

HS-LS1-1 From Molecules to Organisms: Structures and Processes

California Science Test—Item Content Specifications

# HS-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

[*Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.*]

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 |
| --- | --- | --- |
| Constructing Explanations and Designing SolutionsConstructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. | LS1.A: Structure and Function1. Systems of specialized cells within organisms help them perform the essential functions of life.

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, which carry out most of the work of cells. (*Note: This Disciplinary Core Idea is also addressed by HS-LS3-1*.) | Structure and FunctionInvestigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. |

## 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.

6.1 Ability to construct explanations of phenomena

### 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.

6.1.1 Ability to construct quantitative and/or qualitative explanations of observed relationships based on valid and reliable evidence

6.1.2 Ability to apply scientific concepts, principles, theories, and big ideas to construct an explanation of a real-world phenomenon

6.1.3 Ability to use models and representations in scientific explanations

### Disciplinary Core Idea Assessment Targets

#### LS1.A.6

* Explain that multicellular organisms have specialized cells
* Explain that tissues are composed of specialized cells that contribute to functions necessary to maintain life

#### LS1.A.7

* Explain that all cells contain genes composed of DNA
* Explain that DNA contains coded information needed to synthesize proteins
* Explain that genes determine the primary structure of proteins
* Explain that proteins are critical to cell functioning
* Explain that all cells in an organism have the same genetic information, but that expression of the information varies, resulting in different cell types

### Crosscutting Concept Assessment Target(s)

CCC6 Perform a detailed examination of the properties of different materials, the structures of different components, and connections of components to design new systems that solve a problem

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides the nucleotide sequence of a particular segment of DNA:

* Explains how the structure of DNA determines the primary structure of proteins (i.e., amino acid sequence) (6.1.3, LS1.A.7, and CCC6)

Task provides two sequences of nucleotides from two different cells: a wild-type sequence and a variation of the wild-type sequence that contains a nucleotide deletion or addition in the coding region:

* Predicts if the cells will produce proteins encoded by these sequences that differ in structure or that the cell with the mutated sequence will not produce the protein at all (6.1.3, LS1.A.7, and CCC6)
* Explains how the differing nucleotide sequences can cause specialized cells of the same type to differ in phenotype (6.1.2, LS1.A.7, and CCC6)

Task provides information about specialized cells in multicellular organisms from published sources, laboratory data, or simulations:

* Uses the information to support a claim that specialized cells within organisms work together to support the essential functions of life (6.1.2, LS1.A.6, and CCC6)

Task provides a model with undifferentiated stem cells and differentiated specialized cells:

* Uses the model to explain that all the cells have the same DNA sequences, but the differentiated specialized cells express (use) different genes (DNA sequences) and so contain different proteins, which causes them to have specialized functions (6.1.3, LS1.A.7, and CCC6)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Differential gene expression allows cells with the same genetic sequence to express different genes and produce different proteins
* Allelic variations of genes result in proteins of slightly different primary structures in different individuals of the same species.
* Mechanisms such as jumping genes and viral transduction increase variability by introducing genetic material that could produce functional proteins
* Effects of radiation on the structure of DNA and resulting proteins

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Cell types with specialized structures or functions differ in their DNA sequences.
* Changes to the nucleotide sequence of DNA always prevent a protein from being synthesized.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS1-1 Evidence [Statement](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS1-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS1-1%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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