

Properties of Matter

Lesson 4b: What Causes Matter to Change?

Grade 2	Length of lesson: 54 minutes	Placement of lesson in unit: 4b of 5 two-part lessons on properties of matter, with two additional extension lessons
Unit central questions: What is matter made of? How can matter change?		Lesson focus questions: What happens when solid matter becomes liquid matter and liquid matter becomes solid matter? Why do these changes happen?
Main learning goal: Adding or removing heat changes the arrangement and motion of the atoms or molecules that make up a particular kind of matter. Solids can become liquids when heat is added and the molecules speed up and move around more freely. Liquids can become solids when heat is removed (the matter cools) and the molecules slow down and vibrate in place.		
Science content storyline: Heating and cooling (removing heat) can cause changes in matter. When heat is added to a solid, its atoms or molecules begin to move faster. Melting happens when atoms or molecules in a solid move fast enough to break away from their rigid structure and begin flowing around more freely as a liquid. When heat is taken away from a substance and the matter cools, the atoms or molecules slow down and move closer together. Freezing happens when the molecules in a liquid slow down enough to form a more rigid structure and vibrate in place as a solid.		
Ideal student response to the focus questions: All matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i> . In solid matter, molecules vibrate in place, and in liquid matter, they move around more freely. Matter changes from a solid to a liquid when you add heat, and the molecules speed up and begin moving around more freely. Matter changes from a liquid to a solid when you take away heat, and the molecules slow down and begin vibrating in place. The small pieces or molecules that make up the matter don't change. They just move faster and flow around each other when heat is added, and they slow down and vibrate in place when heat is taken away.		

Preparation

<p>Materials Needed</p> <ul style="list-style-type: none"> • Science notebooks • Chart paper and markers • <i>A Drop of Water</i> by Walter Wick (1 copy; from lesson 3a) • Optional: <ul style="list-style-type: none"> • 1 cup of ice cubes and 1 cup of water (per pair) (from lesson 3a) • 1 cup of water and food coloring (for class demo) <p>Student Handouts</p> <ul style="list-style-type: none"> • 3.1 Lego Model (1 per group) (from lesson 3a) 	<p>Ahead of Time</p> <ul style="list-style-type: none"> • Review the content background document. • Review strategy 5 (Engage students in constructing explanations and arguments) in the STeLLA strategies booklet. • Since analyzing an analogy/model will likely be new for many students, acting out the effects on molecules of adding and removing heat will strengthen their understandings of the science content and help them revise their ideas about molecular motion using an alternative information source (their bodies) that is both different from and redundant with language. They can then use this information to analyze the analogy and synthesize the lesson content. • ELL support: Introduce ELL students to the lesson content, structure, materials, and activities in advance so they understand what's expected of them and can participate more fully in the lesson. Identify words in the lesson plan to review in advance with ELL students, including <i>evidence</i>. Review vocabulary words from the previous lesson, including <i>vibrate</i>, <i>vibrate in place</i>, <i>rigid</i>, <i>move freely</i>, <i>hydrogen</i>, <i>oxygen</i>, <i>atoms</i>, <i>molecules</i>, <i>model</i>, and the abbreviation H₂O.
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Lesson 4b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
8 min	Link to previous lessons: The teacher reads a section from <i>A Drop of Water</i> to reinforce how molecules move differently in a solid and a liquid.	<ul style="list-style-type: none"> The molecules in a solid and a liquid are always in motion, but the molecules in a solid can only vibrate in place. The molecules in a liquid move around or flow more freely and slide past one another.
2 min	Lesson focus questions: The teacher introduces the focus questions, <i>What happens when solid matter becomes liquid matter and liquid matter becomes solid matter? Why do these changes happen?</i>	
10 min	Setup for activity: In small groups, students act like water molecules in a role-play to show how matter changes from a solid to a liquid and from a liquid to a solid. Then they relate being human models of water molecules to what happens in real life.	<ul style="list-style-type: none"> Matter changes from a solid to a liquid when heat is added and from a liquid to a solid when heat is removed and the matter cools. In solid matter, molecules can only vibrate in place. In liquid matter, molecules can move around more freely and slide past each other.
10 min	Activity: Students work in pairs to construct a scientific explanation with a claim, evidence, and reasoning that answers the focus questions.	<ul style="list-style-type: none"> Solids and liquids are made up of small particles called <i>atoms</i> and <i>molecules</i>. When heat is added to a solid, the molecules move faster until they break away from their rigid structure and begin flowing around more freely as a liquid. When heat is removed, the molecules slow down and join together in a rigid structure, where they vibrate in place as a solid.
15 min	Follow-up to activity: Students share their scientific explanations (claims, evidence, and reasoning) of what happens when matter changes from a solid to a liquid and from liquid to solid, and why these changes take place.	<ul style="list-style-type: none"> Solids change to liquids when molecules move fast enough to break away from their rigid structure and move around more freely. Liquids change to solids when molecules slow down enough to form a rigid structure and vibrate in place. These changes in the motion and arrangement of atoms and molecules of a particular kind of matter happen because of heat. When heat is added, molecules gain energy, move faster, and flow freely as a liquid. When heat is removed (matter cools), molecules lose energy, slow down, and vibrate in place as a solid.
8 min	Synthesize/summarize today's lesson: Students summarize their understandings of matter by considering whether their scientific explanations of how and why matter changes apply to butter, chocolate, and crayon wax.	<ul style="list-style-type: none"> All matter is made up of small particles called <i>atoms</i> and <i>molecules</i>. The particles themselves don't change; they just gain energy, move faster, and flow around more freely when heat is added, and they lose energy, slow down, and vibrate in place when heat is taken away. This happens when matter of any kind undergoes a physical change from a solid to a liquid and from a liquid to a solid.
1 min	Link to next lesson: The teacher announces that in the next lesson, students will create comic strips to show what they've learned about matter.	

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8 min	<p>Link to Previous Lessons</p> <p>Synopsis: The teacher reads a section from <i>A Drop of Water</i> to reinforce how molecules move differently in a solid and a liquid.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> The molecules in a solid and a liquid are always in motion, but the molecules in a solid can only vibrate in place. The molecules in a liquid move around or flow more freely and slide past one another. 	<p>Link science ideas to other science ideas.</p> <p>Engage students in making connections by synthesizing and summarize key science ideas.</p>	<p>Show slides 1 and 2.</p> <p>In our last lesson, we started pulling together all of the science ideas about matter that we've been exploring in this unit.</p> <p>We've learned a lot about matter, haven't we? Especially water!</p> <p>To help us review these ideas, I'm going to read another section from the book <i>A Drop of Water</i>. Listen carefully to what it says about molecules in liquid water and solid water, or ice.</p> <p>NOTE TO TEACHER: <i>Read pages 18 and 21 from A Drop of Water. Emphasize the molecular motion and the role of heat. If time allows, demonstrate (from page 18) how a drop of food coloring moves around in a cup of water. (See optional materials on the overview page.)</i></p> <p>So who can summarize what we know about how molecules move in a liquid and a solid?</p>	<p>The molecules in liquid water move around more than the molecules in solid water.</p> <p>When we add heat to ice, it turns into</p>	<p>Can someone add to this idea?</p>

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			<p>Our reading mentions another important science idea. What causes matter to change from a solid to a liquid and back to a solid?</p> <p>How does heat change matter from a solid to a liquid and from a liquid to a solid?</p> <p>What did we learn from our Lego model</p>	<p>water.</p> <p>When we add heat to a solid like ice, the molecules move faster, and the solid becomes a liquid like water.</p> <p>Heat!</p> <p>When you add heat to a solid, it melts and becomes a liquid. When you take heat away, the liquid matter cools off and becomes a solid.</p> <p>We looked at ice, chocolate, and crayon pieces.</p> <p>We also looked at melted butter.</p>	<p>Can you use the words <i>solid</i> and <i>liquid</i> in your description?</p> <p>What kinds of matter did we observe in our investigations?</p>

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			<p>about solids, liquids, and heat?</p>	<p>In a solid, the molecules are close together and vibrate in place instead of moving all around.</p> <p>The molecules start moving faster until they break away from each other and move around like the Legos in the plastic bag.</p> <p>When we added heat, we took the Lego water molecules out of the box and put them in the baggie to show the solid melting and changing to a liquid. The cup of ice did the same thing.</p>	<p>So what happens if you add heat to the molecules in a solid that are vibrating in place?</p> <p>Would anyone like to add to that idea? Do you agree or disagree?</p>

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			<p>Today we'll use a different kind of model to show what we know about how matter changes.</p>		
2 min	<p>Lesson Focus Questions</p> <p>Synopsis: The teacher introduces the focus questions, <i>What happens when solid matter becomes liquid matter and liquid matter becomes solid matter? Why do these changes happen?</i></p>	<p>Set the purpose with a <u>focus question</u> or goal statement.</p>	<p>Show slide 3.</p> <p>We'll find out more about this new model in a moment, but first let's talk about today's focus questions, <i>What happens when solid matter becomes liquid matter and liquid matter becomes solid matter? Why do these changes happen?</i></p> <p>Write these questions on a clean page in your science notebooks and draw a box around them.</p> <p>NOTE TO TEACHER: <i>Write the focus questions on the board for students to refer to throughout the lesson.</i></p> <p>Today you'll answer our focus questions the way a scientist would. First, you'll describe what happens when matter changes from a solid to a liquid and from a liquid to a solid. Then you'll explain why you think this happens.</p> <p>In this unit, we've observed several examples of matter changing, haven't we? We observed ice and water, solid butter and melted butter, solid chocolate and melted chocolate, and crayons pieces and melted</p>		

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			<p>crayons.</p> <p>Keeping all of these examples in mind will help us develop scientific explanations of how matter changes and why these changes happen.</p>		
10 min	<p>Setup for Activity</p> <p>Synopsis: In small groups, students act like water molecules in a role-play to show how matter changes from a solid to a liquid and from a liquid to a solid. Then they relate being human models of water molecules to what happens in real life.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Matter changes from a solid to a liquid when heat is added and from a liquid to a solid when heat is removed and the matter cools. In solid matter, molecules can only vibrate in place. In liquid matter, molecules can move around more freely and slide past each other. 	<p>Select content representations and models matched to the learning goal and engage students in their use.</p> <p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p> <p>Make explicit links between science ideas and activities before the activity.</p>	<p>To prepare for developing our scientific explanations, we'll use a new model to help us describe what happens when a solid changes to a liquid and a liquid changes to a solid.</p> <p>In previous lessons, we used a Lego model to show how molecules move in solid water, or ice, and in liquid water.</p> <p>Show slide 4.</p> <p>Today you'll become <i>human</i> models of matter and act out what happens when a solid changes to a liquid and a liquid changes to a solid.</p> <p>Can you imagine how you'd move if you were a water molecule? Let's find out!</p> <p>NOTE TO TEACHER: <i>Divide the class into groups of four and have students discuss how they would behave if they were four water molecules changing from a solid to a liquid and back to a solid.</i></p> <p>Show slide 5.</p>		

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		Ask questions	<p>Talk in your small groups about how you can model four water molecules in a solid and a liquid. How would you behave if you were molecules in solid water or ice? How would you behave if you were molecules in liquid water?</p> <p>Decide how close to <i>stand</i> and how to <i>move</i> as molecules of solid water and liquid water.</p> <p>You have 1 minute to come up with your plan. Then you'll act it out as a team.</p> <p>Small-group discussion time.</p> <p>Now that you have a plan, are you ready to become human models of water molecules?</p> <p>When I give the signal, I want you to act out how <i>solid water</i>, or ice, behaves. Remember, water molecules can't talk, so act this out quietly.</p> <p>Ready, set, GO!</p> <p>NOTE TO TEACHER: <i>Watch how students move during the role-play. As water molecules in a solid state, they should stand close to each other and vibrate in place rather than moving around. Ask probe and challenge questions to make student thinking visible and challenge</i></p>		Questions to ask

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		<p>to probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p><i>incorrect ideas. If several groups are modeling molecular arrangements and movements in a scientifically inaccurate way, stop the role-play and have one group model how molecules should behave in a solid.</i></p> <p>Good job, molecules! Please stop moving now and let's talk about how molecules change from one form to another.</p> <p>What causes water molecules to change from a solid to a liquid?</p> <p>That's right! So pretend that I'm adding heat to your group of molecules and think about what happens when a solid changes to a liquid.</p> <p>When I give the signal, I want you to act out molecules changing from solid water or ice to liquid water. Show how molecules of liquid water would move and behave. And remember that molecules can't make a sound!</p> <p>Ready, set, GO!</p> <p>NOTE TO TEACHER: <i>Watch how students move during the role-play. As water molecules in a liquid state, they should still be standing near each other, but they should move around more freely and slide past each other. They could potentially</i></p>	<p>Adding heat!</p>	<p><i>during the role-play:</i></p> <ul style="list-style-type: none"> • Why are you moving that way? • How does that represent a solid?

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		<p>Ask questions to probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p><i>bump into each other, but they shouldn't move all over the classroom. (Moving all over the room in different directions would represent water molecules as a gas or water vapor.) Ask probe and challenge questions to make student thinking visible and challenge incorrect ideas. If several groups are modeling molecular arrangements and movements in a scientifically inaccurate way, stop the role-play and have one group model how molecules should behave in a liquid.</i></p> <p>You've done a wonderful job, molecules! Please stop moving now and let's talk about how a liquid changes back to a solid.</p> <p>What has to happen for liquid water to change back to solid water, or ice?</p>	<p>It has to get really cold!</p> <p>Heat has to be taken away, like when you took the chocolate and crayons off the griddle.</p>	<p><i>Questions to ask during the role-play:</i></p> <ul style="list-style-type: none"> • Why are you moving that way? • How does that represent a liquid? <p>Can you use the same words scientists do when they talk about changes in matter? How is heat involved?</p>

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		<p>Ask questions to probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p>OK, pretend that I'm removing heat from your group of molecules. Think about what happens when a liquid changes to a solid.</p> <p>When I give the signal, act out molecules changing from liquid water to solid water, or ice. Show how molecules of solid water would move and behave, and remember to act this out quietly!</p> <p>NOTE TO TEACHER: <i>Watch how students move during this role-play. As they change from a liquid to a solid, they should slow down, move closer to one another again, and begin vibrating in place. Ask probe and challenge questions to make student thinking visible and challenge incorrect ideas. If several groups are modeling molecular arrangements and movements in a scientifically inaccurate way, stop the role-play and have one group model how molecules should behave in a solid.</i></p> <p>Thank you, molecules! You can stop moving now and return to your seats.</p> <p>Let's talk about our human model for a moment!</p> <p>NOTE TO TEACHER: <i>Following the role-play, ask students to think about the human model. During this discussion, you might want to review the information on</i></p>		<p><i>Questions to ask during the role-play:</i></p> <ul style="list-style-type: none"> • Why are you moving that way? • How does that represent a solid?

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			<p><i>pages 18 and 21 in A Drop of Water. Point out to students that they didn't melt when they acted like water molecules changing from a solid to a liquid. They were still water molecules; they just moved differently. A common student idea is that the molecules themselves actually melt. Help students see that this is an incorrect idea. When heat is added, instead of melting, the molecules retain their molecular structure. They simply move faster and break out of their rigid formation to flow around more freely as a liquid.</i></p> <p>Show slide 6.</p> <p>How did you move as molecules in solid water or ice?</p> <p>How did you move as molecules in liquid water?</p> <p>What happens to molecules when solid matter becomes liquid matter?</p>	<p>As molecules of solid ice, we just wiggled in place but didn't move around.</p> <p>As molecules of liquid water, we moved around more and slid past each other.</p> <p>The molecules break apart and move</p>	<p>Does that match our definition of a solid?</p>

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			<p>What happens to molecules when liquid matter becomes solid matter?</p> <p>Show slide 7.</p> <p>Do you think our human model shows how water molecules move and change in real life?</p>	<p>around.</p> <p>They break away from each other because they have more energy.</p> <p>From the heat.</p> <p>The heat goes away, and the matter gets cold.</p> <p>When the heat is taken away, the molecules slow down and move closer together. Then they start vibrating in place.</p> <p>Yes, we had more</p>	<p>What do you mean by “break apart”? Can you show us?</p> <p>Where does the energy come from?</p> <p>Can you talk about what happens to the molecules in a liquid when heat is removed?</p>

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			<p>How is our model <i>like</i> or <i>not like</i> what happens in real life?</p> <p>NOTE TO TEACHER: <i>Have students refer to the Lego-model analogy map from the previous lesson to help them compare the human model with molecules in real life.</i></p> <p>You did a great job acting like human water molecules and showing how they move and change in real life!</p>	<p>energy, and then we had less energy, just like molecules in real life.</p> <p>When you added heat, that gave us energy, and we moved around more. Then when the heat was taken away, we had less energy and moved around less.</p> <p>We vibrated just like real molecules in solid water, and then we moved around like real molecules in liquid water.</p>	<p>What does energy have to do with heat?</p> <p>Can anyone add to this idea?</p>
10 min	<p>Activity</p> <p>Synopsis: Students work in pairs to construct a scientific explanation with a claim, evidence, and reasoning that answers the focus questions.</p>	Highlight key science ideas and focus question throughout.	<p>Show slide 8.</p> <p>Next, you'll work with a partner to answer our focus questions, <i>What happens when solid matter becomes liquid matter and liquid matter becomes solid matter? Why do these changes happen?</i></p>		

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	<p>Main science idea(s):</p> <ul style="list-style-type: none"> • Solids and liquids are made up of small particles called <i>atoms</i> and <i>molecules</i>. When heat is added to a solid, the molecules move faster until they break away from their rigid structure and begin flowing around more freely as a liquid. When heat is removed, the molecules slow down and join together in a rigid structure, where they vibrate in place as a solid. 	<p>Make explicit links between science and activities during the activity.</p> <p>Engage students in constructing explanations and arguments.</p>	<p>This is your chance to show what you know about changes in matter!</p> <p>As you work on your explanations, think about the Lego model we used to show how solid matter changes to liquid matter and how liquid matter changes to solid matter. Remember the Lego water molecules in the cardboard box and the baggie.</p> <p>Think about our human model and how your group modeled the different ways water molecules behave in a solid and a liquid.</p> <p>Also think about the different kinds of matter we experimented with in earlier lessons, like the ice, the chocolate, the crayons, and the butter. What happened when we added and removed heat?</p> <p>NOTE TO TEACHER: <i>To help students visualize changes in matter, you might want to give each pair of students a cup of ice and a cup of water as a resource. A familiar example might help them get started constructing their claims.</i></p> <p>Show slide 9.</p> <p>Now find the page in your science notebooks where you wrote today’s focus questions.</p>		

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			<p>Work with your partner to construct a scientific explanation that answers these questions. In your explanation, describe what happens when solid matter becomes liquid matter and liquid matter becomes solid matter. Then explain why you think these changes happen.</p> <p>Write in complete sentences using science ideas about matter and molecules. Include examples and observations from our investigations to support your ideas. This is called <i>evidence</i>. Also make sure to give the reasons for your thinking.</p> <p>Show slide 10.</p> <p>Sentence starters:</p> <ol style="list-style-type: none"> 1. <i>When solid matter becomes liquid matter, _____.</i> 2. <i>When liquid matter becomes solid matter, _____.</i> 3. <i>I think solids become liquids because _____.</i> 4. <i>I think liquids become solids because _____.</i> <p>Or instead of using the sentence starters on the slide, you could come up with your own sentence starters.</p> <p>For example, to explain what happens when solid matter becomes liquid matter, you</p>		

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			<p>could write, <i>When ice becomes water</i>, _____.</p> <p>To explain what happens when liquid matter becomes solid matter, you could write, <i>When water becomes ice</i>, _____.</p> <p>To explain why you think these changes happen, you could say, <i>I think ice becomes water because _____, and I think water becomes ice because _____.</i></p> <p>As you write your sentences, make sure to use the science words on the slide:</p> <ul style="list-style-type: none"> • Water molecules • Solid • Liquid • Add heat • Take heat away • Vibrate in place • Move around freely • Move faster • Move slower <p>Try to come up with your very best explanations for each question and use as many examples, or evidence, from our investigations as you can!</p> <p>NOTE TO TEACHER: <i>Give pairs time to brainstorm their ideas before completing the sentence starters. If students have</i></p>		

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			<p><i>already been introduced to the process of developing claims supported with evidence and reasoning, use this language as they develop their explanations. However, it isn't essential that students know these terms. The goal is for them to use logical thinking as they consider what they've learned from their experiences in this lesson series.</i></p> <p><i>Circulate around the room as pairs work on their claims. Challenge them to complete the sentences using science ideas about matter and molecules and ask them to cite examples (evidence) from one or more of the lesson investigations. Also help them connect their ideas using logical reasoning, key science ideas from the module, and evidence.</i></p>		
15 min	<p>Follow-Up to Activity</p> <p>Synopsis: Students share their scientific explanations (claims, evidence, and reasoning) of what happens when matter changes from a solid to a liquid and from liquid to solid, and why these changes take place.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • Solids change to liquids when molecules move 	<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in communicating</p>	<p>Show slide 11.</p> <p>Now let's hear the explanations you came up with for answering our focus questions, <i>What happens when solid matter becomes liquid matter and liquid matter becomes solid matter? Why do these changes happen?</i></p> <p>Show slide 12.</p> <p>Listen carefully as your classmates share their ideas and reasons, and be ready to agree or disagree, ask questions, or add on</p>		

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	<p>fast enough to break away from their rigid structure and move around more freely. Liquids change to solids when molecules slow down enough to form a rigid structure and vibrate in place. These changes in the motion and arrangement of atoms and molecules of a particular kind of matter happen because of heat. When heat is added, molecules gain energy, move faster, and flow freely as a liquid. When heat is removed (matter cools), molecules lose energy, slow down, and vibrate in place as a solid.</p>	<p>in scientific ways.</p>	<p>to their ideas. Let's communicate in scientific ways!</p> <p>NOTE TO TEACHER: <i>As needed, review the guidelines for strategy 8 (Engage students in communicating in scientific ways) in the STeLLA strategies booklet. This strategy provides language you can use to introduce students to the scientific argumentation process:</i></p> <ul style="list-style-type: none"> • <i>Give evidence for your idea or claim.</i> • <i>Reason from evidence or models to explain your data and observations.</i> • <i>Listen to others' ideas and ask clarifying questions.</i> • <i>Agree or disagree with others' ideas [and state why].</i> • <i>Add onto someone else's ideas.</i> • <i>Let your ideas change and grow.</i> <p><i>Also review the sentence starters on the CSW poster and challenge students to state their ideas in complete sentences.</i></p> <p><i>Students won't be able to provide firsthand evidence of molecular movement; however, they can use evidence from the content representations or models they've worked with throughout the unit to support their ideas.</i></p> <p><i>Help students state their ideas (claims)</i></p>		

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		<p>Ask questions to probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p><i>clearly. Ask, “What happened, and why do you think it happened?” Use questions that probe and challenge student thinking. Make sure students support their ideas/claims with evidence (information, data, and observations of the models) and logical/scientific reasoning. Ask, “What do you think this means?” “How can you connect your claim/ideas to your examples/evidence and reasons?”</i></p> <p>First, let’s hear your ideas about how matter changes from a solid to a liquid.</p> <p>What happens when solid matter becomes liquid matter?</p> <p>NOTE TO TEACHER: <i>Invite students to share the sentences they completed and try to engage everyone in the discussion. Encourage students to talk with their partners before responding. Remind students of previous investigations:</i></p> <ul style="list-style-type: none"> • <i>Observing matter at different stations—ice/water, butter/melted butter, paper/burned paper, baking soda and vinegar (lessons 1a/b)</i> • <i>Observing ice/water, chocolate/melted chocolate, and crayons/crayon wax as heat is added and removed. (lesson 2a)</i> 	<p>When solid matter becomes liquid matter, the molecules move all around.</p> <p>We saw the water molecules moving more when the ice melted and turned to liquid water.</p> <p>When we used a Lego model, we saw the water molecules move around in the</p>	<p>What’s your evidence?</p> <p>Does anyone have other evidence to add?</p>

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			<ul style="list-style-type: none"> • <i>Building sentences with words and pictures (lesson 2b)</i> • <i>Observing changes in solid and liquid matter using the Lego model with the cardboard box and sandwich baggie (lessons 3a/b)</i> • <i>Observing ice and water in cups (lessons 3a/b)</i> • <i>Completing an analogy map of the Lego model (lesson 4a)</i> • <i>Reading about water molecules in A Drop of Water (lessons 3a and 4a)</i> • <i>Acting as human models to show how water molecules behave in solid and liquid states (lesson 4b)</i> <p>What happens when liquid matter becomes solid matter?</p> <p>Why do these changes happen?</p> <p>NOTE TO TEACHER: <i>These questions don't have to be answered separately. Students' ideas and explanations will likely flow back and forth between the three key science ideas: (1) What happens when solid matter becomes liquid matter, (2) what happens when liquid matter becomes solid matter, and (3) why these changes happen (or what causes the changes).</i></p>	baggie.	How do the Lego bricks in the box and the baggie relate to ice and water?

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			<p><i>The goal is to help students explain their thinking in a way that reflects the ideal student response on the overview page.</i></p> <p><i>As students share their explanations, record key ideas and reasoning on chart paper for students to refer to during the synthesize/summarize activity and the next lesson. If students offer evidence to support their ideas, include that as well.</i></p>		
8 min	<p>Synthesize/Summarize Today's Lesson</p> <p>Synopsis: Students summarize their understandings of matter by considering whether their scientific explanations of how and why matter changes apply to butter, chocolate, and crayon wax.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> All matter is made up of small particles called <i>atoms</i> and <i>molecules</i>. The particles themselves don't change; they just gain energy, move faster, and flow around more freely when heat is added, and they lose 	<p>Engage students in making connections by synthesizing and summarizing key science ideas.</p> <p>Engage students in constructing explanations and arguments.</p>	<p>Show slide 13.</p> <p>Now I have a final challenge for you to work on with an elbow partner.</p> <p>Do you think you can explain what happens to other kinds of matter the same way you explained what happens to solid water, or ice, and liquid water?</p> <p>For this challenge, you'll think about other kinds of matter you observed in our investigations: butter, chocolate, and crayons.</p> <p>Show slide 14.</p> <p>Then you'll answer the questions on the slide:</p> <ol style="list-style-type: none"> What do you think happens when butter becomes melted butter and then becomes solid butter again? 		

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	<p>energy, slow down, and vibrate in place when heat is taken away. This happens when matter of any kind undergoes a physical change from a solid to a liquid and from a liquid to a solid.</p>	<p>Engage students in communicating in scientific ways.</p>	<p>Think about our evidence from lesson 1.</p> <ol style="list-style-type: none"> 2. What do you think happens when chocolate and crayon pieces become liquid and then become solid again? Think about our evidence from lesson 2? 3. Why do you think these changes happen? <p>Turn and Talk: Talk about these questions with your partner; then write down your explanations in complete sentences in your science notebooks and use examples, or evidence, from our investigations to support your ideas. Be prepared to share your ideas with the class.</p> <p>NOTE TO TEACHER: <i>Since most of the investigations, readings, and models in this unit have focused on molecular movement in water and ice, students may not have generalized the science ideas to include other kinds of matter they observed. As needed, engage students in communicating in scientific ways to resolve any inaccuracies in their understandings. Help them understand that the specific molecules that make up other substances are different from water molecules, but these molecules behave in the same way when heat is added or removed during a physical change in matter.</i></p>		

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		Summarize key science ideas.	<p>Whole-class share-out: Let’s hear your answers to the questions about what happens when other kinds of matter change, and why these changes happen.</p> <p>NOTE TO TEACHER: <i>Invite a few students to share their explanations for each question. Challenge them to support their ideas using evidence (examples) from previous investigations.</i></p> <p>Great scientific thinking, everyone!</p> <p>Show slide 15.</p> <p>Now let’s summarize what we’ve learned so far about matter and changes in matter:</p> <ul style="list-style-type: none"> • Heating and cooling (removing heat) can cause changes in matter. • When heat is added to a solid, the molecules move faster. When they move fast enough to break away from their rigid structure, they flow around more freely as a liquid. • When heat is removed from a liquid and the matter cools, the molecules slow down, join together in a rigid structure, and vibrate in place as a solid. 		
1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher</p>	Link science	<p>Show slide 16.</p> <p>You did an excellent job constructing</p>		

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	announces that in the next lesson, students will create comic strips to show what they've learned about matter.	ideas to other science ideas.	<p>scientific explanations of what happens when matter changes and why these changes happen!</p> <p>In our next lesson, you'll show what you know about matter by creating a comic strip that explains what matter is made of and how it can change.</p> <p>Are you ready to be creative scientific thinkers?</p>		