

Anchoring Phenomenon

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



Lesson Concept

Planning and conducting an investigation to determine evidence that can be used to construct a claim that some changes caused by heating or cooling can be reversed and some cannot.



Investigative Phenomenon

Crayons are made of wax in a shape that we can hold with our fingers. Birthday candles are made of wax in a shape that we can put on a cake. Lip balm is made of wax in a shape that we can apply to our lips.



Standards

Refer to Appendix 2.5 for NGSS, CCSS (ELA), and California ELD standards.

2.5 The Great Wax Disaster



Storyline Link

In Lesson 4: Reversible and Irreversible Changes, students constructed a claim based on evidence as they explored reversible and irreversible changes that are caused by heating or cooling different substances. In this final lesson, students return to the anchoring phenomenon of materials being made of matter and misshapen objects in order to develop an engineering plan that utilizes their thinking from Lesson 4: Reversible and Irreversible Changes, i.e., the changes that occurred to the misshapen objects are reversible or irreversible. The engineering plan ultimately solves problems generated by the students, i.e., how to keep the objects from becoming misshapen or how to return the objects to their original and useful shape. Students use a design process and 2.1.H1: Engineering Planning Sheet to develop a plan, compare plans with others, and collaboratively revise their plans. After conducting the investigation, students use their data to write a claim of how and if solid objects can be turned into a different shape. From their experiences with properties of materials and how properties of materials are or are not affected by heating and cooling, the students are able to explain the phenomena of the misshapen objects.

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



Time

105 minutes

Part I 30–60 minutes

30–60 minutes Engage

Part II 60 minutes

30 minutes Explore

15 minutes Explain/Evaluate

15 minutes Elaborate



Materials

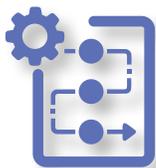
Whole class

- 2.1.C1: Student Question Chart (from Lesson 1: Properties of Matter)
- 2.1.C2: Engineering Design Process (from Lesson 1: Properties of Matter)

Individual

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

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Procedure

Part I

Engage (30–60 minutes)

Observations combined with prior knowledge are used to infer the causes of changes to properties of matter.

1. Bring the students to a central area and have them guide you in drawing a picture on chart paper of what the students recall doing to explore reversible and irreversible changes in the last lesson. 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. Review with students the **2.1.C1: Student Question Chart** and ask them, "Which of these questions have we answered?" Add student responses to the chart. *ESRs: responses will vary depending on the students' questions.*
3. Ask students: "Which questions are you still curious about?" Support student curiosity and autonomy by providing opportunities and materials for students to explore their as yet unanswered questions. Encourage students to elaborate on what evidence will be necessary to answer their questions.

Part II

Explore (30 minutes)

Collaboratively plan and carry out an investigation to gather evidence to support or refute ideas about causes of changes to matter due to heating and cooling.

TEACHER NOTE

This Explore helps students make the connection to the anchoring phenomenon via their learning in Lessons 2.1: Properties of Matter through 2.4: Reversible and Irreversible Changes.

4. Ask students to recall their ideas from Lessons 2.1: Properties of Matter through 2.4: Reversible and Irreversible Changes and think-pair-share about whether the changes to the misshapen objects are reversible or irreversible. Display the anchoring phenomenon: Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle. Chart student ideas. *ESRs: I think the misshapen candles and crayons are reversible changes because they're like the chocolate bar. I disagree; I think the candles and crayons are irreversible because we'll never get them back to their real shape so they can do their job. I disagree because sometimes it changes shape, but when it is a solid, it can still do its job.*

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5. Brainstorm with the students: “What does it mean to undergo a reversible change?” *ESRs: We can get it back to its regular shape. We can get it back so it can do its job. The object has to be a solid. The properties are the same as the regular one. A property like shape helps it do its job.* Chart student responses.
6. Brainstorm with the students: “What does it mean to undergo an irreversible change?” *ESRs: We cannot get it back to its regular shape. We cannot get it back so it can do its job. The object can be a liquid or a solid so the properties may not be the same.* Chart student responses.
7. Explain to students that they will be developing a plan to conduct an investigation. However, before we begin, we need to agree: “Will we be planning for a reversible or irreversible change? Why?” *ESRs: A reversible change because we want the objects to get back to a shape so they can do their jobs.*
8. Guide students to write a plan that results in a reversible change, i.e., getting the misshapen objects to return to their original and useful state or a plan that stops the change from happening altogether. Advise students that they can later write a plan that results in an irreversible change.
9. Help students craft a question they can use to develop a plan to collaboratively conduct an investigation. *ESRs: How can we keep the change from happening? How can we get the misshapen crayon back to a shape so it can do its job? How can we get the misshapen birthday candle back to a shape so it can do its job? How can we get the misshapen lip balm stick back to a shape so it can do its job?*
10. Refer students to the path of learning you have created on chart paper from Lessons 1: Properties of Matter through 4: Reversible and Irreversible Changes. Have students discuss all the different things we did to matter to change it. Now, allow time for them to think-pair-share about any of those ideas they may want to include in their plan.
11. To create a blueprint to guide students’ thinking, use your chart from Lesson 1: Properties of Matter (refer to **2.1.C2: Engineering Design Process** for a sample design process: Imagine, Plan, Create, Test, Improve, Re-create) You can choose to allow students to go through the entire cycle or not. Ask students to identify what materials they will need to carry out their plans.

TEACHER NOTE

Have students choose one misshapen object they want to focus on to plan an investigation. Be aware of safety concerns in the planning, e.g., you can’t put a metal lip balm stick case in a microwave. Here is a sample student plan that only includes the *Imagine and Plan* phase:

Imagine: *I can change the shape of the misshapen crayon.*

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TEACHER NOTE (continued)

Plan: First, I would stick the crayon in a microwave to make it a liquid. Then, I would put it in a mold in the shape of a real crayon. Next, I would put it in the freezer to cool. Last, I would use the crayon to color my picture.

12. Have students compare their plans with a partner and improve their plans.

Explain/Evaluate (15 minutes)

Gather evidence to support or refute ideas about the causes of changes to matter.

13. ► Have students refer to their science notebook entries regarding reversible and irreversible changes. Have students use the evidence in their notebook entries from previous lessons to discuss whether their design plan will work.

TEACHER NOTE

Provide the following sentence frame if your students would benefit:

I think my plan for ___ will work because ___.

For example, *I think my plan for the crayon will work because it is just like what we did with the chocolate. The chocolate melted and turned to a liquid. Then when we put it in a mold, it became hard again after it cooled. I think the crayon will do the same thing. It will have the same shape and hardness (properties) as the regular one.*

14. Revisit the anchoring phenomenon of misshapen objects. Have students collaboratively discuss: How can you turn an ordinary object into a different shape?

TEACHER NOTE

► Throughout the Matter Unit, a 5E the word model was employed; however, at the end of Lesson 5: The Great Wax Disaster, the final Explain is used to Evaluate student understanding of the anchoring phenomenon. Use this rubric to evaluate students' plans.

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TEACHER NOTE (Continued)

3	2	1
The plan includes a logical sequence of steps that involve heating/melting and then cooling the misshapen crayon, candle, or lip balm. The plan includes the idea that a solid such as wax, once liquefied, can be put into an appropriate mold, cooled, and then will function as intended.	The plan includes a somewhat logical sequence of steps that involve some part of heating/melting and cooling the misshapen crayon, candle, or lip balm. May refer to the object being returned to its intended shape for its intended purpose.	Plan is illogical. Vague reference to heating/melting and cooling the misshapen crayon, candle, or lip balm. Limited to no mention of the object being returned to its original shape for intended purpose.

Elaborate (15 minutes)

Defining and delimiting an engineering problem means generating more than one possible solution to a problem.

15. Have students complete the **2.1.H1: Engineering Planning Sheet** with their plans for how to prevent the objects from becoming misshapen again.

Appendix 2.5

The Great Wax Disaster

Next Generation Science Standards (NGSS)

This lesson is building toward:

PERFORMANCE EXPECTATIONS (PE)	
2-PS1-4	Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures.]
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)
Planning and Carrying Out Investigations
<ul style="list-style-type: none">Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
Asking Questions and Defining Problems
<ul style="list-style-type: none">Define a simple problem that can be solved through the development of a new or improved object or tool.
Analyzing and Interpreting Data
<ul style="list-style-type: none">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).
Obtaining, Evaluating, and Communicating Information.
<ul style="list-style-type: none">Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

DISCIPLINARY CORE IDEAS (DCI)
S1.B: Chemical Reactions
<ul style="list-style-type: none">Heating or cooling a substance may cause changes that can be observed.Some changes are reversible and some are not.
ETS1.A Defining and delimiting an engineering problem
<ul style="list-style-type: none">Asking questions, making observations, and gathering information are helpful in thinking about problems.
ETS1.C More than one possible solution to a problem
<ul style="list-style-type: none">Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Appendix 2.5

CROSSCUTTING CONCEPTS (CCC)

Cause and Effect

- Events have causes that generate observable patterns.

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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

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.

EXPANDING

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.

BRIDGING

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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