MS-ETS1-1 Engineering Design

Students who demonstrate understanding can:

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	**ETS1.A: Defining and Delimiting Engineering Problems** 5. The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	**Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

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.

1E.2 Ability to define a design problem

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.

1E.2.1 Ability to define a design problem that would lead to the development or improvement of an object or tool based on an understanding of science concepts and usability considerations

Disciplinary Core Idea Assessment Targets

ETS1.A.5a Describe a problem that is solvable by developing a tool, object, process, or system

ETS1.A.5b Identify features of the system that bound the problem such as:

- The relevant stakeholders
- The needs that are to be met by the solution
- Issues are related to the problem
- The environmental and societal impacts of the solution
- How stakeholders rate the relative importance of the different issues and components of the system

ETS1.A.5c Identify the major components, including their relationships within the system, and the system boundaries in order to clarify the definition of the problem

ETS1.A.5d Define criteria for the solution, including meeting the needs of the individuals that need the problem solved and comparisons of different solutions (qualitative and/or quantitative)

ETS1.A.5e Define constraints for the solution, including safety, other related issues, needs of individuals and/or groups, desires of individuals and/or groups, potential effects on individuals and/or groups, potential negative environmental effects of the solution, potential failure to solve the problem, and/or the time, materials, and cost for solving the problem

Crosscutting Concept Assessment Target(s)

Not applicable.

Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a scenario that provides the basis for a design problem:

- Generates a problem definition or student selects the best problem definition from among a list of alternatives (1E.2.1 and ETS1.A.5)

Task provides a problem statement that is incomplete or insufficiently defined:

- Selects phrase(s) from a list of both relevant and irrelevant/inappropriate phrases to complete or better define the problem (1E.2.1 and ETS1.A.5)

Task provides a scenario that provides the basis for a design problem and states the design problem:

- Suggests an improvement that could be made to the stated design problem including (but not limited to) adding criteria, adding constraints, or adding considerations for testing the solution (1E.2.1 and ETS1.A.5)

Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

- Pollution (air or water)
- Water conservation
- Oil spills
- Air quality
- Endangered species
- Bioengineering scenarios, including artificial limbs

- Sustainable design, including green buildings and hazard-resistant structures

Common Misconceptions

Note that the list in this section is not exhaustive.

- A problem only has one true solution.
- Some problems cannot be solved.
- A solution can be perfect, with no limitations or drawbacks.
- Everyone will benefit from the best solution.

Additional Assessment Boundaries

None listed at this time.

Additional References

MS-ETS1-1 Evidence Statement https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ETS1-1%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