

HS-LS3-2 Heredity: Inheritance and Variation of Traits

California Science Test—Item Content Specifications

# HS-LS3-2 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

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.

[Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process*.]

Continue to the next page for the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.  Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence. | 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.   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. | Cause and Effect Empirical 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.

7.1 Ability to construct scientific arguments

### 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.

7.1.1 Ability to identify evidence/data that supports a claim

7.1.2 Ability to develop scientific arguments that are supported by evidence/data

7.1.3 Ability to use reasoning to explain how relevant evidence/data supports or refutes the claim; the reasoning should reflect application of scientific concepts, principles, ideas, and models

### Disciplinary Core Idea Assessment Targets

#### LS3.B.6

* Describe that crossing over between chromosomes occurs during meiosis
* Describe that crossing over creates new genetic combinations in offspring, resulting in increased genetic variation
* Identify and describe genetic mutations that result from errors in DNA replication that can be a source of genetic variation
* Identify and describe genetic mutations that result from environmental factors that can be a source of genetic variation

#### LS3.B.7

* Describe that environmental factors can affect expression of traits
* Describe that, because environmental factors can affect expression of traits, the frequency of a trait in a population will be affected
* Explain that the variation of traits in a population depends on both genetic and environmental factors

### 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 data on genetic variation for a trait known to be determined by a gene on a particular chromosome in a population:

* Describes that crossing over is responsible for part or all of the variation (7.1.1, LS3.B.6, and CCC2)
* Describes that a genetic mutation is responsible for part or all of the variation (7.1.1, LS3.B.6, and CCC2)
* Describes that genetic mutations can result from environmental factors (7.1.2, LS3.B.6, and CCC2)

Task provides a model of DNA replication:

* Identifies potential types of mutations that occur during replication (7.1.2, LS3.B.6, and CCC2)
* Identifies the impact of the mutations on genetic variation in the population (7.1.2, LS3.B.6, and CCC2)

Task provides a simulation of a trait in a population in which specific environmental conditions can be manipulated:

* Describes how the environmental conditions will impact the expression of the trait (7.1.3, LS3.B.7, and CCC2)
* Describes how the genetic variation in the population will be altered (7.1.3, LS3.B.7, and CCC2)
* Explains that genetic variation depends on both environmental and genetic factors (7.1.3, LS3.B.7, and CCC2)

## California Environmental Principles and Concepts

* EP3: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
* EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* The effect of crossing over during meiosis on genetic variation among offspring
* Mutations
* Variable expression of traits due to environmental factors
* Comparison of two genetically similar populations expressing different phenotypes due to environmental conditions (e.g., rabbit fur color affected by different temperatures)

## Potential Misconceptions

Note that the list in this section is not exhaustive.

* Mutations in somatic cells are passed along to offspring and can impact genetic variation in a population.
* Mutations are always harmful.
* Radiation is the only environmental cause of mutation.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS3-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS3-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)

California Environmental Principles and Concepts <http://californiaeei.org/abouteei/epc/>

California Education and the Environment Initiative <http://californiaeei.org/>

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>

Appendix 2: Connections to Environmental Principles and Concepts <https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix2.pdf>

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