K-12 Conceptual Vertical Articulation of LS3 – Heredity: Inheritance and Variation of Traits

LS3.A: Inheritance of Traits

Grade Band	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
K–2	• Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. (1-LS3-1)
3–5	• Many characteristics of organisms are inherited from their parents. (3-LS3-1) • Some characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)
6–8	• 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. (8-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. (8-LS3-2)
Biology	• The sequence of nucleotides spells out the information in a gene. (B-LS1-1) • DNA controls the expression of proteins by being transcribed into a "messenger" RNA, which is translated in turn by the cellular machinery into a protein. (B-LS1-1) • 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. (B-LS3-1)

K-12 Conceptual Vertical Articulation of LS3 – Heredity: Inheritance and Variation of Traits

LS3.B: Variation of Traits

Grade Band	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
K–2	• Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1)
3–5	• Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) • The environment affects the traits that an organism develops. (3-LS3-2)
6–8	• 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. (8-LS3-1) • 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. In asexual reproduction, an organism's DNA is replicated and passed to its offspring creating a genetic copy of the parent. (8-LS3-2)
Biology	• 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. (B-LS3-2) • 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. (B-LS3-2) (B-LS3-3)

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/