Grade 2 Science, Unit 2

Properties of Matter

Overview

Unit abstract

In this unit of study, students are expected to demonstrate an understanding of observable properties of materials through analysis and classification of different materials. The crosscutting concepts of patterns, cause and effect, and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the second grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations and analyzing and interpreting data. Students are expected to use these practices to demonstrate understanding of the core ideas.

Essential questions

- How are materials similar and different from one another?
- How do the properties of materials relate to their use?

Bristol–Warren, Central Falls, Cranston, Tiverton, and Woonsocket, with process support from The Charles A. Dana Center at the University of Texas at Austin

Written Curriculum

Next Generation Science Standards

2. Structure and Properties of Matter

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 expectations above were 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
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. (2-PS1-1)	**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. (2-PS1-1)	**Patterns** ▪ Patterns in the natural and human designed world can be observed. (2-PS1-1)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **5.PS1.A** (2-PS1-1)

Common Core State Standards Connections:

ELA/Literacy –

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1)

Mathematics –

MP.4 Model with mathematics. *(2-PS1-1)*

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(2-PS1-1)*

2. Structure and Properties of Matter

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 expectations above were 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. (2-PS1-2)	**PS1.A: Structure and Properties of Matter** ▪ Different properties are suited to different purposes. (2-PS1-2)	**Cause and Effect** ▪ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2) --- ***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. (2-PS1-2)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **5.PS1.A** (2-PS1-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.8 Describe how reasons support specific points the author makes in a text. *(2-PS1-2)*

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-2)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-PS1-2)*

MP.4 Model with mathematics. *(2-PS1-2)*

MP.5 Use appropriate tools strategically. *(2-PS1-2)*

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(2-PS1-2)*

K-2. 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 expectations above were 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. (K-2-ETS1-3)	**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. (K-2-ETS1-3)	N/A

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

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

Common Core State Standards Connections:
ELA/Literacy –
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-3)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. *(K-2-ETS1-3)*
Mathematics –
MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-3)*
MP.4 Model with mathematics. *(K-2-ETS1-3)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-3)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(K-2-ETS1-3)*

Clarifying the standards

Prior learning

The following disciplinary core ideas are prior learning for the concepts in this unit of study. In kindergarten and Grade 1, students know that:

- 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.
- 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.

Progression of current learning

Driving question 1
How can observable properties be used to describe and classify different kinds of materials?

Concepts	Practices
• Patterns in the natural and human-designed world can be observed. • 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.	• Observe patterns in the natural and human-designed world. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Plan and conduct an investigation to describe and classify different kinds of material by their observable properties. – Observations could include color, texture, hardness, and flexibility. – Patterns could include the similar properties that different materials share.

Driving question 2
How can the properties of different materials be used to determine which materials are best suited for an intended purpose?

Concepts	Practices
• Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. • Simple tests can be designed to gather evidence to support or refute student ideas about causes. • Different properties are suited to different purposes. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	• Design simple tests to gather evidence to support or refute student ideas about causes. • Analyze data from tests of an object or tool to determine if it works as intended. • Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. (Assessment of quantitative measurements is limited to length.) Examples of properties could include: – Strength – Flexibility – Hardness – Texture – Absorbency • Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of each.

Integration of content, practices, and crosscutting concepts

In this unit of study, students look for patterns and cause-and-effect relationships as they describe and classify materials using physical properties. In addition, students collaboratively plan and carry out investigations and analyze and interpret data in order to determine which materials are best suited for an intended purpose.

In the natural world, different types of matter exist, and all matter can be described and classified according to physical properties. To begin this unit's progression of learning, students plan and conduct investigations to describe different kinds of material using observable properties. They will collect data during these investigations; analyze the data to find patterns, such as similar properties that different materials share; and use the data to classify materials. Materials can be classified by color, texture, hardness, flexibility, or state of matter. For example, students can explore hardness of rocks by shaking them in containers to see how easily they break apart. They can explore viscosity by pouring a set amount of various liquids, such as glue, oil, and water, from one container to another to observe the relative speed that each flows. Students can also heat or cool a variety of materials, such as butter, chocolate, or pieces of crayon, in order to determine whether or not these materials can be either solid or liquid depending on temperature.

Because every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world, it is important that students understand that different properties are suited to different purposes. After investigating and classifying a variety of materials based on their physical properties, students will engage in the **engineering design process**. Students can work collaboratively, with adult guidance, to test different materials to determine which have properties that are best

suited for an intended purpose. For example, this project could be launched using the children's story, *The Three Little Pigs*. After reading the story, students would:

- Investigate the physical properties of straw, sticks, and bricks in order to determine what properties make bricks the material best suited for building a house.
- Work together to brainstorm a list of possible structures that could be built with different materials. For example, students could build bridges or simple roller coasters for marbles.
- Select one structure from the list and determine the intended purpose of that structure.
- Select two or three different materials that could be used to build the structure.
- Investigate the physical properties of the materials, including shape, strength, flexibility, hardness, texture, or absorbency.
- Collect and analyze data to determine whether or not the given materials have properties that are suited for the intended purpose of the selected structure.
- In groups, use one of the materials to build the structure. (Teachers should have different groups use different materials.)
- Test and compare how each structure performs. Because there is always more than one possible solution to a problem, it is useful to compare the strengths and weaknesses of each structure and each material used.

Teachers can structure this engineering design project to suit their students' needs.

Integration of engineering

In this unit, students investigate the physical properties of a variety of materials, then build a structure with materials that are best suited for the structure's intended purpose. This process is outlined in greater detail in the previous section.

Integration of DCI from other units within this grade level

Other connections to DCIs within this grade level are found in engineering design. These connections can be found in Unit 1, Relationships in Habitats, and Unit 5 Changes to Earth's Land.

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for solving a problem to other people.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
- 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.

Integration of English language arts and mathematics

English language arts

The CCSS for English Language Arts can be incorporated in this unit in a number of ways. Students can participate in shared research, using trade books and online resources, to learn about the properties of matter. As students explore different types of materials, they can record their observations in science journals, then use their notes to generate questions that can be used for formative or summative assessment. Students can add drawings or other visual displays to their work, when appropriate, to help clarify their thinking. To teach students how to describe how reasons support specific points an author makes in a text, teachers can model the comprehension skill of main idea and details using informational text about matter. Technology can be integrated into this unit of study using free software programs (e.g., Animoto) that students can use to produce and publish their writing in science.

Mathematics

Throughout this unit of study, students have opportunities to model with mathematics and reason abstractly and quantitatively. During investigations, students can collect and organize data using picture graphs and/or bar graphs (with a single-unit scale). This can lead to opportunities to analyze data and solve simple put-together, take-apart, and compare problems using information presented in these types of graphs. Some examples of ways to sort and classify materials in order to create graphs include:

- Classifying materials as solids, liquids, or gases.
- Classifying materials by color, shape, texture, or hardness.
- Classifying materials based on what they are made of (e.g., wood, metal, paper, plastic).
- Classifying materials based on potential uses.

With any graph that students create, they should be expected to analyze the data and answer questions that require them to solve problems.

Future learning

The following disciplinary core ideas are future learning for the concepts in this unit of study.

In Grade 5, students will know that

- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and that are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.
- Measurements of a variety of properties can be used to identify materials. At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.

In Grades 3–5, students will know that

- 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 and takes the constraints into account.
- Research on a problem should be carried out before solution design begins. 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.
- Tests are often designed to identify a design's failure points or difficulties, which suggest the elements of the design that need to be improved.

  Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Number of Instructional Days

Recommended number of instructional days: 20 (1 day = approximately 45–60 minutes)

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.