

HS-LS3-1 Heredity: Inheritance and Variation of Traits

California Science Test—Item Content Specifications

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

Students who demonstrate understanding can:

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

[*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*]

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Asking Questions and Defining ProblemsAsking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining and evaluating empirically testable questions and design problems using models and simulations.Ask questions that arise from examining models or a theory to clarify relationships. | LS1.A: Structure and Function7. 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. *(secondary to HS-LS3-1)* *(Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)*LS3.A: Inheritance of Traits5. 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. | Cause and EffectEmpirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. |

## Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

### Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

1.2 Ability to ask and evaluate scientific questions arising from examining models, explanations, and arguments to specify relationships between variables

### Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

1.2.1 Ability to ask questions that clarify and refine a model or an explanation

1.2.3 Ability to ask and/or evaluate questions that challenge the premise(s) of an argument, or provide interpretation of a data set

### Disciplinary Core Idea Assessment Targets

#### LS1.A.7

* Use representations and models of DNA to formulate questions to clarify the relationship between genes, the proteins they code for, and the resulting traits in organisms

#### LS3.A.5

* Use representations and models of DNA to formulate questions about the regulation of gene expression in a cell
* Use representations and models of DNA to formulate questions to clarify the relationship between non-protein coding genes and their functions in an organism

### Crosscutting Concept Assessment Target(s)

CCC2 Identify empirical evidence to differentiate between cause and correlation and make claims about specific causes and effects

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a scenario or model of gene expression and scientific questions about the scenario:

* Selects a question that correctly addresses the relationship between a chromosome and genes (1.2.1, LS1.A.7, LS3.A.5, and CCC2)
* Selects a question that correctly addresses the relationship between chromosomes and proteins produced by a cell (1.2.1, LS1.A.7, LS3.A.5, and CCC2)
* Selects a question that correctly addresses the relationship between chromosomes and non-protein coding regions of DNA (1.2.1, LS1.A.7, LS3.A.5, and CCC2)

Task provides a scenario of gene expression and an incomplete model of the scenario:

* Proposes a scientifically correct question about an aspect of gene expression that helps to revise or clarify the model (1.2.1, LS1.A.7, and LS3.A.5)

Task provides an argument containing incorrect information about gene expression:

* Asks a scientifically correct question that challenges the argument (1.2.3, LS1.A.7, LS3.A.5, and CCC2)

Task provides the genotypes of parental organisms and incorrect genotypes of the gametes produced by the organisms:

* Asks or selects a scientifically correct question, based on an understanding of chromosome movement during meiosis, that challenges the proposed genotypes of the gametes (1.2.3, LS1.A.7, LS3.A.5, and CCC2)

Task provides a Punnett square and incorrect conclusions about the phenotypes of offspring produced by a particular cross:

* Asks or selects a scientifically correct question that challenges the conclusions about the offspring phenotypes (1.2.3, LS1.A.7, LS3.A.5, and CCC2)

Task provides data about the types of proteins produced by a variety of cell types and an interpretation of the data stating that all cells produce the same types of proteins:

* Asks a scientifically correct question supported by evidence to challenge the interpretation (1.2.3, LS1.A.7, LS3.A.5, and CCC2)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Models that show the relationship between genes and chromosomes
* The relationship between genotype and phenotype using Punnett squares
* Models that compare the movement of chromosomes to the assortment of genetic traits during gamete formation
* Differential gene expression in cells with the same genotype but which display different phenotypes
* Inheritance patterns and genetic disorders

## Common Misconceptions

Note that the list in this section is not exhaustive.

* All regions of DNA code for proteins.
* The terms gene and chromosome can be used interchangeably.
* Cell types differ because their DNA genomes differ.
* Two cells that have the same genetic content also express the same genes.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS3-1 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS3-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)

The *2016 Science Framework for California Public Schools Kindergarten through Grade 12*

Appendix 1: Progression of the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts in Kindergarten through Grade 12 <https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix1.pdf>

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