2nd Grade – Thematic Model – Bundle 1
Matter

This is the first bundle of the 2nd Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the questions "How do we design better products?"

Summary
The bundle organizes performance expectations with a focus on engineering design and the study of matter. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
The idea that matter can be described and classified by its observable properties (PS1.A as in 2-PS1-1) connects to the idea that different properties of matter are suited to different purposes (PS1.A as in 2-PS1-2 and 2-PS1-3).

The engineering design idea that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-2-ETS1-1) could connect to multiple science concepts such as that different properties are suited to different purposes (PS1.A as in 2-PS1-2 and 2-PS1-3) and that matter can be described and classified by its observable properties (PS1.A as in 2-PS1-1). The first connection could be made by challenging students to define a problem caused by using an unsuitable material. The second connection could be made by having students first identify a situation related to the properties of materials that people want to change, and then write about how they would approach that situation as a problem that can be solved through engineering.

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of asking questions and defining problems (K-2-ETS1-1); planning and carrying out investigations (2-PS1-1); analyzing and interpreting data (2-PS1-2); and constructing explanations and designing solutions (2-PS1-3). Many other practice elements can be used in instruction.

Bundle Crosscutting Concepts
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (2-PS1-1); Cause and Effect (2-PS1-2); and Energy and Matter (2-PS1-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	**2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.] **2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: Assessment of quantitative measurements is limited to length.*] **2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

Performance Expectations (Continued)	**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**
Example Phenomena	A platform made of crayons glued together supports more weight at room temperature than it does outside on a hot summer day. Cotton fabric is not used to make drinking cups.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students *could identify questions that can be answered by an investigation* [about whether] ***different kinds of matter can be either solid or liquid, depending on temperature***. 2-PS1-1 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could develop a model to represent patterns [between] ***properties of different*** [materials and their] ***purposes***. 2-PS1-1 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. Students could *make observations and measurements* [to] ***classify matter by its observable properties*** 2-PS1-1 **Analyzing and Interpreting Data** ● Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. Students could *use firsthand observations to describe the pattern* [that] ***a great variety of objects can be built from a small set of pieces***. 2-PS1-3 **Using Mathematical and Computational Thinking** ● Decide when to use qualitative vs. quantitative data. Students could *decide when to use qualitative vs. quantitative data* [when] ***describing and classifying matter by its observable properties***. 2-PS1-1 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students could *compare multiple solutions to a problem* [caused by the fact that] ***matter can be either solid or liquid, depending on temperature***. 2-PS1-1 **Engaging in Argument from Evidence** ● Construct an argument with evidence to support a claim. Students could *construct an argument with evidence to support a claim* [about] ***temperature and different kinds of matter that can be either solid or liquid***. 2-PS1-1

Additional Practices Building to the PEs (Continued)	**Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g. a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how a diagram showing how* [to build different things from a set of building blocks] *supports* [the idea that] ***a great variety of objects can be built up from a small set of pieces***. 2-PS1-3
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could *observe patterns* [and] *use* [the patterns] *as evidence to describe* [that] ***different properties are suited to different purposes***. 2-PS1-3 **Cause and Effect** ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students can *design simple tests to gather evidence to* [try to] *refute* [their own] *ideas about* [what] *causes* ***different kinds of matter*** [to] ***be either solid or liquid***. 2-PS1-1 **Systems and System Models** ● Objects and organisms can be described in terms of their parts. Students could use a model to describe that [different] ***objects can be built from a small set of pieces***, [and those] *objects can be described in terms of their parts*. 2-PS1-3
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Scientific investigations begin with a question. Students could describe why they *began* [their] *investigation* [of whether] ***different kinds of matter can be either solid or liquid*** *with a question*. 2-PS1-1 **Science Addresses Questions About the Natural and Material World** ● Scientists study the natural and material world. Students could describe how they, like *scientists, studied the natural and material world* [when they investigated that] ***different properties are suited to different purposes***. 2-PS1-3

2-PS1-1 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-1. **Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

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 K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	Students identify and describe* the phenomenon under investigation, which includes the following idea: different kinds of matter have different properties, and sometimes the same kind of matter has different properties depending on temperature.
	b	Students identify and describe* the purpose of the investigation, which includes answering a question about the phenomenon under investigation by describing* and classifying different kinds of materials by their observable properties.
2	Identifying the evidence to address the purpose of the investigation	
	a	Students collaboratively develop an investigation plan and describe* the evidence that will be collected, including the properties of matter (e.g., color, texture, hardness, flexibility, whether is it a solid or a liquid) of the materials that would allow for classification, and the temperature at which those properties are observed.
	b	Students individually describe* that:
		i. The observations of the materials provide evidence about the properties of different kinds of materials.
		ii. Observable patterns in the properties of materials provide evidence to classify the different kinds of materials.
3	Planning the investigation	
	a	In the collaboratively developed investigation plan, students include:
		i. Which materials will be described* and classified (e.g., different kinds of metals, rocks, wood, soil, powders).
		ii. Which materials will be observed at different temperatures, and how those temperatures will be determined (e.g., using ice to cool and a lamp to warm) and measured (e.g., qualitatively or quantitatively).
		iii. How the properties of the materials will be determined.
		iv. How the materials will be classified (i.e., sorted) by the pattern of the properties.
	b	Students individually describe* how the properties of materials, and the method for classifying them, are relevant to answering the question.
4	Collecting the data	
	a	According to the developed investigation plan, students collaboratively collect and record data on the properties of the materials.

2-PS1-2 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-2. **Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: Assessment of quantitative measurements is limited to length.*]

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

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.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Different properties are suited to different purposes.

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Connections to Engineering, Technology, and Applications of Science

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

- Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Using graphical displays (e.g., pictures, charts, grade-appropriate graphs), students use the given data from tests of different materials to organize those materials by their properties (e.g., strength, flexibility, hardness, texture, ability to absorb).
2	Identifying relationships	
	a	Students describe* relationships between materials and their properties (e.g., metal is strong, paper is absorbent, rocks are hard, sandpaper is rough).
	b	Students identify and describe* relationships between properties of materials and some potential uses purpose (e.g., hardness is good for breaking objects or supporting objects; roughness is good for keeping objects in place; flexibility is good to keep a materials from breaking, but not good for keeping materials rigidly in place).
3	Interpreting data	
	a	Students describe* which properties allow a material to be well suited for a given intended use (e.g., ability to absorb for cleaning up spills, strength for building material, hardness for breaking a nut).
	b	Students use their organized data to support or refute their ideas about which properties of materials allow the object or tool to be best suited for the given intended purpose relative to the other given objects/tools (e.g., students could support the idea that hardness allows a wooden shelf to be better suited for supporting materials placed on it than a sponge would be, based on the patterns relating property to a purpose; students could refute an idea that a thin piece of glass is better suited to be a shelf than a wooden plank would be because it is harder than the wood by using data from tests of hardness and strength to give evidence that the glass is less strong than the wood) .
	c	Students describe* how the given data from the test provided evidence of the suitability of different materials for the intended purpose.

2-PS1-3 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-3. **Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

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 K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Different properties are suited to different purposes.
- A great variety of objects can be built up from a small set of pieces.

Crosscutting Concepts

Energy and Matter

- Objects may break into smaller pieces and be put together into larger pieces, or change shapes.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that an object made of a small set of pieces can be disassembled and made into a new object.	
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.	
2	Evidence		
	a	Students describe* evidence from observations (firsthand or from media), including:	
		i.	The characteristics (e.g., size, shape, arrangement of parts) of the original object.
		ii.	That the original object was disassembled into pieces.
		iii.	That the pieces were reassembled into a new object or objects.
		iv.	The characteristics (e.g., size, shape, arrangement of parts) of the new object or objects.
3	Reasoning		
	a	Students use reasoning to connect the evidence to support an explanation. Students describe* a chain of reasoning that includes:	
		i.	The original object was disassembled into its pieces and is reassembled into a new object or objects.
		ii.	Many different objects can be built from the same set of pieces.
		iii.	Compared to the original object, the new object or objects can have different characteristics, even though they were made of the same set of pieces.

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.