

LS4.A: Evidence of Common Ancestry and Diversity

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
3	<ul style="list-style-type: none"> Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (3-LS4-1) Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)
8	<ul style="list-style-type: none"> The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (8-LS4-1) Anatomical similarities and differences among modern organisms and between modern and fossil organisms in the fossil record enable the reconstruction of the history and the inference of lines of ancestral relationships. (8-LS4-2)
Biology	<ul style="list-style-type: none"> Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; notably, 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 embryological evidence. (B-LS4-1)
Biology 2	<ul style="list-style-type: none"> Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; notably, 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 embryological evidence. (B-LS4-1) (repeat)

LS4.B: Natural Selection

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3	<ul style="list-style-type: none"> • Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)
8	<ul style="list-style-type: none"> • Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (8-LS4-4) • In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. (8-LS4-5)
Biology	<ul style="list-style-type: none"> • 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. (B-LS4-2)
Biology 2	<ul style="list-style-type: none"> • 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. (B-LS4-3) • The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (B-LS4-3)

LS4.C: Adaptation

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3	<ul style="list-style-type: none"> Adaptation can lead to organisms that are better suited for their environment. (3-LS4-3) For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)
8	<ul style="list-style-type: none"> Adaptation by natural selection occurring over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not, become less common. Thus, the distribution of traits in a population changes. (8-LS4-6)
Biology 1	<ul style="list-style-type: none"> Evolution is driven by 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. (B-LS4-2) 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. (B-LS4-4) 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. (B-LS4-5) 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. (B-LS4-5)

K-12 Conceptual Vertical Articulation of LS4 – Biological Evolution: Unity and Diversity

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Biology 2	<ul style="list-style-type: none"><li data-bbox="422 240 1969 423">• 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. (B-LS4-3)<li data-bbox="422 472 1934 505">• Adaptation also means that the distribution of traits in a population can change when conditions change. (B-LS4-3)<li data-bbox="422 553 1969 659">• 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. (B-LS4-6)

LS4.D: Biodiversity and Humans

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
2	<ul style="list-style-type: none"> • There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)
3	<ul style="list-style-type: none"> • Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)
7	<ul style="list-style-type: none"> • Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary) (7-LS2-5)
Biology 1	<ul style="list-style-type: none"> • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary) (B-LS2-7) • Humans depend on the living world for the resources and other benefits provided by biodiversity. Human activity is having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. These problems have the potential to cause biological extinctions which result in decreased biodiversity and the effects may be harmful to humans and other living things. Sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. (B-LS2-7) • Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary) (B-LS2-7)
Biology 2	<ul style="list-style-type: none"> • 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. (B-LS4-6)

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Adapted from *The Framework for K-12 Science Education* and the *Next Generation Science Standards*.

References:

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States (Appendix E: Disciplinary Core Idea Progression)*. Retrieved from <https://www.nextgenscience.org/>