

HS-PS3-2 Energy

California Science Test—Item Content Specifications

# HS-PS3-2 Energy

Students who demonstrate understanding can:

Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

[Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

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 |
| --- | --- | --- |
| Developing and Using Models  Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.  Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. | PS3.A: Definitions of Energy  9. Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.  10. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.  11. These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. | Energy and Matter  Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems. |

## 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.

2.1 Ability to develop models

2.2 Ability to use models

### 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.

2.1.1 Ability to determine components of a scientific event, system, or design solution

2.1.2 Ability to determine the relationships among multiple components of a scientific event, system, or design solution

2.1.3 Ability to determine scope, scale, and grain-size of models, as appropriate for their intended use

2.1.4 Ability to represent mechanisms, relationships, and connections to illustrate, explain, or predict a scientific event

2.2.1 Ability to use models to identify concepts and relationships represented in the models

2.2.2 Ability to use models to generate explanations and predictions about a scientific phenomenon

### Disciplinary Core Idea Assessment Targets

#### PS3.A.9

* Describe that energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system
* Describe that energy is transferred from one object to another and between different forms of energy but that the total energy of the system is conserved at both the macroscopic and microscopic scales unless energy is transferred into or out of the system, in which case the total energy of the system and its surroundings is conserved

#### PS3.A.10

* Recognize forms of energy at the macroscopic scale—including motion, sound, light, and thermal energy—and energy stored in gravitational, magnetic, and electric fields
* Use concepts of kinetic and potential energy to describe matter on the atomic/molecular and macroscopic scales

#### PS3.A.11

* Describe that energy at the microscopic scale is a combination of the energy associated with the motion of particles (kinetic energy) and the energy associated with the relative position of particles (potential energy)
* Describe that electromagnetic radiation is a form of energy stored in oscillating electric and magnetic fields

### Crosscutting Concept Assessment Target(s)

CCC5 Identify that energy cannot be created or destroyed; it only moves between places, between objects and/or fields, or between systems

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides both a description of a system and a list of relevant and irrelevant components to model the system:

* Selects the relevant components that account for the energy changes of the system at a macroscopic scale (2.1.1, PS3.A.9, and CCC5)

Task provides a diagram illustrating an object in a gravitational field:

* Selects the relative amounts of potential and kinetic energy associated with the object as it moves through the field (2.1.1, PS3.A.11, and CCC5)

Task provides both a description of energy changes in a system and a list of components with multiple scales:

* Selects the components with the appropriate scale to illustrate the energy changes (2.1.2, PS3.A.9, and CCC5)

Task provides representations (labels, arrows, text) to illustrate a behavior related to an energy change in a system:

* Selects the representation that best illustrates the energy change (2.1.3, PS3.A.10, and CCC5)

Task provides an interactive model that can be used to generate evidence to support a hypothesis about the change to a system when energy is added:

* Uses the interactive model to generate evidence to support or refute the hypothesis (2.2.1, PS3.A.9, and CCC5)

Task provides evidence generated from a model of energy changes in a system:

* Uses the evidence to identify the relationship between the components of the model (2.2.1, PS3.A.9, and CCC5)

Task provides a model that illustrates energy changes in a system:

* Uses the model to make a prediction about a change in the system (2.2.2, PS3.A.9, and CCC5)
* Uses the model to explain energy changes in the system (2.2.2, PS3.A.9, and CCC5)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Ball rolling down a hill
* Pendulum swinging
* Expanding or compressing a gas in a cylinder with a piston
* Propagation of sound waves in water or air
* Transfer of energy in systems with multiple components and forms of energy

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Energy can be created or destroyed.
* Lighter objects move faster than heavier ones.
* Thermal energy is independent of the material nature of the object.
* The gravitational potential energy of an object depends upon the path the object takes to get to the distance above the reference points.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-PS3-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-PS3-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-2%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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