

4-PS3-4 Energy

California Science Test—Item Content Specifications

# 4-PS3-4 Energy

Students who demonstrate understanding can:

Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

[Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.][*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*]

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 Solutions  Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.  Apply scientific ideas to solve design problems. | PS3.B: Conservation of Energy and Energy Transfer   1. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.   PS3.D: Energy in Chemical Processes and Everyday Life   1. The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.   ETS1.A: Defining Engineering Problems   1. Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account*.(secondary to 4-PS3-4)* | Energy and Matter  Energy can be transferred in various ways and between objects.  Connections to Engineering, Technology, and Applications of Science  Influence of Engineering, Technology, and Science on Society and the Natural World  Engineers improve existing technologies or develop new ones.  Connections to Nature of Science  Science is a Human Endeavor  Most scientists and engineers work in teams.  Science affects everyday life. |

## 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.

6E.1 Ability to solve design problems

6E.2 Ability to evaluate and/or refine solutions to design problems

### 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.

6E.1.4 Ability to apply relevant scientific knowledge and/or evidence in designing solutions

6E.2.1 Ability to compare or critique competing design solutions based on design criteria

6E.2.2 Ability to evaluate and/or refine (optimize) design solutions based on scientific knowledge or evidence

### Disciplinary Core Idea Assessment Targets

#### PS3.B.4

* Recognize that electric current transfers energy from place to place
* Describe that electrical energy can be transformed into motion, light, sound, and/or heat energy
* Describe that the energy of motion can be transformed into electrical energy

#### PS3.D.1

* Recognize that energy can be stored in one form (e.g., chemical energy) and later converted to a more usable form (e.g., electrical energy)

#### ETS1.A.4

* Identify the criteria of a device design intended for the specific transformation of energy from one form to another
* Identify the constraints of a design (e.g., materials, costs, and safety)
* Evaluate designs based on the specified criteria and constraints

### Crosscutting Concept Assessment Target(s)

CCC5 Describe how energy can be transferred in various ways between objects

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a description of a problem to be solved by a device that converts one form of energy to another and a design solution:

* Identifies the scientific concepts (e.g., conversion of energy from one form to another) underlying the performance of the device (6E.1.4, PS3.B.4, and CCC5)

Task provides a description of a problem to be solved by a device that converts one form of energy to another, multiple design solutions, and criteria (e.g., a particular type of energy conversion):

* Selects the design solution(s) that best meet(s) the criteria (6E.2.1, PS3.B.4, and CCC5)

Task provides a description of a problem that can be solved by a device that converts one form of energy to another, multiple design solutions, and relevant data/evidence for each design solution, and a prioritized criteria or constraint:

* Selects the best design from among multiple designs and provides justification for the selection based on prioritized criteria or constraint (6E.2.1, ETS.1.A.4, and CCC5)

Task provides a description of a problem to be solved by a device that converts one form of energy to another and a refinement to a prototype device:

* Identifies the scientific explanation(s) that supports the effectiveness of the refinement to the design (6E.2.2, PS3.B.4, and CCC5)

Task provides a description of a problem to be solved by a device that converts one form of energy to another, a list of possible refinements to the prototype device, relevant data/evidence for each refinement, and a prioritized criteria or constraint:

* Selects the best refinement(s) and provides justification for the selection(s) based on the data/evidence (6E.2.2, ETS.1.A.4, and CCC5)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Simple electrical circuits with sound, light, or motion components
* Devices that convert electrical energy to mechanical energy, and vice versa
* Devices that convert solar power into mechanical energy or thermal energy
* Devices that convert elastic potential energy into mechanical energy
* Basic household appliances that convert electrical energy to sound, light, or motion

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Energy is found only in living things.
* Energy is created rather than converted from one form to another.
* Energy is destroyed during the conversion from one form to another.
* Batteries generate the electrons that move in a circuit.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

4-PS3-4 Evidence Statement

<https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/4-PS3-4%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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