3-5. Engineering Design

Students who demonstrate understanding can:

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.

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.

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.

The performance expectations above were developed using the following elements from the NRC document: A Framework for K-12 Science Education:

Science and Engineering Practices

<table>
<thead>
<tr>
<th>Asking Questions and Defining Problems</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
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<tr>
<td>Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</td>
<td>ETS1A: Defining and Delimiting Engineering Problems</td>
<td>Influence of Science, Engineering, and Technology on Society and the Natural World</td>
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<tr>
<td>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)</td>
<td>• 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)</td>
<td>• People’s needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)</td>
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<td>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.</td>
<td>ETS1B: Developing Possible Solutions</td>
<td>• Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)</td>
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<td>• 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)</td>
<td>• 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)</td>
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<td>Constructing Explanations and Designing Solutions</td>
<td>ETS1C: Optimizing the Design Solution</td>
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<tr>
<td>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.</td>
<td>• 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)</td>
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<td>• 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)</td>
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Connections to 3-5-ETS1-A: Defining and Delimiting Engineering Problems include:

Fourth Grade: 4-ESS3-4

Connections to 3-5-ETS1-B: Designing Solutions to Engineering Problems include:

Fourth Grade: 4-ESS3-2

Connections to 3-5-ETS1-C: Optimizing the Design Solution include:

Fourth Grade: 4-PS3-3

Articulation of DCIs across grade-bands: K-2.ETS1.A (3-5-ETS1-1); 3-5-ETS1-1 and 3-5-ETS1-2; 3-5-ETS1-3; ETS1.A (3-5-ETS1-1); MS.ETS1.A (3-5-ETS1-1); MS.ETS1.B (3-5-ETS1-1); MS.ETS1.C (3-5-ETS1-1); MS.ETS1.C (3-5-ETS1-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 | Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2)

RI.5.7 | 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)

RI.5.9 | Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2)

W.5.7 | Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-3)

W.5.8 | 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-ETS1-2)

W.5.9 | Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1), (3-5-ETS1-3)

Mathematics –

MP.2 | Reason abstractly and quantitatively. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)

MP.4 | Model with mathematics. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)

MP.5 | Use appropriate tools strategically. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)

3-5-0A | Operations and Algebraic Thinking (3-5-ETS1-1), (3-5-ETS1-2)