

Educational Resources from *Phenomenon Science Education*

Student Proficiency Goals for **NGSS MS-PS1-6**



Information about MS-PS1-6

NGSS Performance Expectation MS-PS1-6.

Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*

Clarification Statement.

Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.

Assessment Limits.

Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.

Science and Engineering Practice (Constructing Explanations and Designing Solutions)

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

Disciplinary Core Idea (PS1.B: Chemical Reactions)

- Some chemical reactions release energy, others store energy.

Disciplinary Core Idea (ETS1.B: Developing Possible Solutions)

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary).

Disciplinary Core Idea (ETS1.C: Optimizing the Design Solution)

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (secondary)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary)

Crosscutting Concept (Energy and Matter)

- The transfer of energy can be tracked as energy flows through a designed or natural system.

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Student Proficiency Goals for **NGSS MS-PS1-6**



Student Proficiency Goals

SEP (Constructing Explanations and Designing Solutions):

- Students design a device, to solve specific problems, that either releases or absorbs thermal energy through a chemical reaction using given design criteria and constraints.
- Students construct and test their device according to their designs, and the given criteria and constraints.
- Students revise and modify their device to better meet design criteria and constraints.

DCI (PS1.B Chemical Reactions):

- Students know that chemical reactions can release energy or absorb energy for storage.
- Students know that the concentration or the form of a substance can be changed to control the flow of energy in a chemical reaction.

DCI (ETS1.B Developing Possible Solutions):

- Students know that the design process includes testing and modifying their designs to address test results.

DCI (ETS1.C Optimizing the Design Solution):

- Students know that identifying positive and negative aspects of their designs in different tests can provide useful information for design revision.
- Students know that creating the best design involves an iterative process of design, testing, and redesign.

CCC (Energy and Matter):

- Students consider energy flow in chemical reactions.
- Students recognize that transfer of energy can be tracked as energy flow through a natural or designed system.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.