# Grade 8 STEM Unit 1: The Engineering Design Process and Simple Machines

Content Area: **STEM**
Course(s): **STEM Grade 8**
Time Period: **MP1**
Length: **8 days**
Status: **Published**

## NJSLS - Science

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| MS-ETS1-1 | 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. |
| MS-ETS1-2 | Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. |
| MS-ETS1-3 | Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. |
| MS-ETS1-4 | Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. |

## Science and Engineering Practices

### Asking Questions and Defining Problems

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. (MS-ETS1-1)

### Developing and Using Models

Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

### Analyzing and Interpreting Data

Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

### Engaging in Argument from Evidence

Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

## Disciplinary Core Ideas

**ETS1.A: Defining and Delimiting Engineering Problems**

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. (MS-ETS1-1)

**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. (MS-ETS1-4)

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MSETS1-2), (MS-ETS1-3)

Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MSETS1-3)

Models of all kinds are important for testing solutions. (MS-ETS1-4)

**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 those characteristics may be incorporated into the new design. (MS-ETS1-3)

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. (MS-ETS1-4)

## Crosscutting Concepts

**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. (MS-ETS1-1)

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. (MS-ETS1-1)

## Rationale and Transfer Goals

Building on their previous exposure to Simple Machines and Engineering Design, this unit focuses on extending students' understanding to more complex engineering challenges. By deepening their grasp of the principles of simple machines and the engineering design process, students will develop the skills and mindset necessary for innovative problem-solving and design.

## Enduring Understandings

Simple machines are foundational components in various mechanical systems.

The engineering design process is iterative and involves identifying problems, generating solutions, prototyping, testing, and refining designs.

## Essential Questions

How do simple machines influence the efficiency and effectiveness of complex mechanical systems?

How can the engineering design process be utilized to solve multifaceted problems and create innovative solutions?

What connections exist between the principles of simple machines, engineering design, and real-world applications?

## Content - What will students know?

- Advanced Understanding of Simple Machines
- Real-world application of simple machines, both past and present.
- The Engineering Design Principles

## Skills - What will students be able to do?

- Compare and Contrast the different types of Simple Machines
- Identify challenges and iterate on solutions
- Apply Engineering Design Principles
- Build and test prototypes

## Activities - How will we teach the content and skills?

- Simple machines notes and Class discussion
- Simple Machines Kahoot and/or Baamboozle game
- Design a carnival style game using simple classroom materials
- Build a structure using K'Nex

## Evidence/Assessments - How will we know what students have learned?

- Question and answer worksheet accompanying google slides Pre/post quiz
- Final Builds for projects
- Formative Assessments

## Spiraling for Mastery

| Content or Skill for this Unit | Spiral Focus from Previous Unit | Instructional Activity |
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| Engineering design process | Previous grade level introduction to Simple Machines and Engineering Design process. | Reflect on the similarities and differences between the engineering design process applied to simple machines and the more complex challenges in this unit. |

## Key Resources

- www.teachengineering.org
- www.awea.org
- www.energyquest.ca.gov/
- www.eia.gov/kids/
- www.nrel.gov

## 21st Century Life and Careers

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| 9.2.8.CAP.12 | Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential. |

## Career Readiness, Life Literacies, & Key Skills

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| 9.4.8.CT.1 | Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2). |
| 9.4.8.CT.2 | Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1). |
| 9.4.8.CT.3 | Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome. |

## Interdisciplinary Connections/Companion Standards

**NJSLS ELA**

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2), (MS-ETS1-3)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4)

**NJSLS Mathematics**

MP.2 Reason abstractly and quantitatively. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4)

7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3)

7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)