Lab-Aids Correlations for

NEXT GENERATION SCIENCE STANDARDS

HIGH SCHOOL LEVEL, LIFE SCIENCE

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Mark Koker, Ph D, Director of Curriculum &Professional Development, Lab-Aids
Lisa Kelp, Curriculum Specialist, Lab-Aids

This document is intended to show the alignment of *Science and Global Issues: Biology* with the *Next Generation Science Standards*[1] and *Common Core*[2] documents.

ABOUT OUR PROGRAMS
Lab-Aids Core Science Programs are developed to support current knowledge on the teaching and learning of science. All materials support an inquiry-driven pedagogy, with support for literacy skill development and with assessment programs that clearly show what students know and are able to do from using the programs. All programs have extensive support for technology in the school science classrooms and feature comprehensive teacher support.

ABOUT SEPUP
Materials from the Science Education for Public Understanding Program (SEPUP) are developed at the Lawrence Hall of Science, at the University of California, Berkeley, and distributed nationally by Lab-Aids, Inc. Development of SEPUP materials is supported by grants from the National Science Foundation. SEPUP programs are available as full year courses, or separately, as units, each taking 3-9 weeks to complete. For more information about SEPUP, visit www.sepuplhs.org.

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[1] http://www.nextgenscience.org/next-generation-science-standards
[2] http://www.corestandards.org/

ABOUT SCIENCE AND GLOBAL ISSUES BIOLOGY

Science and Global Issues: Biology was developed by SEPUP with grant support from the National Science Foundation. It was field tested nationally in classrooms across the country. The program consists of a student book, equipment kit, print and online teacher resources, and online content for students, including additional print, video, digital simulations and more. The five units in this course look at topics such as human impact on ecosystems, world health, genetically modified organisms, and biodiversity. In each unit, students are challenged to reason scientifically while applying their understanding of the main concepts of that unit: sustainability, ecology, cell biology, genetics, and evolution. For more information on the *Science and Global Issues: Biology* program, please visit https://store.lab-aids.com/high-school-curriculum/science-global-issues-biology.

Science in Global Issues Biology Unit Title	**Student Book Pages**	**Issue Focus**
Sustainability	1-46	Aspects of sustainability from a personal, community and global perspective
Ecology: Living on Earth	43-154	Sustainability from an ecosystems perspective, with a focus on humans' impacts on ecosystems Making decisions regarding fisheries management
Cell Biology: World Health	155-258	Disparities between developing and developed countries in terms of diseases' impacts on life Making decisions about priorities for diseases that limit social, economic, and environmental progress
Genetics: Feeding the World	259-412	Comparison of selective breeding and genetic modification Use of genetically modified organisms, particularly in the production of agricultural crops
Evolution: Maintaining Diversity	413-512	Conserving genetic, species and ecosystem diversity Ecosystems services and intrinsic value models for conservation

ABOUT THE NEXT GENERATION SCIENCE STANDARDS

The National Academy of Sciences, Achieve, the American Association for the Advancement of Science, and the National Science Teachers Association have collaborated over several years to develop the *Next Generation Science Standards* (NGSS). The first step of the process was led by The National Academies of Science, a non-governmental organization commissioned in 1863 to advise the nation on scientific and engineering issues. On July 19, 2011, the National Research Council (NRC), the functional staffing arm of the National Academy of Sciences, released the *Framework for K-12 Science Education*.

The *Framework* was a critical first step because it is grounded in the most current research on science and science learning and it identifies the science all K–12 students should know. The second step in the process was the development of standards grounded in the NRC Framework. A group of 26 lead states and writers, in a process managed by Achieve, has been working since the release of the Framework to develop K-12 *Next Generation Science Standards*. The *Standards* have undergone numerous lead states and all state reviews as well as two public comment periods, the most recent of these in January, 2013. The final release of the Standards coincided with the National Conference of the National Science Teachers Association Annual Conference in San Antonio, TX, the week of April 8, 2013.

The *Next Generation Science Standards* (NGSS) provide an important opportunity to improve not only science education but also student achievement. Based on the *Framework for K–12 Science Education*, the NGSS are intended to reflect a new vision for American science education. *The Next Generation Science Standards* are student performance expectations – NOT curriculum. Even though within each performance expectation Science and Engineering Practices (SEP) are partnered with a particular Disciplinary Core Idea (DCI) and Crosscutting Concept (CC) in the NGSS, these intersections do not predetermine how the three are linked in curriculum, units, or lessons. Performance expectations simply clarify the expectations of what students will know and be able to do be the end of the grade or grade band.

The following middle level standard from the life sciences is used to show the basic structure. Standards, as performance indicators, are in the white box on top, and the relevant Practices, Disciplinary Core Ideas, and Crosscutting Concepts are listed below in the blue, orange, and green boxes, respectively. Clarification Statements, in red, list assessment boundaries or further describe the standard; statements marked with an asterisk (*) denote integration of engineering content.

MS-LS3 Heredity: Inheritance and Variation of Traits

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Students who demonstrate understanding can:

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	**LS1.B: Growth and Development of Organisms** • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)* **LS3.A: Inheritance of Traits** • Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) • In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Connections to other DCIs in this grade-band: **MS.LS1.A** (MS-LS3-1); **MS.LS4.A** (MS-LS3-1)

Articulation across grade-bands: **3.LS3.A** (MS-LS3-1),(MS-LS3-2); **3.LS3.B** (MS-LS3-1),(MS-LS3-2); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1),(MS-LS3-2); **HS.LS3.A** (MS-LS3-1),(MS-LS3-2); **HS.LS3-B** (MS-LS3-1),(MS-LS3-2)

Common Core State Standards Connections:

ELA/Literacy –

Various other appendices describe other important elements of the Standards, such as DCI progressions, STS, nature of science, and more.

ABOUT THE LAB-AIDS CITATIONS

The following tables are presented in a Disciplinary Core Idea arrangement – Earth Space Science (ESS), Life Science (LS), Physical Science (PS) and Engineering, Technology and Applications of Science (ETS). These are provided first by PE element and later by SGI Bio activity and unit. Some unit content may contain science content that falls outside NGSS specifications and are not listed here.

Citations included in the correlation document are as follows:

Unit title, Activity Number and Description:
Genetics: Feeding the World 6 MODELING : Breeding Corn for Two Traits
Students use Punnett squares to predict the outcome of a cross between corn plants for two traits. Students create a plan to determine the genotype of a parent based on observing the results of crosses for two traits

NGSS Performance Expectations	HS-LS3-3
Science and Engineering Practices	Analyzing and Interpreting Data
	Developing and Using Models
	Using Mathematics and Computational Thinking
Crosscutting Concepts	Patterns
	Systems and System Models
Disciplinary Core Ideas	(ETS1.A)*
	ETS1.B
	ETS1.C
Common Core English-Language Arts	WHST.9-12.9
Common Core Mathematics	MP.2

*The use of parenthesis () indicates partial coverage.

SGI: BIOLOGY NGSS COMPLETE ANALYSIS

(The use of parentheses indicates a partial or incomplete correlation.)

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
LS1.A: Structure and Function	(1) Systems of specialized cells within organisms help them perform the essential functions of life.	(C2),(C3),(C4),C5,C6,C10,(C12), (C13), C14, D17
	(2) 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.	C6, C10, (D2), D3, D9, D10, D14, D16, D17, (D19)
	(3) Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	C3, C4, C9, C12, C14, C15
	(4) 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.	(C6)
LS1.B: Growth and Development of Organisms	(1) 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.	C13, C14, D3, (D14), D17
LS1.C: Organization for Matter	(1) The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars	B9, B11, C12

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
and Energy Flow in Organisms	plus released oxygen.	
	(2) The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.	B9, B11, C12, Appendix F
	(3) As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	B11, C11, C12
	(4) As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken, and new compounds are formed that can transport energy to muscles.	B9, B10, B11, C12
LS2.A: Interdependent Relationships in Ecosystems	(1) 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 abundance (number of individuals) of species in any given ecosystem.	B2, B3, B6, B8, (B12), B13, B14, (B16)
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	(1) Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.	B9, B10, B11, C12

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems (continued)	(2) 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, and much is discarded. The chemical elements that make up the molecules of organ- isms 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.	B6, B7, B9, (B10), B11, (C12)
	(3) 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.	B8, B9, B10, (B11), (C12)
LS2.C: Ecosystem Dynamics, Functioning, and Resilience	(1) 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.	B1, B4, B7, B14, B16, B17, B18, E1, E2
	(2) Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.	B1, B4, B5, B7, B8, B15, B16, B17, B18, E1, E2, E9
LS2.D: Social Interactions and Group Behavior	(1) Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
LS3.A Inheritance of Traits	(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.	D9, D10, D11, D12, D17
LS3.B: Variation of Traits	(1) In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.	(C13,) D4, D5, D13, D14, D16
	(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.	D17
LS4.A: Evidence of Common Ancestry and Diversity	(1) Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryo- logical evidence.	(D11), E5, E6, E7, E8, E9, E10, E14, (E15)
LS4.B: Natural Selection	(1) 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.	E4, E11, E13, review
	(2) The traits that positively affect survival are more likely to be	E4, E5, E6, E11, E12, E14

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
	reproduced, and thus are more common in the population.	
LS4.C: Adaptations	(1) Evolution is a consequence of the interaction of four factors: (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.	E4, E11, E12, E13, E14
	(2) Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.	E4, E11, E12, E13, E14
	(3) Adaptation also means that the distribution of traits in a population can change when conditions change.	E11, E12, E13, E14
	(4) Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.	(E3), E11, (E12), E13
	(5) Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	E11, E13
LS4.D: Biodiversity and Humans	(1) Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).	(E1), (E2), (E3), E9, E11, E13, E15

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
	(2) Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.	(A1), E1, E2, E9, E15
PS3.D: Energy in Chemical Processes	(1) The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.	(B6), (B7), (B8), B9, B11, C12
ETS1.A: Defining and Delimiting Engineering Problems	(1) Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	A1, A2, A5, A6, B19, C15, (C17), (D1), (D2), (D6), (D13), D15, D16, D18, D19, D20, (E1), (E2), E9, E15
	(2) Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	A1, A2, A3, A4, A5, A6, (B4), (B5), (B15), (B16), B18, B19, C1, (C2), (C3), (C7), (C8), (C13), C16, D1, D6, D13, D16, D18, D19, D20, (E1), E2, E9, E15
ETS1.B: Developing Possible Solutions	(1) When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.	(A1), A2, A3, A6, (B4), (B7), (B15), (B16), B18, B19, C1, (C2), (C8), (C13), (C15), (C18), D1, (D2), D6, D15, D20, (E9), E15
ETS1.B: Developing Possible Solutions (continued)	(2) Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	A4, (B5), (B14)

	HS LS DISCIPLINARY CORE IDEAS	ACTIVITIES
ETS1.C: Optimizing the Design Solution	(1) Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	A1, A2, A3, A4, A5, A6, B4, B15, B18, C1, C18, D1, D6, D15, D20, (E2), E9, E15

	SCIENCE AND ENGINEERING PRACTICES	ACTIVITIES
Analyzing and Interpreting Data	(1) Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	A1, A2, A5, B2, B3, (B10), (B11), (B12), B14, B15, B16, (B18), (B19), C1, (C7), (C8), (C11), D2, D4, D6, D7, D8, D16, D18, D20, E1, (E11), (E12)
Asking Questions and Defining Problems	(1) Ask questions that arise from examining models or a theory to clarify relationships.	C1, C15, D1, D15, E8
Constructing Explanations and Designing Solutions	(1) Construct (and revise) an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	(B6), B7, B9, (B11), B12, B13, B14, B15, B17, (C6), C9, (C11), (C12), C13, C14, C16, (C17), D3, (D4), D5, D8, (D11), D12, D13, D14, D17, D18, D19, E1, E2, E3, E4, E5, E6, E7, E8, E10, E11, E12, E13, E15
	(2) Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	A3, A6, (B4), (B5), B7. (B16), B18, B19, C18, (D1), (D20), E9
Developing and Using Models	(1) (Develop and) Use a model based on evidence to illustrate the relationships between systems or between components of a system.	A4, (A5), B5, B7, B8, B9, (B13), (B14), (B15), (B16), (C4), (C5), C7, C8, C12, C13, C14, C16, C17, D3, D4, D5, D6, D7, D8, D10, D12, D13, D16, D17, (D19), (E1), E3, (E5), (E8), E11, E12
Engaging in Argument from Evidence	(1) Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to	A5, A6, B4, (B11), C18, (D16), (D18), (D20), E6, E8, E11, E12, E13, E14

	SCIENCE AND ENGINEERING PRACTICES	ACTIVITIES
	determine the merits of arguments.	
	(2) Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.	A5, (B3), B4, B5, B7, C1, C2, (C8), (C13), C17, D1, D5, D8, D15, D18, D20, E5, E7, E9, E10, E15
Obtaining. Evaluating, and Communicating Information	(1) Communicate scientific information (e.g., about phenomena and/ or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	(A5), A6, B1, (B3), B4, B15, B16, B18, (C1), C6, C10, C12, C17, C18, D4, D7, D8, D11, D15, (D16), (D17), (D20), E10, E14, E15
Planning and Carrying Out Investigations	(1) Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	A5, B2, B6, B10, B11, (C2), (C3), C7, (C8), C11, D2, D9, D18, (E8)
Using Mathematics and Computational Thinking	(1) Use mathematical and/or computational representations of phenomena or design solutions to support (and revise) explanations.	A1, A2, B3, B6, B14, B15, B16, (B19), C1, D4, D6, D7, E3, E11, E12
	(2) Use mathematical representations of phenomena or design solutions to support claims.	A1, A2, B2, B3, B6, C1, (D4), D7, (D20)
	(3) Create or revise a simulation of a phenomenon, designed device, process, or system.	

KEY: A = Sustainability, B = Ecology, C = Cell Biology, D = Genetics, E = Evolution

	CROSSCUTTING CONCEPTS	ACTIVITIES
Cause and Effect	(1) Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	A3, A5, A6, B1, B2, B4, B5, B6, B10, B14, B15, B16, C5, C7, (C8), (C17), D1, D7, (D17), D20, E1, E2, E4, (E9), E10, E11, E12, E13, E14, E15
Energy and Matter	(1) Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.	(B1), (B6), (B7), (B8), B9, B11, B12, C12
	(2) Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.	B7, B9
	(3) Energy drives the cycling of matter within and between systems.	B7, B9
Patterns	(1) Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.	A1, A2, A4, B3, B4, B13, C1, (C3), (C4), (C12), D4, D5, D6, D7, D8, D9, D10, (D11), D16, D17, D18, (D20), (E4), E5, E6, E7, E8, E9, E10, (E11), E12, (E13), E14, (E15)
Scale, Proportion, and Quantity	(1) The significance of a phenomenon is dependent on the scale, pro- portion, and quantity at which it occurs.	A4, B6, B14, B15, (C3), (C16), (D3), E6, E7
	(2) Using the concept of orders of magnitude allows one to under- stand how a model at one scale relates to a model at another scale.	B5
	(3) Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	
Stability and Change	(1) Feedback (negative or positive) can stabilize or destabilize a system.	B1, (C6), (C9), (C13)
	(2) Much of science deals with constructing explanations of how things change and how they remain stable.	B4, B12, (B14), B15, B16, B17, B18, B19, (C9), C11, C13, (C14), (C16), (C17), (C18), (D15), (D16), E1, E2, E3, E4, E6, E9, E11, (E12), (E13), E15

	CROSSCUTTING CONCEPTS	ACTIVITIES
Structure and Function	(1) Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.	A3, (B9), C2, (C3), C4, C5, C6, C7, C8, C9, C10, C12, C13, C14, C15, C16, C17, (D1), D2, D3, D10, D14, D16, D17, (D19), (E5), (E6), (E7), E8, E13
Systems and System Models	(1) Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.	(A5), B5, B7, B8, B9, B12, B13, B14, B15, B16, B19, (C4), (C5), C7, C8, C12, C13, C14, C16, C17, (C18), (D3), D4, (D6), D7, D8, D10, D12, D13, D16, D17, D19, (E1) E11, E12

PERFORMANCE EXPECTATIONS IN SGI BIOLOGY

	PERFORMANCE EXPECTATIONS (RELATED TO OR BUILDING TOWARDS)	ACTIVITIES
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.	C10, C14, D2, (D3), (D5), D10, D11, (D14), D16, (D17), (D19)
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	C3, C4, C9, C12, C14, C15
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	C13, C14, C15, D17
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	(B9), (B10), (B11), C12

	PERFORMANCE EXPECTATIONS (RELATED TO OR BUILDING TOWARDS)	ACTIVITIES
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.	(B9), B11, C12, Appendix F
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.	B9, B10, B11, C12
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	B14, B17
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.	B16, B17
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.	(B8), (B9), (B10), (B11), (B12)
HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	(B7), (B8)
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.	(B8), B9
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	(B1), (B4), (B5), (B12), (B13), (B14), B16, (B17), (B18), (B19)

	PERFORMANCE EXPECTATIONS (RELATED TO OR BUILDING TOWARDS)	ACTIVITIES
	ecosystem.	
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*	(B4), (B15), (B16), (B18),(B19)
HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	
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.	D1, D2, D3, D5, D10, D11, D15, D16
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.	(C13,) D12, D13, D14, D16
HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	D4, D5, D6, D7, D12
HS-LS4-1 HS-LS4-2	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. 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	E4, E5, E6, E7, E8, E9, E10, E11, E13, E14 E4, E11, E12, E13

	PERFORMANCE EXPECTATIONS (RELATED TO OR BUILDING TOWARDS)	ACTIVITIES
	in the environment.	
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.	E11, E12
HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	E4, E5, E6, E7, (E8), E11, E12, E13
HS-LS4-5	Evaluate the evidence supporting claims that changes in environ- mental 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.	E3, E4, E5, E6, E7, (E8), E10, E11, E12, E13, E14
HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*	E9, E11, E12, E15
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	A1, A2, A3, A4, A5, A6, (B1), (B4), (B18), (B19), C1, C17, C18, (D1), (D15), (D20), (E1), (E2), (E9), (E15)
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability,	(A3), A6, B1, B4, B18, B19, C17, C18, D6, D15, D18, D19, D20, E9, E15

	PERFORMANCE EXPECTATIONS (RELATED TO OR BUILDING TOWARDS)	ACTIVITIES
	and aesthetics, as well as possible social, cultural, and environmental impacts.	
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	

HS LS COMMON CORE CONNECTIONS: ELA/LITERACY

STANDARD	DESCRIPTION	ACTIVITIES
RST.9-10.8	Assess the extent to which the reasoning and evidence in a text sup- port the author's claim or a recommendation for solving a scientific or technical problem.	(C13), (C16), D1, D20
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	(A3), (C6), (D11), D20
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	A1, A2, B3, (B19), C2, (C3), (C12), (C16), (C17), (D8), (D17), (D19), (D20), E8, E15
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	(C2), (C11), (E6)
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	(B8), C4, C5, C10, C12, C13, C14, (C15), C17, C18, (D15), D16, D17, (D18), D19, (E1), (E8), (E11), (E15)
WHST.9-12.1	Write arguments focused on discipline-specific content.	(A1), (A4), A5, (B2), (B3), B4, B5, B7, B11, C3, (C8), (C9), (C13), C18, D1, D5, D8, D15, D18, D20, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	(B2), B3, B4, B6, B7, B8, B9, B10, B11, B12, B14, B16, B17, (B18), (B19), (C2), (C4), (C6), (C7), (C9), C11, C14, C18, D2, D4, D14, E3, E4, E5, E6, E10, E11, E12, E13, E15
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.	(B1)

STANDARD	DESCRIPTION	ACTIVITIES
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	B4, B5, C10, (C17), D15
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.	C10, C17, (C18), (D15)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research.	B1, B4, B8, C2, C3, (C6), (C7), C9, C10, (C11), (C12), (C13), (C15), (C16), D6, D7, D15, (E10), E14, E15
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.	(A5), A6, B4, C1, C10, C17, C18, D1, D15
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance under- standing of findings, reasoning, and evidence and to add interest.	(A6), C10, C17, C18, D15

HS LS COMMON CORE CONNECTIONS: MATH

STANDARD	DESCRIPTION	ACTIVITIES
MP.2	Reason abstractly and quantitatively.	A1, A2, B2, B6, B19, C1, (C11), D4, D5, D6, D7, E3, E8
MP.4	Model with mathematics.	(B14), (B15), (C1), E3, (E11), (E12)
HSF-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	B3
HSF-BF.A.1	Write a function that describes a relationship between two quantities.	
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	B2, B3
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.	C1, E3
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
HSS-ID.A.1	Represent data with plots on the real number line.	B2, B3, B15, B16
HSS-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.	(A1), (A2), (C1), (D20)
HSS-IC.B6	Evaluate reports based on data.	(A1), (A2), (A5), (D20)

KEY: A = Sustainability, B = Ecology, C = Cell Biology, D = Genetics, E = Evolution

SGI: BIOLOGY NGSS CORRELATIONS BY ACTIVITY

(The use of parentheses indicates a partial or incomplete correlation. See end of document for explanation of codes used.)

ACTIVITY	PERFORMANCE EXPECTATION (RELATED TO OR BUILDING TOWARDS)	DISCIPLINARY CORE IDEA	SCIENCE AND ENGINEERING PRACTICE	CROSSCUTTING CONCEPT
UNIT A: SUSTAINABILITY				
1	ETS1-1	LS4.D.2, ETS1.A.1, ETS1.A.2, ETS1.C.1, (ETS1.B.1)	AID, UMCT	P
2	ETS1-1	ETS1.A.1, ETS1.A.2, ETS1.B.1, ETS1.C.1	AID, UMCT	P
3	ETS1-1, (ETS1-3)	ETS1.A.2, ETS1.B.1, ETS1.C.1	CEDS	C&E, S&F
4	ETS1-1	ETS1.A.2, ETS1.B.2, ETS1.C.1	DUM	P, SPQ
5	ETS1-1	ETS1.A.1, ETS1.A.2, ETS1.C.1	AID, EAE, PCI, (DUM), (OECI)	C&E, (SSM)
6	ETS1-1, ETS1-3	ETS1.A.1, ETS1.A.2, ETS1.B.1, ETS1.C.1	CEDS, EAE, OECI	C&E
UNIT B: ECOLOGY				
1	ETS1-3, (LS2-6), (ETS1-1),	LS2.C.1, LS2.C.2	OECI	C&E, S&C, (E&M)
2		LS2.A.1	AID, PCI, UMCT	C&E
3		LS2.A.1	AID, UMCT, (EAE), (OECI)	P
4	ETS1-3, (LS2-6), (LS2-7), (ETS1-1)	LS2.C.1, LS2.C.2, (ETS1.A.2), (ETS1.B.1), ETS1.C.1	EAE, OECI	C&E, P, S&C
5	LS1-5, LS1-6, (LS2-6)	LS2.C.2, (ETS1.A.2), (ETS1.B.2)	DUM, EAE, (CEDS)	C&E, SPQ, SSM
6		LS2.A.1, LS2.B.2, (PS3.D.1)	PCI, UMCT, (CEDS)	C&E, SPQ, (E&M)
7	(LS2-4)	LS2.B.2, LS2.C.1, LS2.C.2, (ETS1.B.1), (PS3.D.1)	CEDS, DUM, EAE	E&M, SSM

ACTIVITY	PERFORMANCE EXPECTATION (RELATED TO OR BUILDING TOWARDS)	DISCIPLINARY CORE IDEA	SCIENCE AND ENGINEERING PRACTICE	CROSSCUTTING CONCEPT
8	(LS2-3), (LS2-4), (LS2-5)	LS2.A.1, LS2.B.3, LS2.C.2, (PS3.D.1)	DUM	E&M, SSM
9	LS1-7, LS2-5, (LS1-5), (LS1-6), (LS2-3)	LS1.C.1, LS1.C.2, LS1.C.4, LS2.B.1, LS2.B.2, LS2.B.3, PS3.D.1	CEDS, DUM	E&M, SSM, (S&F)
10	LS1-7, (LS1-5), (LS2-3)	LS1.C.4, LS2.B.1, LS2.B.3, (LS2.B.2)	PCI, (AID)	C&E
11	LS1-6, LS1-7, (LS1-5), (LS2-3)	LS1.C.1, LS1.C.2, LS1.C.3, LS1.C.4, LS2.B.1, LS2.B.2, PS3.D.1, (LS2.B.3)	PCI, (AID), (CEDS), (EAE),	E&M
12	(LS2-3), (LS2-6)	(LS2.A.1)	CEDS, (AID)	E&M, S&C, SSM
13	(LS2-6)	LS2.A.1	CEDS, (DUM)	P, SSM
14	LS2-1, (LS2-6)	LS2A.1, LS2.C1, (ETS1.B.2)	AID, CEDS, UMCT, (DUM)	C&E, S&C, SPQ, SSM,
15	(LS2-7)	LS2.C.2, ETS1.C.1, (ETS1.A.2), (ETS1.B.1),	AID, CEDS, OECI, UMCT, (DUM)	C&E, S&C, SPQ, SSM
16	LS2-2, LS2-6, (LS2-7)	LS2.C.1, LS2.C.2, (LS2.A.1), (ETS1.A.2), (ETS1.B.1)	AID, OECI, UMCT, (CEDS), (DUM),	C&E, S&C, SSM
17	LS2-1, LS2-2, (LS2-6)	LS2.C.1, LS2.C.2	CEDS	S&C
18	ETS1-3, (LS2-6), (LS2-7), (ETS1-1)	LS2.C.1, LS2.C.2, ETS1.A.2, ETS1.B.1, ETS1.C.1	CEDS, OECI, (AID)	S&C
19	ETS1-3, (LS2-6), (LS2-7), (ETS1-1)	ETS1.A.1, ETS1.A.2, ETS1.B.1	CEDS, (AID), (UMCT)	S&C, SSM
UNIT C: CELL BIOLOGY				
1	ETS1-1	ETS1.A.2, ETS1.B.1, ETS1.C.1	AID, AQDP, EAE, UMCT, (OECI)	P

ACTIVITY	PERFORMANCE EXPECTATION (RELATED TO OR BUILDING TOWARDS)	DISCIPLINARY CORE IDEA	SCIENCE AND ENGINEERING PRACTICE	CROSSCUTTING CONCEPT
2		(LS1.A.1), (ETS1.A.2), (ETS1.B.1)	EAE, (PCI)	S&F
3	LS1-2	LS1.A.3, (LS1.A.1), (ETS1.A.2)	(PCI)	S&F, (P), (SPQ)
4	LS1-2	LS1.A.3, (LS1.A.1)	DUM	S&F, (P), (SSM)
5		LS1.A.1	(DUM)	C&E, S&F, (SSM)
6		LS1.A.1, LS1.A.2, (LS1.A.4)	OECI, (CEDS)	S&F, (S&C)
7		(ETS1.A.2)	DUM, PCI, (AID)	C&E, S&F, SSM
8		(ETS1.A.2), (ETS1.B.1)	DUM, (AID), (EAE), (PCI)	S&F, SSM, (C&E)
9	LS1-2	LS1.A.3	CEDS	S&F, (S&C)
10	LS1-1	LS1.A.1, LS1.A.2	OECI	S&F
11		LS1.C.3	PCI, (AID), (CEDS)	S&C
12	LS1-2, LS1-5, LS1-6, LS1-7	LS1.A.3, LS1.C.1, LS1.C.2, LS1.C.3, LS1.C.4, LS2.B.1, PS3.D.1, (LS1.A.1), (LS2.B.2), (LS2.B.3)	DUM, OECI, (CEDS)	E&M, S&F, SSM, (P)
13	LS1-4, (LS3-2)	LS1.B.1, (LS1.A.1), (LS3.B.1), (ETS1.A.2), (ETS1.B.1)	CEDS, DUM, (EAE)	S&C, S&F, SSM
14	LS1-1. LS1-2, LS1-4	LS1.A.1, LS1.A.3, LS1.B.1	CEDS, DUM	S&F,SSM, (S&C)
15	LS1-2, LS1-4	LS1.A.3, ETS1.A.1, (ETS1.B.1)	AQDP	S&F
16		ETS1.A.2	CEDS, DUM	S&F, SSM, (S&C), (SPQ)
17	LS1-4, ETS1-1. ETS1-3	(ETS1.A.1)	DUM, EAE, OECI, (CEDS)	S&F, SSM, (C&E), (S&C)
18	ETS1-1, ETS1-3	ETS1.C.1, (ETS1.B.1)	CEDS, EAE, OECI	(S&C), (SSM)

ACTIVITY	PERFORMANCE EXPECTATION (RELATED TO OR BUILDING TOWARDS)	DISCIPLINARY CORE IDEA	SCIENCE AND ENGINEERING PRACTICE	CROSSCUTTING CONCEPT
UNIT D: GENETICS				
1	LS3-1, (ETS1-1)	ETS1.A.2, ETS1.B.1, ETS1.C.1, (ETS1.A.1),	AQDP, EAE, (CEDS)	C&E, (S&F)
2	LS1-1, LS3-1	(LS1.A.2), (ETS1.A.1), (ETS.1.B.1)	PCI, AID	S&F
3	LS3-1, (LS1-1)	LS1.A.2, LS1.B.1	CEDS, DUM	S&F, (SPQ), (SSM)
4	LS3-3	LS3.B.1	AID, DUM, OECI, UMCT, (CEDS)	P, SSM
5	LS3-1, LS3-3, (LS1-1)	LS3.B.1, LS3.B.2	EAE, CEDS, DUM	P
6	LS3-3, ETS1-3	ETS1.A.2, ETS1.B.1, ETS1.C.1, (ETS1.A.1)	AID, DUM, UMCT	P, (SSM)
7	LS3-3	LS3.B.1, LS4.B.2	AID, DUM, OECI, UMCT	C&E, P, SSM,
8		LS3.B.1	AID, CEDS, DUM, EAE, OECI	P
9		LS1.A.2, LS3.A.1	PCI	P
10	LS1-1, LS3-1	LS1.A.2, LS3.A.1	DUM	P, S&F, SSM
11	LS1-1, LS3-1	LS3.A.1, (LS4.A.1)	(CEDS), OECI	(P)
12	LS3-2, LS3-3	LS3.A.1	CEDS, DUM	SSM
13	LS3-2	LS3.B.1, ETS1.A.2, (ETS1.A.1)	CEDS, DUM	SSM
14	LS3-2, (LS1-1)	LS1.A.2, LS3.B.1, (LS1.B.1),	CEDS	S&F
15	LS3-1, ETS1-3, (ETS1-1)	ETS1.A.1, ETS1.B.1, ETS1.C.	AQDP, EAE, OECI	(S&C)
16	LS1-1, LS3-1, LS3-2	LS1.A.2, LS3.B.1, ETS1.A.1, ETS1.A.2	AID, DUM, (EAE), (OECI)	P, S&F, SSM, (S&C)
17	LS1-4, (LS1-1)	LS1.A.1, LS1.A.2, LS1.B.1, LS3.A.1, LS3.B.2	CEDS, DUM, (OECI)	P, S&F, SSM, (CE)
18	ETS1-3	ETS1.A.1, ETS1.A.2	AID,CEDS, EAE, PCI	P

ACTIVITY	PERFORMANCE EXPECTATION (RELATED TO OR BUILDING TOWARDS)	DISCIPLINARY CORE IDEA	SCIENCE AND ENGINEERING PRACTICE	CROSSCUTTING CONCEPT
19	ETS1-3, (LS1-1)	ETS1.A.1, ETS1.A.2, (LS1.A.2),	CEDS, (DUM)	SSM, (S&F)
20	ETS1-3, (ETS1-1)	ETS1.A.1, ETS1.A.2, ETS1.B.1, ETS1.C.1	AID, EAE, (CEDS), (OECI), (UMCT)	CE, (P)
UNIT E: EVOLUTION				
1	(ETS1-1)	LS2.C.1, LS2.C.2, LS4.D.2, (LS4.D.1), (ETS1.A.1), (ETS1.A.2)	AID, CEDS, (DUM)	C&E, S&C, (SSM)
2	(ETS1-1)	LS2.C.1, LS2.C.2,.D.2, ETS1.A.2, (LS4.D.1), LS4 (ETS1.A.1), (ETS1.C.1)	CEDS	C&E, S&C
3	LS4-5	(LS4.C.4), (LS4.D.1)	CEDS, DUM, UMCT	S&C
4	LS4-1, LS4-2, LS4-4, LS4-5	LS4.B.1, LS4.B.2, LS4.C.1, LS4.C.2	CEDS	P, C&E, S&C
5	LS4-1, LS4-4, LS4-5	LS4.A.1, LS4.B.2	CEDS, EAE, (DUM)	P, (S&F)
6	LS4-1, LS4-4, LS4-5	LS4.A.1, LS4.B.2	CEDS, EAE	P, S&C, SPQ, (S&F)
7	LS4-1, LS4-4, LS4-5	LS4.A.1	CEDS, EAE	P, SPQ, (S&F)
8	LS4-1, (LS4-4), (LS4-5)	LS4.A.1	CEDS, DUM, EAE, AQDP, (PCI)	P, S&F
9	LS4-1, LS4-6, ETS1-3, (ETS1-1)	LS2.C.2, LS4.A.1, LS4.D.1, LS4.D.2, ETS1.A.1, ETS1.A.2, ETS1.C.1, (ETS1.B.1)	CEDS, EAE	P, S&C, (C&E)
10	LS4-1, LS4-5	LS4.A.1	CEDS, EAE, OECI	C&E, P
11	LD4-1, LS4-2, LS4-3, LS4-4, LS4-5, LS4-6	LS4.B.1, LS4.B.2, LS4.C.1, LS4.C.2, LS4.C.3, LS4.C.4, LS4.C.5,	CEDS, DUM, EAE, UMCT, (AID)	C&E, S&C, SSM, (P)

ACTIVITY	PERFORMANCE EXPECTATION (RELATED TO OR BUILDING TOWARDS)	DISCIPLINARY CORE IDEA	SCIENCE AND ENGINEERING PRACTICE	CROSSCUTTING CONCEPT
		LS4.D.1		
12	LS4-2, LS4-3, LS4-4, LS4-5, LS4-6	LS4.B.2, LS4.C.1, LS4.C.2, LS4.C.3, LS3.B.1, (LS4.C.4)	CEDS, DUM, EAE, UMCT, (AID)	P, C&E, SSM, (S&C)
13	LS4-1, LS4-2, LS4-4, LS4-5	LS4.B.1, LS4.C.1, LS4.C.2, LS4.C.3, LS4.C.4, LS4.C.5, LS4.C.6, LS4.D.1	CEDS, EAE	C&E, S&F, (P), (S&C)
14	LS4-1, LS4-5	LS4.A.1, LS4.B.1, LS4.B.2, LS4.C.1, LS4.C.2, LS4.C.3	EAE, OECI	P, C&E
15	LS4-6, ETS1-3, (ETS1-1)	LS4.D.1, LS4.D.2, ETS1.A.1, ETS1.A.2, ETS1.B1, ETS1.C.1, (LS4.A.1)	CEDS, EAE, OECI	C&E, S&C, (P)

KEY

SCIENCE AND ENGINEERING PRACTICES	CROSSCUTTING CONCEPTS
AID = Analyzing and Interpreting Data	C&E = Cause and Effect
AQDP = Asking Questions and Defining Problems	E&M = Energy and Matter
CEDS = Constructing Explanations and Designing Solutions	P = Patterns
DUM = Developing and Using Models	S&C = Stability and Change
EAE = Engaging in Argument from Evidence	S&F = Structure and Function
OECI = Obtaining, Evaluating, and Communicating Information	SPQ = Scale, Proportion, and Quantity
PCI = Planning and Carrying Out Investigations	SSM = Systems and System Models
UMCT = Using Mathematics and Computational Thinking	