

## MS-LS3-1 Heredity: Inheritance and Variation of Traits

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.]

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

### Science and Engineering Practices

#### 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.

### Disciplinary Core Ideas

#### 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.

#### LS3.B: Variation of Traits

- 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.

### Crosscutting Concepts

#### 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.

### Observable features of the student performance by the end of the course:

1	Components of the model	
	a	Students develop a model in which they identify the relevant components for making sense of a given phenomenon involving the relationship between mutations and the effects on the organism, including:
	i.	Genes, located on chromosomes.
	ii.	Proteins.
	iii.	Traits of organisms.
2	Relationships	
	a	In their model, students describe* the relationships between components, including:
	i.	Every gene has a certain structure, which determines the structure of a specific set of proteins.
	ii.	Protein structure influences protein function (e.g., the structure of some blood proteins allows them to attach to oxygen, the structure of a normal digestive protein allows it break down particular food molecules).
	iii.	Observable organism traits (e.g., structural, functional, behavioral) result from the activity of proteins.
3	Connections	
	a	Students use the model to describe* that structural changes to genes (i.e., mutations) may result in observable effects at the level of the organism, including why structural changes to genes:
	i.	May affect protein structure and function.

	ii.	May affect how proteins contribute to observable structures and functions in organisms.
	iii.	May result in trait changes that are beneficial, harmful, or neutral for the organism.
b		Students use the model to describe* that beneficial, neutral, or harmful changes to protein function can cause beneficial, neutral, or harmful changes in the structure and function of organisms.