# Life Sciences—High School

# Alternate Item Content Specifications

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HS-LS1-2 From Molecules to Organisms: Structures and Processes

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Using model(s), identify that different systems of the body carry out essential functions (e.g., digestive system, respiratory system, circulatory system, nervous system). | 1. Ability to identify how the digestive system of the body carries out essential functions (e.g., breakdown and absorption of fats, proteins, and carbohydrates).
2. Ability to identify how the respiratory system of the body carries out essential functions (e.g., movement of oxygen to the body).
3. Ability to identify how the circulatory system of the body carries out essential functions (e.g., movement of blood and nutrients throughout the body).
4. Ability to identify how the nervous system of the body carries out essential functions (e.g., brain controls body movement, breathing, and heartbeat; brain processes physical sensations).
 | Identify which organ performs a specific function. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] *[Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]*

### Mastery Statements

Students will be able to:

* Identify the function of the brain, stomach, lungs, or heart
* Identify the function of the digestive system
* Identify the function of the respiratory system
* Identify the function of the circulatory system
* Identify the function of the nervous system
* Recognize how the digestive system works
* Recognize how the respiratory system works
* Recognize how the circulatory system works
* Recognize how the nervous system works

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Circulatory system
* Respiratory system
* Digestive system
* Nervous system

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS1-2

[https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls1-2.docx](https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls1-2.docx%22%20%5Co%20%22California%20Science%20Test%20Item%20Specification%20for%20HS-LS1-2)

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

The *2016 Science Framework for California Public Schools Kindergarten through Grade Twelve* <https://www.cde.ca.gov/ci/sc/cf/cascienceframework2016.asp>

Appendix 1: Progression of the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts in Kindergarten through Grade Twelve

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#

HS-LS1-4 From Molecules to Organisms: Structures and Processes

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Identify how growth occurs when cells multiply (mitosis) by using a model. | 1. Ability to use a model to identify how organisms grow in size through the process of mitosis.
 | Recognize that organisms are composed of a collection of different types of cells. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** *[Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]*

### Mastery Statements

Students will be able to:

* Identify an example of a structure made of more than one kind of cell
* Recognize organisms that are made of more than one kind of cell
* Recognize an example of an organism growing by increasing the number of cells
* Identify examples of cell division
* Identify the correct order for the process of one cell dividing to become up to four cells

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Examples of multicellular and unicellular organisms
* Examples of body parts composed of different types of cells
* Simple models of cell division

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS1-4

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls1-4.docx>

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##

HS-LS1-6 From Molecules to Organisms: Structures and Processes

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Identify a model that demonstrates how organisms take in matter (allowing growth and maintenance) and rearrange the atoms to make new structures in chemical reactions. | 1. Identify a model which demonstrates how animals take in matter and rearrange molecules to grow
2. Identify a model which demonstrates how plants take in matter and rearrange molecules to grow.
 | Recognize that all organisms take in matter in order for growth to occur. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] *[Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]*

### Mastery Statements

Students will be able to:

* Recognize that food is needed for animals to grow
* Recognize parts of the body used to process food
* Identify water, light, and air are needed for plants to grow
* Recognize that plants make their own food from other materials
* Identify examples of an animal growing due to the intake food
* Identify examples of a plant growing due to the intake of water, light, and air

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Plant growth
* People eat food to grow
* The digestive system in common animals as well as humans
* Animals eat food to grow

### Additional Assessment Boundaries

* Body systems should be those in common animals that are large enough to be clearly and simply shown.

### Additional References

California Science Test Item Specification for HS-LS1-6

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls1-6.docx>

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##

HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Use mathematical representations (e.g., trends, averages, graphs) to identify dependencies of an animal population on other organisms for food and their environment for shelter. | 1. Ability to use mathematical representations to identify dependencies of an animal population on other organisms for food and their environment for shelter.
 | Identify factors (e.g., competition) that affect the numbers of organisms in an ecosystem. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.** [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] *[Assessment Boundary: Assessment is limited to provided data.]*

### Mastery Statements

Students will be able to:

* Recognize the effect on a population of organisms when there is a significant increase or decrease in the availability of food or shelter
* Use data from a graph or data table to identify the effect on a population of organisms of an increase or decrease in food or shelter resources
* Use data from a graph or data table to identify the cause of a change in the size of a population of organisms

### Environmental Principles and Concepts

Principle 1—The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Principle 2—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 or prescriptive.*

**Possible contexts include the following:**

* Resource availability—an increase or decrease in the availability of food, water, and shelter
* Competition, including an increase or decrease in the number of the same kind of organism that uses a resource or the introduction of new organisms that would use a resource
* Drought or extreme weather conditions
* Significant change to an ecosystem, including the complete eradication of a forest or body of water, or the elimination of an animal population
* Tables or graphs that present changes over time in the numbers and types of organisms in a given ecosystem

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS2-2

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls2-2.docx>

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##

HS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Using a graphical representation, identify the changes in the amount of matter or energy as it travels through an energy pyramid or food web. | 1. Ability to identify using a graphical representation the changes in the amount of matter as it travels through an energy pyramid or food web.
2. Ability to identify using a graphical representation the changes in the amount of energy as it travels through an energy pyramid or food web.
 | Recognize that there are generally fewer organisms at higher levels of an energy pyramid or food web (e.g., a graphical representation) than at lower levels. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen, and nitrogen being conserved as they move through an ecosystem.] *[Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.]*

### Mastery Statements

Students will be able to:

* Recognize that there are fewer organisms at higher levels in an energy pyramid, food chain, or food web
* Recognize that energy or matter decreases when moving to higher levels in an energy pyramid or food web

### Environmental Principles and Concepts

Principle 1—The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Principle 2—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 or prescriptive.*

**Possible contexts include the following:**

* The flow of energy through a food web or ecosystem, e.g. plants obtain energy from the Sun, an insect obtains energy by eating the plant, an animal obtains energy by eating the insect
* The cycling of matter through a food web or ecosystem, e.g. the matter produced by photosynthesis in plants is consumed by an animal such as a rabbit and then the rabbit is consumed by another animal, such as a coyote
* The numbers of organisms found at each trophic level, e.g. one mouse eats many plants, and one bobcat eats many mice, so the number of organisms decreases as you move up a matter or energy pyramid

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS2-4

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls2-4.docx>

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##

HS-LS2-8 Ecosystems: Interactions, Energy, and Dynamics

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Identify evidence supporting the outcome of group behavior (e.g., predation, life expectancy) on species’ chances to survive and reproduce. | 1. Ability to identify evidence supporting an outcome of group behavior.
 | Identify an example of group behavior (e.g., flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming). |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce.** [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]

### Mastery Statements

Students will be able to:

* Identify animals acting as a group
* Recognize different types of group behavior
* Identify an outcome of group behavior
* Recognize that group behavior helps animals survive

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Colonizing insects, such as bees and ants
* Penguins grouping together for warmth
* Herbivores watching for danger and issuing a warning
* Beavers building dams
* Birds building a group nest

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS2-8

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls2-8.docx>

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##

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

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Identify a model showing evidence that parents and offspring may have different traits. | 1. Identify examples of offspring who have different combinations of traits inherited from their parents.
 | Identify traits in offspring that are different from those of the parents. |

### CA NGSS Performance Expectation

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.]*

### Mastery Statements

Students will be able to:

* Identify offspring with traits different from those of their parents
* Identify offspring with combinations of traits different from those of their parents

### Environmental Principles and Concepts

Principle 1—Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.

Principle 2—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 or prescriptive.*

**Possible contexts include the following:**

* Plants or animals and their offspring
* Traits may include coat color and texture or length, tail shape, shape of head or ears, flower color, hair color or eye color

### Additional Assessment Boundaries

* No reference should be made to meiosis.

### Additional References

California Science Test Item Specification for HS-LS3-2

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls3-2.docx>

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

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##

HS-LS4-3 Biological Evolution: Unity and Diversity

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Recognize that data can be used to determine that organisms with advantageous heritable traits will increase in proportion over a period of time. | 1. Ability to use data to recognize that while the total number of individuals in a population may remain relatively constant, the traits represented in that population can change in response to environmental change.
 | Recognize that traits that positively affect survival are more likely to be passed on to offspring. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.** [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] *[Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]*

### Mastery Statements

Students will be able to:

* Identify which organism will most likely survive in a given environment based on a trait
* Recognize that beneficial traits promote survival
* Recognize that beneficial traits are more likely to be passed to offspring
* Identify which organism is more likely to have offspring based on varying traits in a given environment
* Recognize ways traits can change in a population based on environmental change
* Use data to identify a change in the environment which has led to an increase in the frequency of a specific trait

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* A specific variation of a trait is observed to increase over time in a given population in a given environment.
* Two populations of the same species are in two different habitats. Each population has a different variation of an advantageous trait based on features of the habitats.
* Habitats that clearly require specific adaptations to survive and reproduce successfully.

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS4-3

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls4-3.docx>

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##

HS-LS4-6 Biological Evolution: Unity and Diversity

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Analyze data to determine a potential solution to mitigate adverse impacts of human activity on biodiversity. | 1. Ability to look at data and determine that there is a solution to mitigate adverse impacts of human activity on biodiversity.
 | Recognize that human activities can affect biodiversity. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.** [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

### Mastery Statements

Students will be able to:

* Recognize examples of human activities that support an increase in biodiversity
* Recognize examples in which a population of organisms is reduced as a result of human activity
* Identify data that support the claim that a human activity increased biodiversity

### Environmental Principles and Concepts

Principle 1—Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.

Principle 2—Methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.

Principle 3—The expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.

Principle 4—The legal, economic, and political systems that govern the use and management of natural systems directly influence the geographic extent, composition, biological diversity, and viability of natural systems.

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Fishing practices that protect juvenile fish and non-fish species
* The use of certain polluting herbicides and pesticides
* The destruction of habitat for development
* The degree of global climate change
* Human population growth

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-LS4-6

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ls4-6.docx>

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