Different Properties for Different Purposes

2.3

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Anchoring Phenomenon

Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle.

Lesson Concept

Analyze and interpret data to determine which properties of materials are best suited for a specific purpose.

Investigative Phenomenon

Crayon marks are difficult to remove from school surfaces. I wonder what materials would work best to remove them?

Standards

Refer to Appendix 2.3 for NGSS, CCSS (ELA and Math), and California ELD standards.

A project of CA NGSS K–8 Early Implementation Initiative.

Storyline Link

This lesson builds on ideas developed in the two prior lessons in which students planned and conducted investigations that helped them explore patterns of properties of solid and liquid materials. In this lesson, students are presented with a problem and record data as they test the use of materials with different properties to solve the problem. Students collect and analyze more data in order to determine the materials that can be used to solve the problem and to explain the properties of the materials that made them well suited for the solution. Students apply what they have learned in this lesson to add to their engineering design plan. In the next lesson, students will learn to make a claim based on evidence they gain from exploring the reversible and irreversible changes caused by heating or cooling matter.

Throughout the lesson, a flag (▶) denotes formative assessment opportunities where you may change instruction in response to students' level of understanding and making sense of phenomena.

Time

145 minutes

Part I	35 minutes	
	35 minutes	Engage
Part II	45 minutes	
	30 minutes	Explore A
	15 minutes	Explain A
Part III	65 minutes	
	15 minutes	Explain B
	20 minutes	Elaborate
	30 minutes	Evaluate

Materials

Whole Class

- ❑ Book: *Rosie Revere, Engineer* by Andrea Beaty
- ❑ Book: *Iggy Peck, Architect* by Andrea Beaty
- ❑ Chart paper
- ❑ Markers
- ❑ 2.1.C1: Student Question Chart (from Lesson 1: Properties of Matter)

Group (Groups of 4)

- ❑ Tray
- ❑ Sponge (divided into four equal parts)

- ❑ Sandpaper (2 in. x 2 in. piece)
- ❑ Paper towels
- ❑ Sock or felt (2 in. x 2 in. pieces)
- ❑ Cotton balls
- ❑ Paper
- ❑ Wooden block
- ❑ Straws
- ❑ Aluminum foil
- ❑ Wax paper
- ❑ Crayon
- ❑ Two crayon-marked cups (See Advanced Preparation)
- ❑ 2.3.G1: Crayon-marked Cup Rubric

Individual

- ❑ Science notebook
- ❑ Pencils
- ❑ 2.1.H1: Engineering Planning Sheet (from Lesson 1: Properties of Matter)

Advance Preparation

1. Obtain a copy of *Rosie Revere, Engineer and Iggy Peck, Architect* by Andrea Beaty. You can either purchase or check out from the library.
2. Gather materials for the Explore stage for each group and put them on the tray.
3. Prepare two crayon cups for each group. Use a black crayon to cover at least 4 sections of the side of one of the plastic cup. This will enable students to try different materials on different sections of the cup. Use a black crayon to completely cover the bottom of another cup to be used as a control to compare the "cleaned" cups.
4. Either make one copy per group of **2.3.G1: Crayon-marked Cup Rubric** or display it on a chart where everyone can view it.

Procedure

Part I

Engage (35 minutes)

Analyze and interpret data to determine via cause and effect which properties of materials are best suited for a specific purpose.

1. Bring the students to a central area. Prompt students to guide you in drawing on chart paper a picture of what the students recall doing to the liquids in Lesson 2: Properties of Liquids. Be sure to label and clarify students' current thinking and wonderings. Any student questions should be added to the **2.1.C1: Student Question Chart**.
2. Refer to the **2.1.C1: Student Question Chart** and engage students in a conversation about what they have learned about solids and liquids that helps them to explain what might have caused the objects to become misshapen. *ESRs: I tried different things from my investigation plan. I made a plan, and I tried out my ideas. I had lots of questions, and I got answers after I tried out my plan.*
3. Have a class discussion about how people might solve problems. *ESRs: I ask for help. I don't give up. I make a plan. I think about it. I think about how I could fix it. I try and try again.*

> **TEACHER NOTE**
>
> To facilitate this discussion, it may be helpful to refer to a recent problem that the class has solved or that a group has solved.

4. Read aloud *Rosie Revere, Engineer* by Andrea Beaty. Ask, "How does Rosie solve problems? Does Rosie's solution always work the first time?" *ESRs: Rosie tries different materials. Rosie keeps trying different ways. Rosie tests materials to see if they will help her solve a problem. Her solutions don't always work the first time.*
5. Ask students to think-pair-share as they compare how they solve problems with how Rosie solves problems. Prompt students to notice what is the same and what is different about how Rosie solves problems and how they solve problems.

Part II

Explore A (30 minutes)

Analyze and interpret data to determine via cause and effect which properties of materials are best suited for a specific purpose.

6. Say to students, "Just as Rosie had a problem to solve, we have a problem to solve at our school. We have had crayon marks show up around our school on different surfaces. How can we clean the crayon marks from our school surfaces?"

TEACHER NOTE

The problem students are trying to solve is how to remove crayon marks from school surfaces. If there has been a recent episode of crayon marks on desks or other surfaces at the school, use that incident as a setting for the problem. Alternatively, the problem can be set in the context of wanting to recycle the cups for a different purpose in order to establish the need to remove the crayon marks from the cups.

7. Ask students, "What do you think will clean crayon marks from our school surfaces? Why? How?" *ESRs: I can try rubbing it off. I can use a napkin. I can use my shirt. I can use an eraser. I can use water. I can use soap. I think it will work because rubbing takes marks off, and I've done it before.*
8. Distribute the tray of materials to each group of four. Allow students time to explore and observe the materials and consider how they could be used to remove the crayon marks from the cups. Have them think-pair-share and then record their observations in a student-designed table (chart) in their science notebook. Observations could include: *the sandpaper is rough*, *the cotton ball is fluffy and white*, *or the sponge is dry and has holes*, etc. Remind students to record their data with the name of the item and its properties.

TEACHER NOTE

Student data tables should reflect student thinking; therefore, it is not necessary to have them organized in the same way. Select a few data tables for students to display later to the class and have a conversation about which features of the data table make it easier to look at the data and understand the data, e.g., labels and one-to-one correspondence between the item and its properties.

9. ▶ Ask students to use the properties they've listed in their table to make a prediction about which of the items might work best to remove the crayon from the cup. Have students write their predictions in their science notebook. Encourage students to back up their claim with what they observed about the properties of the object(s) and how those properties will help clean the crayon marks.

TEACHER NOTE

▶ As you walk around, assess students' responses using this rubric.

TEACHER NOTE (continued)

3	2	1
Identifies the object, states a property of the object, and explains how that property will help.	Identifies the object and states a property of the object	Identifies the object.
The _____ (sandpaper) will work the best because it is _____ (rough), and it will rub the crayon mark off the cup completely.	*The _____ (sandpaper) will work the best because it is _____ (rough).*	*I will use the ___ (sandpaper)*

10. Allow time for students to test their predictions. Have students record their findings in their science notebooks.
11. ▶ Have the class compare their results to the control cup. Allow students to self-assess their results by using **2.3.G1: Crayon-marked Cup Rubric** or the chart on the wall. Construct a class chart to determine the overall best material for cleaning the crayon marks.

Explain A (15 minutes)

Analyze and interpret data to determine via cause and effect which properties of materials are best suited for a specific purpose.

12. Have students refer to their data tables and the class data table. Ask students, "What properties of these materials were best suited for cleaning the crayon marks from our school surfaces? Why? What patterns did you notice?" Chart student responses.

Part III

Explain B (15 minutes)

Analyze and interpret data to determine via cause and effect which properties of materials are best suited for a specific purpose.

13. Engage students in a conversation about the crayon problem and the different properties of the materials that helped to clean the crayon off the cup. Facilitate the conversation so that students clarify that there were several different properties that served the same purpose: cleaning. Have students review the way the problem was solved and the way the data were used to determine success in solving the problem.
14. Ask students to think about other objects used in the classroom and share with a partner the object's use. Ask, "What are the properties of your object that makes it useful for that purpose?" For example, a student might say that a pencil is used to write, and it's made of wood to hold it in your hand. Have students think-pair-share about the different properties

of the pencil that make it useful for writing. Ask a few students to share an object that was talked about, its purpose, and the properties that made it useful for that purpose. Ask if the object could be made of different materials and still be useful for its purpose.

15. Refer to the **2.1.C1: Student Question Chart** with the questions generated in Lesson 1: Properties of Matter about crayons. Ask students to identify any questions that may have been answered or partially answered or addressed during the investigations. Direct student thinking toward how the misshapen objects were formed and how to prevent it from happening. The student responses will depend on the questions your students generated.

Elaborate (20 minutes)

Analyze and interpret data to determine via cause and effect which properties of materials are best suited for a specific purpose.

16. Read aloud, *Iggy Peck, Architect* by Andrea Beaty. Ask students: "How does Iggy solve problems? Does Iggy's solution always work the first time?" *ESRs: Iggy was using materials for different purposes. Iggy writes a plan on paper. Iggy keeps trying different ways. Iggy doesn't give up. Iggy uses evidence from his tests to revise his designs. Iggy teaches his classmates how to solve problems. Iggy's solutions don't always work the first time.*

Evaluate (30 minutes)

Analyze and interpret data to determine via cause and effect which properties of materials are best suited for a specific purpose.

17. Turn to the page in *Iggy Peck, Architect* that begins: "The class was amazed. They stood there uncertain of what they should do." Display the page. (You may be able to display the book page from a video on the Internet.)
18. Ask students to evaluate how well the solids that the second-grade students in the story have chosen will work (based on the solid's properties) for the purpose of building a bridge.
19. Have students record responses in their science notebook using statements of evidence to represent cause and effect. *ESRs: Because sticks are strong and hard and will hold up (or support) a bridge, they are a good choice for building a bridge.*
20. Turn to the page in the book that begins. "And when she came to, Miss Lila Greer knew." Display the page.
21. Have students evaluate how well each solid in the bridge would work based on where the solid is in the bridge. Invite students to compare the properties of each part to its function in the bridge, i.e., certain materials are used based on the ability to hold up the bridge. *ESRs: The sticks made the bridge strong. The kids in the story needed a strong bridge so they can cross back. The sticks were used to hold up the shoelaces in the bridge because it is their job. I think that that is a good use of the sticks because they are hard (structure) and strong and will hold up the shoelaces.*
22. Have students give an alternative solid that could be used to support the bridge based on the properties (structure) and function of the solid. *ESRs: The little boy could have also used a piece of metal in place of the stick because it is also strong and hard (structure) and could help with the job (function) of holding up the shoelaces in the bridge.*

23. Return to the **2.1.C1: Student Question Chart**. Have students add responses to any of the questions they have that can now be answered.
24. Have students reflect on how the children in the stories solved problems. Ask students to think about how some of the children's ideas may be incorporated into their engineering plans.
25. Refer to **2.1.H1: Engineering Planning Sheet,** which students should have a copy in their science notebooks. Have students begin the Create Phase by attempting to actualize the plan to solve their design problem, which is "How can we keep our three regular objects from becoming misshapen?"

Toolbox Table of Contents

Crayon-marked Cup Rubric

3	2	1
The cup is free of crayon marks and not damaged.	The cup is free of crayon marks but is damaged.	The cup still has crayon marks or is destroyed.

Appendix 2.3

Different Properties for Different Purposes

Next Generation Science Standards (NGSS)

This lesson is building toward:

PERFORMANCE EXPECTATIONS (PE)	
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.*]

NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

SCIENCE AND ENGINEERING PRACTICES (SEP)
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.
Planning and Carrying Out Investigations
• Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons • Make predictions based on prior experiences.
Engaging in Argument from Evidence
• Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.
Constructing Explanations and Designing Solutions
• Use information from observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Generate and/or compare multiple solutions to a problem.

DISCIPLINARY CORE IDEAS (DCI)
PS1.A Structure and Properties of Matter
• Different properties are suited to different purposes.
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.

Appendix 2.3

CROSSCUTTING CONCEPTS (CCC)
Cause and Effect
• Simple tests can be designed to gather evidence to support or refute student ideas about causes. • Events have causes ~~that generate observable patterns~~.
Structure and Function
• Students observe that the shape and stability of structures of natural and designed objects are related to their function(s). • The shape and stability of structures of natural and designed objects are related to their function(s).
Patterns
• Patterns in the natural and human designed world can be observed.

Common Core State Standards (CCSS)

CCSS ELA SPEAKING & LISTENING
CCSS.ELA-LITERACY. SL.2.1 Participate in collaborative conversations with diverse partners about *grade 2 topics and texts* with peers and adults in small and larger groups.
CCSS.ELA-LITERACY. SL.2.6 Produce complete sentences when appropriate to task and situation in order to provide requested detail or clarification.
CCSS ELA LANGUAGE
CCSS.ELA-LITERACY. L.2.3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.
CCSS MATHEMATICAL PRACTICES
MP.2 Bring up Reason Reason abstractly and quantitatively.
MP.5 Bring up Use Use appropriate tools strategically.

Appendix 2.3

California English Language Development (ELD) Standards

CA ELD		
Part 1.2.1 Exchanging information and ideas with others through oral collaborative conversations on a range of social and academic topics		
EMERGING	**EXPANDING**	**BRIDGING**
P1.2.1 Contribute to conversations and express ideas by asking and answering yes-no and wh- questions and responding using gestures, words, and learned phrases.	**P1.2.1** Contribute to class, group, and partner discussions, including sustained dialogue, by listening attentively, following turn-taking rules, asking relevant questions, affirming others, and adding relevant information.	**P1.2.1** Contribute to class, group, and partner discussions, including sustained dialogue, by listening attentively, following turn-taking rules, asking relevant questions, affirming others, adding pertinent information, building on responses, and providing useful feedback.
In addition to the standard above, you may find that you touch on the following standard in this lesson as well: **P1.2.5** Listening actively to spoken English in a range of social and academic contexts		