

Properties of Liquids

2.2



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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

Plan and carry out an investigation to observe and classify patterns of properties of different kinds of materials.



Investigative Phenomenon

Water poured from one container to a different container takes the shape of the new container.



Standards

Refer to Appendix 2.2 for NGSS, CCSS (ELA), and California ELD standards.

2.2 Properties of Liquids



Storyline Link

In the prior learning sequence, students observed, described, and classified properties of solid materials. Students also began to develop an engineering problem. In this learning sequence, students plan and conduct investigations to observe and classify patterns of properties of liquids to answer a question generated by the class. Based on their sense-making, students use their observations to compare properties of liquids and solids. The properties of liquids relate to the anchoring phenomenon: "Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle." Eventually students will understand that when some solids melt, they spread out to take the shape of their container. When cooled, some liquids become a solid that doesn't need a container to have that shape, e.g., chocolate bars, chocolate bunnies, etc. This foundational understanding of the properties of matter will help students with the Plan phase of the Engineering Design Process. In the next learning sequence, students will explore the idea that materials are used for different purposes depending upon their properties.

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

140 minutes

Part I 45 minutes

- | | |
|------------|---------|
| 30 minutes | Engage |
| 15 minutes | Explore |

Part II 50 minutes

- | | |
|------------|---------|
| 30 minutes | Explore |
| 20 minutes | Explain |

Part III 45 minutes

- | | |
|------------|-----------|
| 15 minutes | Elaborate |
| 30 minutes | Evaluate |



Materials

Whole Class

- Chart paper
- Different-sized containers for student investigations
- 8 solid objects (from Lesson 1)
- Bottle of water
- 2.1.C1: Student Question Chart (from Lesson 1: Properties of Matter)

2.2 Properties of Liquids

Groups (Groups of 2)

- 2.2.G1: Investigation Planner
- 1 500-mL bottle of water
- 2 9-oz clear plastic cups
- 1 clear bowl (of a different width than the cups)
- One ice cube in a cup
- Paper towels
- Small disposable cup with water

Each station (Assemble various liquid containers)

- Plastic cups for pouring liquids
- Plastic storage containers of various sizes
- Various-sized containers with lids (e.g., 500 mL empty water bottles)
- One bottle of each of the following liquids:
 - Tap water with food coloring
 - Baby oil
 - Dish soap
 - Pancake syrup
 - Bottle of juice

Individual

- Science notebook
- Pencils
- Funnels (optional)
- Measuring cups (optional)

Advance Preparation



1. Have **2.1.C1: Student Question Chart** (from Lesson 1: Properties of Matter) available for this and subsequent lessons. This will help students develop better explanations for the anchoring phenomenon: Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle and continue to build on their understanding of the crosscutting concept of patterns from previous grade levels.
2. Make a copy of **2.2.G1: Investigation Planner** for every pair of students.
3. Gather the liquids for the Explore (preferably based on student wonderings).

2.2 Properties of Liquids



Procedure

Part I

Engage (30 minutes)

Carry out an investigation to observe and classify patterns of properties of different kinds of materials.

1. Bring students to a central area and have them guide you in drawing a picture on chart paper of what they recall doing to the solid objects in Lesson 1: Properties of Matter. Be sure to label and clarify students' current thinking and wonderings.
2. As a whole group, students can view the eight solid objects from Lesson 1: Properties of Matter, a variety of containers, and a water bottle. Have students connect their thinking about properties from the previous lesson by asking, "What do you wonder about the items?" Encourage students to explore the objects by asking the following questions:
 - What do you feel when you touch the objects?
 - How do the objects smell?
 - What is the same about the objects?
 - What is different about the objects? What does it make you wonder?

ESRs: I wonder if I can hit the water bottle with a hammer. I wonder if I can smash the water bottle.

TEACHER NOTE

To increase student-driven learning, connect to the student ideas and wonderings about the bottle of water while introducing the activity. If all student wonderings are about changing the water bottle, redirect student wonderings to the contents of the water bottle. A possible exchange between you and your students might be:

Student: "What happens if we hit the water bottle with a hammer?"

Teacher: "Remember what happened when we hit the crayons and other objects with the hammer?"

Students: "They were smashed."

Teacher: "So we know what's going to happen if we hit it with a hammer. Let's focus on the water inside. What do you wonder about the water?"

Students: "I wonder if we can take it out. I wonder if we can put it in those containers. I wonder if it will spill. I wonder if it will get things wet. I wonder if it will dry up. I wonder if we can put it back in the water bottle."

2.2 Properties of Liquids

3. Invite pairs of students to select a bottle of water and a variety of containers to investigate their wonderings. Have students work in pairs to explore the materials by pouring water into different containers, then think-pair-share observations of how the water behaves. Ask students to write—in words or pictures—in their science notebook what they observed and questions that they have about water based on the investigative phenomenon, “Water poured from one container to a different container takes the shape of the new container.” *ESRs: The water is wet. It spreads out. It looks like there is more or less in different containers. It is wider or taller. It changed shape. What happened to the water? What happens if I pour it back into the bottle? Why did it change shape? Is there more water now? Is there less? Do other things change shape also?* Add their questions to the **2.1.C1: Student Question Chart**.
4. Ask students to name other substances/items that behave like water when they are poured. *ESRs: I can pour milk. I can pour pancake syrup. I can pour juice. Rain pours. I can pour glue. I can pour oil.*

TEACHER NOTE

In the materials, it was suggested that you provide certain liquids for the Explore. However, if you are able, it is best to provide the liquids the students identified.

Explore (15 minutes)

Plan and conduct an investigation to observe and classify patterns of properties of different kinds of materials.

TEACHER NOTE

Set boundaries for this investigation to ensure student safety.

5. If students used the word *liquids* in the Engage stage, affirm that the substances/items they listed that act like water when they are poured are called liquids. If the word *liquid* was not mentioned by students, introduce the term.
6. Show students the liquids they can choose to investigate and the different materials and containers they can use in their investigation. Provide each pair with **2.2.G1: Investigation Planner**. Have students work in pairs to create a plan about how they will investigate the different liquids. Prompt students to think about how much liquid is in the bottle/container and the shape of the liquid in the container. Allow five to ten minutes for students to work on their plan.

2.2 Properties of Liquids

Part II

Explore (30 minutes)

Plan and conduct an investigation to observe and classify patterns of properties of different kinds of materials.

7. Circulate among the students; as needed, encourage students to create ways in their investigation plan to answer questions from **2.1.C1: Student Question Chart** or other questions they might have about the properties of liquids.
8. Have students share their plans with the whole class. Allow time for them to ask questions about each other's plans. Then allow time for students to revise based on the ideas they heard from other students.
9. Explain to students that they will be choosing the liquids described in their plan from the materials table to carry out their investigations. Students will record their observations in their science notebook using **2.2.G1: Investigation Planner**. Remind students of the safety boundaries for this investigation.
10. Allow time for students to conduct their investigations and record data. Ask students to note any patterns they notice in their observations (similarities, differences, things that happen repeatedly, etc.).
11. Refer to the question in **2.2.G1: Investigation Planner**: "What patterns did you see when you observed the liquids?" Have students think-pair-share the similarities and differences they observed about the different liquids. Then select some students to share their own or their partner's observations, facilitating a student-to-student conversation about how some of the observable properties are similar to each other, and some are different.
12. As students share ideas using their own words, help students discuss why certain properties belong together. *ESRs: The liquids spread out in their new container. Some liquids poured fast. When we poured two liquids into the same container, one liquid was on top of the other. The liquids didn't mix. The liquids looked like the shape of the new container. The liquids looked taller or shorter depending on the container's shape. The liquids looked fatter or skinnier depending on the container's shape.*

TEACHER NOTE

The properties of liquids relate to the anchoring phenomenon. Eventually students will understand that when some solids melt, they spread out to take the shape of their container. When cooled, the liquids become a solid that doesn't need a container to keep that shape, e.g., chocolate bars, chocolate bunnies, etc.

13. Have students refer to the **2.1.C1: Student Question Chart**. Ask students to think-pair-share which of the questions have been answered. Record answers on the chart. *ESR: Liquids spread out and take the shape of their new container.*

2.2 Properties of Liquids

Explain (20 minutes)

Plan and conduct an investigation to observe and classify patterns of properties of different kinds of materials.

14. ► Have students write or draw their observations of the liquids in their science notebook. Remind students to use examples from their investigations in their explanation. *ESRs: Liquids pour, but I observed that the water poured easier than the syrup. Liquids spread out in their containers. The water and the dish soap spread out when they were poured into a container. When I poured two liquids into the same container, they didn't mix. The syrup spread out, but it was slow. Some liquids are bubbly, and some liquids are clear.*
15. Have students review the **2.1.C1: Student Question Chart** to recall the properties they observed about the solid objects. Have students answer the question, "How are liquids similar to or different from the solid objects?" in their science notebook. *ESRs: The liquids are wet, and the solid objects are dry. The liquids are soft, and the solid objects are hard. The misshapen objects spread out like the liquids. They are similar because both are smooth.*

Part III

Elaborate (15 minutes)

Plan and conduct an investigation to observe and classify patterns of properties of different kinds of materials.

16. Distribute an ice cube in a cup and a cup of water to each student pair. Have students make observations of the ice and the water as it changes from a solid to a liquid.
17. Encourage students to explore the materials. Allow students to decide how to explore the cup with ice and the cup with water. Have students think-pair-share observations. *ESRs: The ice cube is hard. The ice cube doesn't spread out. The water spread out. Water is wet, and the ice cube is wet. When we put the ice in the water, it floated. It was solid and then it was a liquid. The ice cube melted in my hand.*
18. Ask students to think-pair-share how the ice cube and water are like the misshapen and regular solid objects. *ESRs: The ice cube is hard like the solid objects. The ice cube doesn't spread out when it is frozen. The regular objects don't spread out. The water is like the misshapen objects because it spreads out.*

TEACHER NOTE

Students are beginning to explain the anchoring phenomenon: "Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle" by noticing when the ice cube (a solid) gets heated, it becomes liquid water.

2.2 Properties of Liquids

19. Ask students to think-pair-share how the ice cube and water are like the misshapen and regular solid objects. *ESRs: The ice cube is hard like the solid objects. The ice cube doesn't spread out when it is frozen. It spreads out in my hand as it melts. When the ice becomes water in my hand, it is like (the crayon, lip balm, or candle) because it spreads out.*
19. Ask students if anything they just did with the liquids would help the objects go back to their original shape. Refer to the **2.1.C1: Student Question Chart** and the engineering question from Lesson 1: Properties of Matter, "How can we keep this from happening?" *ESR: Don't warm them up!*
21. ► Provide a block and a glass of milk and two different-sized containers for students to observe. Have students think-pair-share to describe how they would plan and conduct an investigation to find evidence to describe the patterns of the properties of each. Encourage students to recall what they know about the properties of solids and liquids.

Evaluate (30 minutes)

Observe and classify properties of solids and liquids.

22. Have students refer to the **2.2.G1: Investigation Planner** they completed in the Explore. Have students write their own investigation plan.

TEACHER NOTE

You can provide your students with scaffolds to write their investigation plans. For example:

First, I would...

Next, I would...

Then, I would...

Last, I would...

Finally, I would...

23. ► Based on the investigation plan, have students write in their science notebook about the differences between solids and liquids. They should base the differences on the evidence they found in patterns of observation, including classifying each as a solid or liquid and identifying at least three properties. *ESRs: I know that the block is a solid. I know because I observed it is hard, brown, wooden, and square. I know the milk is a liquid. I know this because it is white, runny, cold, foamy, flowing, spreads, and takes the shape of the glass.*

2.2 Properties of Liquids

TEACHER NOTE

► Review your student's responses. Use the following rubric for evaluating student understanding of solids and liquids in step 23.

3	2	1
The student identifies the state (solid or liquid), provides 3 or more properties, and fully explains how he or she found out or used evidence to find out about those properties.	The student identifies the state (solid or liquid) and provides 2–3 properties but does not fully explain how he or she used evidence to find out about those properties.	The student demonstrates minimal understanding. Can identify solid or liquid and 1–2 properties but does not explain how he or she used evidence to find out about those properties.

Toolbox

2.2

Properties of Liquids

Toolbox Table of Contents

2.2.G1 Investigation Planner

2.2.11

2.2.10

Investigation Planner

Name the Liquid	What do you want to find out about the liquid?	What are you going to do to find out?	What did you find out?	What patterns did you see when you observed the liquids?
	We want to find out	We are going to	We found out	The patterns we saw are
	We want to find out	We are going to	We found out	
	We want to find out	We are going to	We found out	

Appendix 2.2

Properties of Liquids

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. <i>[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]</i>
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.* <i>[Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]</i>

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

SCIENCE AND ENGINEERING PRACTICES (SEP)

Planning and Carrying Out Investigations

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
- Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.

ASKING QUESTIONS AND DEFINING PROBLEMS

- Ask questions based on observations to find more information about the natural and/or designed world(s).

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.
- Record information (observations, thoughts, and ideas).

DISCIPLINARY CORE IDEAS (DCI)

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.

Appendix 2.2

CROSSCUTTING CONCEPTS (CCC)

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

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Common Core State Standards (CCSS)

CCSS ELA WRITING

CCSS.ELA LITERACY.W.2.8

Recall information from experiences or gather information from provided sources to answer a question.

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.

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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.

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