High School Life Science

Essential Standards Extended Guide

HIGH SCHOOL LIFE SCEINCE

Background information about this document:

In response to requests from schools and districts for guidance on essential standards, committees of educators from around Idaho collaborated in the summer of 2024 to categorize Science standards into three groups:

1. **Essential standards** are explicitly taught, assessed multiple times, and receive targeted interventions for students who have not yet reached proficiency.
2. **Supporting standards** are taught to reinforce essential standards and may or may not be formally assessed.
3. **Additional standards** extend learning and are incorporated as time allows within course units, with assessment being optional.

This guidance helps LEAs prioritize the most critical standards, recognizing that not all standards are of equal importance. This document serves as a resource—not a mandate—to assist local efforts. Importantly, this work did not remove or revise any of the adopted Idaho Content Standards and is intended to refocus time and effort.

The committees developed instructional grouping models to demonstrate how standards can be combined into focused units. However, this is just one approach, and other combinations are possible. Educators can use this guide to begin developing scope and sequence for their instructional time and district-specific courses. It also provides a useful starting point for creating formative and summative assessments aligned with the standards.

Instructional Grouping 1: Hierarchical Structure of Life

Essential Standards **Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.**	**Supporting Standards and Content** **Taught to support the learning of essential standards and may or may not be formally assessed.**
HS-LS-1.1 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.	Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS-1.1) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS-1.1, HS-LS-3.1)
HS-LS-1.3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS-1.3)
HS-LS-1.4 Students who demonstrate understanding can: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS-1.4)
	Supporting Standard: HS-LS-1.2 Students who demonstrate understanding can: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Further explanation:

1. Emphasis is on the structure of the double helix, the pairing and sequencing of the nitrogenous bases, transcription, translation, and protein synthesis.
2. Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.

Assessment limits:

1. Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis
2. Assessment does not include the cellular processes involved in the feedback mechanism.
3. Assessment does not include specific gene control mechanisms.

Instructional Grouping 2: Flow of Energy and Matter

Essential Standards **Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.**	**Supporting Standards and Content** **Taught to support the learning of essential standards and may or may not be formally assessed.**
HS-LS-1.7 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	Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the
HS-LS-2.1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PSC-1.3, HS-PSC-1.5) Attraction and repulsion between electric charges at the atomic scale explain the structure, properties (physical and chemical), and transformations of matter, as well as the contact forces between material objects. (HS-PSC-1.3, HS-PSC-1.5, HS-PSP-1.6)
HS-LS-2.3 Construct an explanation using mathematical representations to support claims for the flow of energy through trophic levels and the cycling of matter in an ecosystem.	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS-2.3, HS-LS-2.4) Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures,

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	and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS-2.3)
HS-LS-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.	Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS-2.4) Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS-2.3, HS-LS-2.4)
HS-LS-2.5 Evaluate the claims, evidence, and reasoning that changing the conditions of a static ecosystem may result in a new ecosystem.	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2.2, HS-LS-2.5)
HS-LS-2.6 Design, evaluate, and/or refine practices used to manage a natural resource based on direct and	Changes in the environment, including habitat destruction, pollution, introduction of invasive species, overexploitation, and

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indirect influences of human activities on biodiversity and ecosystem health.	climate variability, can disrupt an ecosystem and threaten the survival of some species. (HS-LS-2.6) Changes in the physical environment have contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline or possible extinction of some species. (HS-LS-2.6, HS-LS-4.5) Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (HS-LS-2.6) Sustaining ecosystem health and biodiversity is essential to support and enhance life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational, cultural, or inspirational value. Humans depend on the living world for the resources and other benefits provided by biodiversity. Effects on biodiversity can be mitigated through actions such as habitat conservation, reclamation practices, wildlife management, and invasive species control. Understanding the effects of population growth, wildfire, pollution, and climate variability on changes in biodiversity could help maintain the integrity of biological systems. (HS-LS-2.6) Resource availability has guided the development of human society. (HS-LS-2.6, HS-ESS-3.1) When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and

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	aesthetics, and to consider social, environmental, and cultural impacts. (HS-LS-2.6)
	Supporting Standard: HS-LS-2.2 Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity at different scales within an ecosystem.

Additional Standards If time allows, these standards may be taught and/or assessed with Instructional Group 2.
HS-LS-1.6 Construct 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.

Further explanation:

1. Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.
2. Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.
3. Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.
4. Examples of models could include simulations and mathematical models.
5. Examples of changes in ecosystem conditions could include modest biological or physical changes, such as a seasonal flood, and extreme changes, such as volcanic eruption or sea level rise.
6. Emphasis is on how natural resources such as forests, waterways, and land are managed in ways that minimize harm to biodiversity and ecosystem health and activities that can improve and or maintain existing health of ecosystems.

Assessment limits:

1. Assessment should not include identification of the steps or specific processes involved in cellular respiration.

2. Assessment does not include deriving mathematical equations to make comparisons.
3. Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.
4. Assessment does not include the specific chemical steps of photosynthesis and respiration.

Instructional Grouping 3: Inheritance

Essential Standards **Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.**	**Supporting Standards and Content** **Taught to support the learning of essential standards and may or may not be formally assessed.**
HS-LS-1.4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS-1.4)
HS-LS-3.1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS-1.1, HS-LS-3.1) Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS-3.1)
HS-LS-3.2 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.	In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis, thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and

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	result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS-3.2) Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS-3.2, HS-LS-3.3)
HS-LS-3.3 Apply concepts of probability and statistical analysis to explain the variation and distribution of expressed traits in a population.	Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS-3.2, HS-LS-3.3)

Further explanation:

1. Emphasis is on using data to support claims about the way variation occurs.
2. Emphasis is on the use of mathematics to describe the probability of traits (alleles) as it relates to genetic and environmental factors in the expression of traits

Assessment limits:

1. Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.
2. Assessment does not include specific gene control mechanisms.
3. Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.
4. Assessment does not include Hardy-Weinberg calculations.

Instructional Grouping 4: Evolution and Natural Selection

Essential Standards **Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.**	Supporting Standards and Content **Taught to support the learning of essential standards and may or may not be formally assessed.**
HS-LS-4.1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information can be derived from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS-4.1)
HS-LS-4.2 Students who demonstrate understanding can: Construct an explanation based on evidence that the process of evolution, through the mechanism of natural selection, 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.	Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information— that is, trait variation—that leads to differences in performance among individuals. (HS-LS4.2, HS-LS-4.3) Evolution is a consequence of the interaction of four factors of natural selection: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS-4.2)
HS-LS-4.5 Students who demonstrate understanding can: Evaluate models that demonstrate how changes in an environment may result in the evolution of a population of a given species; the emergence of new species over generations; or the extinction of other species due to the processes of genetic drift, gene flow, mutation, and natural selection.	Changes in the physical environment have contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline or possible extinction of some species. (HS-LS-2.6, HS-LS-4.5) Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot

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	adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS-4.5)
	Supporting Standard: HS-LS-2.7 Evaluate the evidence for the role of group behavior on individual and species' ability to survive and reproduce
	Supporting Standard: HS-LS-4.3 Students who demonstrate understanding can: Apply concepts of probability and statistical analysis to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
	Supporting Standard: HS-LS-4.4 Students who demonstrate understanding can: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Further explanation:

1. Emphasis is on using evidence to explain the influence each of the four factors has on the number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.
2. Emphasis is on determining cause and effect relationships for how changes to the environment such as drought, flood, fire, deforestation, overfishing, application of fertilizers and pesticides, and the rate of change of the environment affect the distribution or disappearance of traits in species.

Assessment limits:

1. Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.