedback system. Assessment should not include cellular processes involved in these mechanisms.

Vocabulary Unit #1

breakdown of food molecules
cellular communication
cellular regulation
cellular response
cellular waste disposal
environmental influence
enzyme
equilibrium
feedback inhibition
gene expression
homeostasis
hormone
metamorphosis
neuron
neurotransmitter
pH
recombination of genes
regulatory response

Unit #2
Photosynthesis and Cellular Respiration

Standard HS LS1.5

☐ **I CAN** explain how photosynthesis results in macromolecules with stored chemical energy, which formed from solar energy and less energetic molecules.

Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Clarification: Emphasis on illustrating inputs and outputs of photosynthesis, and the transfer and transformation of energy. Specific biochemical steps in the process should not be assessed.

Standard 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.

Clarification: Students should be able to construct explanations regarding the source of the macromolecules resulting from photosynthesis, and how larger carbon molecules such as amino acids result from sugars.

Standard HS LS1.7

☐ **I CAN** use a model to show how energy is transferred during cellular respiration, and the resulting molecules that form.

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.

Clarification: When teaching cellular respiration, emphasis is on inputs and outputs, and energy transfers and transformations, not on biochemistry of steps or processes.

Vocabulary Unit #2

aerobic
anaerobic
ATP
breakdown of food molecules
carotenoids
cellular energy conversion
cellular respiration
chemical bond
chemical reaction
chlorophyll
chloroplast
enzyme
mitochondrion
molecular energy
molecule
photosynthesis
potential energy
product
reactant
transforming matter and/or energy

Unit #3
Energy Cycling and Carbon Cycling

Standard HS LS2.3

☐ **I CAN** explain matter and energy cycling in an ecosystem, under aerobic and anaerobic conditions.

Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Clarification: Students construct explanations of how photosynthesis and respiration drive cycling of matter and flow of energy, including the presence of anaerobic respiration (glycolysis and fermentation) in anaerboic environments.

Standard HS LS2.4

☐ **I CAN** describe the movement of carbon through the biotic and abiotic systems as it relates to photosynthesis and cellular respiration.

Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Clarification: Students use mathmatical models of energy and biomass at different trophic levels to support their claims regarding energy transfer in food webs. Assessment limited to proportional reasoning when describing flow of matter and energy.

Standard 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.

Clarification: Assessment should not include specific steps of chemical processes or quantitative analysis of carbon cycling.

Vocabulary Unit #3

abiotic components of ecosystems
autotroph
biological molecule
breakdown of food molecules
carbon
carbon cycle
carbon dioxide
cellular energy conversion
cellular respiration
chemical bond
chemical organization of organisms
consumer
decomposition
energy requirements of living systems
flow of energy
flow of matter
heterotroph
organic compound
organic compound synthesis
organic matter
photosynthesizing organism
producer
product
reactant
release of energy
transforming matter and/or energy
transporting matter and/or energy
trophic level

Labs And Activities

Unit #4

HS-LS 2-1, HS-LS 2-2, HS-LS 2-6 For an online activity involving populations of African Lions go to: http://concord.org/stem-resources/african-lions-modeling-populations

HS-LS 2-1, HS LS 2-2 For an online activity involving populations of rabbits, grasses and weeds that emphasizes the role of competition go to:http://concord.org/stem-resources/competition

HS-LS 2-1, HS-LS 2-2 For an online activity that allows students to gather and analyze data related to populations and predator/prey interactions go to: http://concord.org/stem-resources/experiment-ecosystems

HS-LS 2-1 and HS-LS 2-2 For an online activity that involves population sizes and carrying capacity, go to: http://concord.org/stem-resources/population-explosion

HS-LS 2-1 and HS-LS 2-2 Activity that models population growth and density determined limiting factors: http://www.lessonplansinc.com/lessonplans/population_ecology_lab.pdf

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Biology • Second Quarter

Pacing Guide

Science

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Biology — Science — Second Quarter

Unit #4
Ecosystems

Standard HS LS2.1

☐ **I CAN** use mathmatical representations to determine factors affecting carrying capacity and biodiversity.

Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Clarification: Emphasis on quantitative analysis and comparison among interdependent factors (boundaries, resources, climate, etc.) Students should not be assessed on their ability to derive appropriate equations.

Standard HS LS2.2

☐ **I CAN** investigate and draw conclusions regarding how environmental stability and behaviors affect species diversity, speciation, and extinction.

Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Clarification: Examples of mathematical comparisons can include graphs, tables, histograms, and population data gathered from simulations or historical data sets.

Standard 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.

Clarification: When discussing ecosystem stability and effects of change, examples of change can be modest, such as a seasonal flood, or extreme, such as a volcanic eruption or effects of climate change.

Standard HS LS2.8

**

Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Clarification: Evaluating the role of group behavior on individual and species' survival should include (1) distinguishing between group and individual behavior (2) identifying evidence supporting outcomes of group behavior and (3) developing rational arguments based on evidence. Examples of group behaviors include flocking, schooling, traveling in herds and cooperative behaviors like hunting and migrating.

Vocabulary Unit #4

abiotic component of the ecosystem
biological adaptations
carrying capacity
ecosystem stability
equilibrium of ecosystems
exponential growth
population dynamics
reproductive capacity
succession

Unit #5
Human Impacts and Mitigations

Standard HS LS2.7

☐ **I CAN** design, evaluate, and revise methods for reducing adverse human environmental impacts.Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Clarification: Examples of human activities with an environmental impact include urbanization, dam building, dissemination of invasive species and increasing insulating properties of the atmosphere.

Standard HS LS4.6

**

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Clarification: When students are designing solutions to mitigate human impact, emphasis is on designing solutions to a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.

Vocabulary Unit #5

climate change
conservation
desertification
extinction
global warming
invasive species
resource management
urbanization

Labs And Activities

Unit #6
HS-LS 1-1 For activities linking DNA to proteins, many resources are available. A partial list of online resources follows:
http://concord.org/stem-resources/dna-protein http://concord.org/stem-resources/dna-protein-0
http://learn.genetics.utah.edu/content/molecules/
HS-LS 1-1 For an online activity that shows how genetic mutations affect the resulting protein go to:
http://concord.org/stem-resources/mutations
HS-LS 1-1 Activity involving extracting and comparing DNA from two different organisms:
http://www.lessonplansinc.com/lessonplans/dna_extraction_lab.pdf

Unit #7
HS-LS 1-4 Mitosis Movie Activity can be found at:
http://www.resa.net/downloads/science__pd/cellular_division_model_hs_azanetti_20140206_094218_18.pdf

Unit #8
HS-LS 3-3 Punnet squares and other visual aids to demonstrate probabilities should be used to predict ratios of genotypes and phenotypes.
HS-LS 3-2 and HS-LS 3-3 For an online activity involving genetic traits and breeding dragons, go to:
http://concord.org/stem-resources/geniverse
HS-LS 3-2 and HS-LS 3-3 For an online activity involving meiosis and how it leads to genetic recombination within dragons go to: http://concord.org/stem-resources/meiosis
HS-LS 3-2 and HS-LS 3-3 More dragon genetics activities at: http://concord.org/stem-resources/modern-genetics

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Biology • Third Quarter Pacing Guide

Science

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Biology — Science — Third Quarter

Unit #6
DNA to Protein

Standard HS LS1.1

☐ **I CAN** use evidence to explain the structure of DNA, and how DNA determines the structure of essential proteins.

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.

Clarification: This standard includes DNA structure,and relating that structure to the mechanisms of protein synthesis. Biochemistry of protein synthesis not assessed. While some explanations of proteins is required, assessment should not extend to the details of protein structure. Emphasis is placed on amino acid composition and general functions of proteins in living systems. Genes can be described as regions of DNA that code for proteins or have a regulatory function. Gene sequence affects which proteins result and their function, and thus the function of body tissues. Assessment should not include identification of cell or tissue types, whole body systems or specific protein structures.

Vocabulary Unit #6

amino acid sequence
cell nucleus
DNA molecule
DNA sequence
DNA subunit
double helix
enzyme
gene
messenger RNA
protein
protein structure
protein synthesis
ribosome
specialized cell
storage of genetic information
tissue
transcription
transfer RNA
translation

Unit #7
Mitosis and Chromosomes

Standard HS LS1.4

☐ **I CAN** use a model to illustrate the process of mitosis and explain its role in cellular differentiation.

Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Clarification: Emphasis is on the overall process and its role, not memorizing the names of the steps or specific gene control mechanisms.
Include the concept of differentiated cell types in multicellular organisms forming due to different expression of genes, not different genetic content.
The models used to describe mitosis should be evaluated by students in terms of accuracy.

Vocabulary Unit #7

cancer
chromosome
chromosome pair
differentiation
diploid
duplication of genes
haploid
mitosis
multicellular
mutation

Unit #8 (will finish in Q4)
Inheritance and Variation

Standard HS LS3.1

☐ **I CAN use questioning to clarify the roles of DNA and chromosomes in heredity.**

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Clarification: Explicitly teach the cause and effect relationship between DNA, the proteins it codes for, and the resulting traits.

Standard HS LS3.2

☐ **I CAN** use evidence to determine sources of genetic variability.

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.

Clarification: Students should be able to analyze and interpret data to recognize and explain patterns in trait distribution within a population if environmental variables change.

Standard HS LS3.3

☐ **I CAN** use mathematical models to explain variation and distribution of traits.

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Clarification: Emphasis is on using mathematical models and data to support arguments regarding mechanisms of inheritance, and to predict outcomes. Hardy-Weinberg calculations and the phases of meiosis should not be part of assessment.

Vocabulary Unit #8

biological adaptation
complementary sequence
crossing over
degree of kinship
deletion
DNA
DNA replication
dominant
evidence for unity among organisms
Gametes
genetic diversity
genetic mutation
genetic variation
genotype
heterozygous
homozygous
inherited trait
jumping genes
karyotype
meiosis
new gene combinations
phenotype
progeny
recessive
recombination of genetic material
sex cell
sex chromosomes

Labs And Activities

Unit #8

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HS-LS 3-2 and HS-LS 3-3 More dragon genetics activities at: http://concord.org/stem-resources/modern-genetics

Unit #9

HS-LS 3-3 Go to: http://www.resa.net/curriculum/curriculum/science/professionaldevelopment/ngss-pd/lesson-plans-exploring-ngss/ and click on the link for "Genetics Probability".
HS-LS 4-5 For an activity that shows how a changing environment affects the evolution of a population, go to: http://concord.org/stem-resources/changes-environment
HS-LS 4-3 For an online activity that shows how heredity and natural selection lead to an adapted population go to: http://concord.org/stem-resources/conflicting-selection-pressures
HS-LS 4-4 and HS-LS 4-5 For an online activity that shows how a diverse population adapts to a changing environment, go to: http://concord.org/stem-resources/mystery-plant-adaptation
and also http://concord.org/stem-resources/mystery-plants-mystery
HS-LS 4-4 and HS-LS 4-5 For an online activity that demonstrates the effect of geographic isolation on populations go to: http://concord.org/stem-resources/natural-selection
HS-LS 4-4 An outdoor activity that models Darwin's observations and conclusions about Bird evolution and adaptation: http://concord.org/stem-resources/natural-selection

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Biology • Fourth Quarter

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Biology — Science — Fourth Quarter

Unit #8 (start in Q3)
Inheritance and Variation

Standard HS LS3.1

☐ **I CAN use questioning to clarify the roles of DNA and chromosomes in heredity.**

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Clarification: Explicitly teach the cause and effect relationship between DNA, the proteins it codes for, and the resulting traits.

Standard HS LS3.2

☐ **I CAN** use evidence to determine sources of genetic variability.

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.

Clarification: Students should be able to analyze and interpret data to recognize and explain patterns in trait distribution within a population if environmental variables change.

Standard HS LS3.3

☐ **I CAN** use mathematical models to explain variation and distribution of traits.

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Clarification: Emphasis is on using mathematical models and data to support arguments regarding mechanisms of inheritance, and to predict outcomes. Hardy-Weinberg calculations and the phases of meiosis should not be part of assessment.

Vocabulary Unit #8

biological adaptation
complementary sequence
crossing over
degree of kinship
deletion
DNA
DNA replication
dominant
evidence for unity among organisms
Gametes
genetic diversity
genetic mutation
genetic variation
genotype
heterozygous
homozygous
inherited trait
jumping genes
karyotype
meiosis
new gene combinations
phenotype
progeny
recessive
recombination of genetic material
sex cell
sex chromosomes

Unit #9
Evolution and Natural Selection

Standard HS LS4.1

☐ **I CAN** use genetic, biochemical, anatomical, and embryological information, as well as order of appearance, to provide evidence of evolution.

Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Clarification: Students should be able to use at least two formats to identify and communicate scientific information regarding common ancestry and biological evolution supported by multiple lines of empirical evidence.

Standard HS LS4.2

☐ **I CAN** use evidence to explain how different factors can influence an organism's ability to compete for limited resources and subsequent survival and adaptation of the species.

Construct an explanation based on evidence that the process of evolution primarily results from four factors.

Clarification: Process of evolution can be explained as driven primarily by four factors; (1) Potential for population growth (2) Heritable genetic variation (3) Competition for limited resources (4) Proliferation of organisms better able to survive and reproduce. Additional mechanisms of evolution, such as gene flow,genetic drift and co-evolution can be discussed but should not be assessed.

Standard HS LS4.3

☐ **I CAN** evaluate changes in species population and diversity and relate them to changes in the environment.

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.

Clarification: While numerical representations and analysis of trait distribution can be used to support explanations, assessment should not include allele frequency calculations.

Standard HS LS4.4

**

Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Clarification: Emphasis on how specific biotic and abiotic factors, including the actions of humans, contribute to a change in gene frequency over time.

Standard 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.

Vocabulary Unit #9

biodiversity
biological evolution
chance inherited variants
comparative anatomy
degree of kinship
differential survival
DNA
DNA molecule
embryonic stages of development
evidence for the unity among organisms
gene pool
genetic drift
genetic diversity
genetic mutation
genetic variation
homologous structures
molecular structures
morphological structures
natural selection
origin of life
phylogenetics
recombination of genetic material
speciation