3.ETS1.A: Defining and Delimiting Engineering Problems

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. (3-5-ETS1-1)

3.ETS1.B: Developing Possible Solutions

Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

3.ETS1.B: Developing Possible Solutions

At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
3.ETS1.B: Developing Possible Solutions

Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

3.ETS1.C: Optimizing the Design Solution

Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

3.PS3.B: Conservation of Energy and Energy Transfer

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. (4-PS3-4)
The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

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. (4-PS3-4)

Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)
3.EVS1.C: Optimizing the Design Solution
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (4-PS4-3)

3.EVS3.B: Natural Hazards
A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (4-ESS3-2)

3.EVS1.B: Developing Possible Solutions
Testing a solution involves investigating how well it performs under a range of likely conditions. (4-ESS3-2)
Performance Expectation

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Clarification Statement: none
Assessment Boundary: none

Performance Expectation

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Clarification Statement: none
Assessment Boundary: none

Performance Expectation

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Clarification Statement: none
Assessment Boundary: none
Performance Expectation

4-PS3-4: 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.

Performance Expectation

4-PS4-3: Generate and compare multiple solutions that use patterns to transfer information.

Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1’s and 0’s representing black and white to send information about a picture, and using Morse code to send text.

Assessment Boundary: none

Performance Expectation

4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.

Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.
Science and Engineering Practice

**Asking Questions and Defining Problems**

Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

---

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

---

**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.

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)
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. (4-PS3-4)

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.

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

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.

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)
Crosscutting Concept

**Energy and Matter**

Energy can be transferred in various ways and between objects. (4-PS3-4)

Crosscutting Concept

**Patterns**

Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Crosscutting Concept

**Cause and Effect**

Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2)
People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies. (3-5-ETS1-1)

Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (3-5-ETS1-2)

Science affects everyday life. (4-PS3-4)
Science Is a Human Endeavor
Most scientists and engineers work in teams. (4-PS3-4)

Influence of Science, Engineering, and Technology on Society and the Natural World
Engineers improve existing technologies or develop new ones. (4-PS3-4)

Interdependence of Science, Engineering, and Technology
Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)
Influence of Science, Engineering, and Technology on Society and the Natural World

Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Reading Informational Text

RI.5.1 - Key Ideas and Details

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2)

Reading Informational Text

RI.5.7 - Integration of Knowledge and Ideas

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS1-2)
Reading Informational Text
RI.5.9 - Integration of Knowledge and Ideas
Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2)

Card Type name
W.5.7 - Research to Build and Present Knowledge
Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1), (3-5-ETS1-3)

Card Type name
W.5.8 - Research to Build and Present Knowledge
Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-1), (3-5-ETS1-3)
Common Core State Standards for ELA/Literacy

<table>
<thead>
<tr>
<th>Card Type name</th>
<th>W.5.9 - Research to Build and Present Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1), (3-5-ETS1-3)</td>
</tr>
</tbody>
</table>

Common Core State Standards for Mathematics

<table>
<thead>
<tr>
<th>Card Type name</th>
<th>3.OA - undefined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operations and Algebraic Thinking (3-5-ETS1-1), (3-5-ETS1-2)</td>
</tr>
</tbody>
</table>

Common Core State Standards for Mathematics

<table>
<thead>
<tr>
<th>Mathematical Practices</th>
<th>MP.2 - Reason abstractly and quantitatively</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CCSS text (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)</td>
</tr>
</tbody>
</table>
Common Core State Standards for Mathematics

Mathematical Practices
MP.4 - Model with mathematics
CCSS text (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)

Common Core State Standards for Mathematics

Mathematical Practices
MP.5 - Use appropriate tools strategically
CCSS text (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)