Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

K-2-ETS1-1 Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-1. **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**

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

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.

- Ask questions based on observations to find more information about the natural and/or designed world(s).
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

Crosscutting Concepts

Observable features of the student performance by the end of the grade:		
1	Addressing phenomena of the natural or designed world	
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:
		i. A given situation that people wish to change.
		ii. Why people want the situation to change.
		iii. The desired outcome of changing the situation.
2	Identifying the scientific nature of the question	
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.
3	Identifying the problem to be solved	
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.
4	Defining the features of the solution	
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.

K-2-ETS1-2 Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

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

Science and Engineering Practices

Developing and Using Models

Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Develop a simple model based on evidence to represent a proposed object or tool.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:
		i. The object.
		ii. The relevant shape(s) of the object.
		iii. The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.
2	Relationships	
	a	Students identify relationships between the components in their representation, including:
		i. The shape(s) of the object and the object's function.
		ii. The object and the problem is it designed to solve.
3	Connections	
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.

K-2-ETS1-3 Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended.	**ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.
2	Identifying relationships	
	a	Students use their organization of the data to find patterns in the data, including:
		i. How each of the objects performed, relative to:
		1. The other object.
		2. The intended performance.
		ii. How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3	Interpreting data	
	a	Students use the patterns they found in object performance to describe*:
		i. The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		ii. The strengths and weaknesses of each design.
		iii. Which object is better suited to the desired function, if both solve the problem.

3-5-ETS1-1 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.

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

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in 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.

Disciplinary Core Ideas

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.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies.

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people's needs and wants change over time.
2	Defining the boundaries of the system	
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3	Defining the criteria and constraints	
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

3-5-ETS1-2 Engineering Design

Students who demonstrate understanding can:

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.

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

Science and Engineering Practices

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.

Disciplinary Core Ideas

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.
- 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.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

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

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

3-5-ETS1-3 Engineering Design

Students who demonstrate understanding can:

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 expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices

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.

Disciplinary Core Ideas

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.

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.

Crosscutting Concepts

Observable features of the student performance by the end of the grade:			
1	Identifying the purpose of the investigation		
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.	
2	Identifying the evidence to be address the purpose of the investigation		
	a	Students describe* the evidence to be collected, including:	
		i.	How well the model/prototype performs against the given criteria and constraints.
		ii.	Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii.	Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.	
3	Planning the investigation		
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:	
		i.	The specific criterion or constraint to be used.
		ii.	What is to be changed in each trial (the independent variable).
		iii.	The outcome (dependent variable) that will be measured to determine success.
		iv.	What tools and methods are to be used for collecting data.
		v.	What is to be kept the same from trial to trial to ensure a fair test.
4	Collecting the data		
	a	Students carry out the investigation, collecting and recording data according to the developed plan.	