

Properties of Matter

Lesson 5a: Changes in Matter—Before, During, and After

Grade 2	Length of lesson: 47 minutes	Placement of lesson in unit: 5a 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 is matter made of? How can matter change?
<p>Main learning goal: All matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change from a solid to a liquid when heat is added and the molecules begin to move faster. When they move fast enough, they break away from their rigid structure and flow around more freely as a liquid. Matter can change from a liquid to a solid when heat is removed and the molecules slow down. When they slow down enough, they join together in a rigid structure and vibrate in place as a solid.</p>		
<p>Science content storyline: All matter is made up of very small particles that are either atoms or combinations of atoms called <i>molecules</i>. Matter undergoes physical changes when heat is added or removed. These changes cause the molecules to move more rapidly or more slowly, but the structure of the molecules doesn't change. In physical changes, the matter is always the same substance, like water or butter, but the states of matter (solid, liquid, gas) are reversible. Solid matter can become liquid matter when heat is added, and liquid matter can become solid matter again when heat is removed and the matter cools down.</p>		
<p>Ideal student response to the focus question: Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change when heat is added or taken away. If you add heat to a solid, the molecules move faster. When they move fast enough, they break away from each other and flow around more freely as a liquid. If you take heat away from a liquid, the matter cools down, and the molecules move more slowly until they stick together and vibrate in place as a solid. This process is reversible, so solid matter can change to liquid matter and back to solid matter over and over again when heat is added or taken away. The molecules themselves don't change, so water is always water as a solid or a liquid. The only thing that changes is how the molecules are arranged and move.</p>		

Preparation

Materials Needed

- Science notebooks
- Chart paper and markers
- Colored pencils, pens, or crayons (for drawing comic strips)
- **Optional:** Comic strips from the local newspaper (for activity)

Student Handouts

- 5.1 Changes in Matter—Before, During, and After (1 per student, plus a few extras for revisions)

Ahead of Time

- Review the content background document.
- Make all charts, lists, models, and visual aids from previous lessons available for students to use during the lesson activity.
- **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. Review vocabulary words from the previous lesson, including *rigid*. Identify vocabulary terms in the lesson plan to introduce ahead of time, including *panel*. Consider having students write these words and their meanings in their science notebooks or add them to a key-word or picture dictionary. Also post them on a word wall for students to refer to as needed.

Lesson 5a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
5 min	Link to previous lessons: Students summarize what they learned in previous lessons about the properties of matter and how matter changes.	<ul style="list-style-type: none"> Matter can change when heat is added or removed (when matter cools). When heat is added, solid matter can melt and become liquid matter. When heat is removed, liquid matter can cool down and become solid matter again. This process of melting and freezing can cycle back and forth as heat is added and removed.
1 min	Lesson focus questions: The teacher introduces the focus questions, which are also the unit central questions: <i>What is matter made of? How can matter change?</i>	
7 min	Setup for activity: Students share examples of how matter changes in their everyday lives. Then they imagine what they would see if they could fit inside matter that's undergoing a physical change.	<ul style="list-style-type: none"> Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i> that are too small to see. Molecules move in different ways in solids and liquids. Molecules in a solid vibrate in place, but molecules in a liquid move around more freely. When matter is heated, the molecules move faster; when heat is removed and the matter cools, the molecules move more slowly.
15 min	Activity: The teacher shows students a few examples of cartoon strips from a local newspaper. Then students work together in teams to create comic strips that illustrate how different kinds of matter change.	<ul style="list-style-type: none"> All matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change from a solid to a liquid when heat is added and the molecules move fast enough to flow around each other more freely. Matter can change from a liquid to a solid when heat is removed and the matter cools. When the molecules slow down enough, they form a rigid structure and vibrate in place.
10 min	Follow-up to activity: Teams pair up to share their comic strips and exchange feedback and suggestions for improving them.	
8 min	Synthesize/summarize today's lesson: Students discuss with their teammates the feedback and suggestions they received. Then based on this feedback, they revise their comic strips to reflect their best answers to the unit central questions.	<ul style="list-style-type: none"> Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change when heat is added or removed (when matter cools). Solid matter changes to liquid matter when heat is added and the molecules move fast enough to flow around more freely. Liquid matter changes to solid matter when heat is removed and the molecules slow enough to stick together and form a rigid structure that vibrates in place. The molecules themselves don't change; only their arrangement and motion change. The process of melting and freezing is reversible. Matter can change from a solid to a liquid and back to a solid again as heat is added or taken away.
1 min	Link to next lesson: The teacher announces that in the final lesson, students will share their revised comic strips with the class and answer the unit central questions.	

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5 min	<p>Link to Previous Lessons</p> <p>Synopsis: Students summarize what they learned in previous lessons about the properties of matter and how matter changes.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Matter can change when heat is added or removed (when matter cools). When heat is added, solid matter can melt and become liquid matter. When heat is removed, liquid matter can cool down and become solid matter again. This process of melting and freezing can cycle back and forth as heat is added and removed. 	<p>Link science ideas to other science ideas.</p> <p>Summarize key science ideas.</p> <p>Ask questions to</p>	<p>Show slides 1 and 2.</p> <p>What have you learned about matter in this unit? What do you know now that you didn't know before? What science ideas were new to you?</p> <p>Look back through your science notebooks and handouts and think about our investigations in other lessons. How would you summarize what you've learned?</p> <p>Turn and Talk (2–3 min): Turn to an elbow partner and share some of the science ideas you've learned about in this unit that were new to you. Be prepared to share these ideas with the class.</p> <p>Whole-class share-out: What have you learned about matter in this unit that you didn't know about before?</p> <p>ELL support: During the lesson preview, let ELL students know that you'll be asking them to share their ideas with the class. Give them time to practice answering these review questions in advance. Then make sure to ask students to share their responses during the actual lesson. Also let them know it's OK to repeat someone else's ideas. This is good practice and will make student thinking visible.</p> <p>NOTE TO TEACHER: <i>As students share their ideas, record them on chart paper. Ask probe and challenge questions to clarify student thinking and</i></p>	<p>I didn't really know what matter was.</p> <p>That matter is just about everything.</p> <p>I didn't know that matter was made of little pieces like molecules.</p> <p>They move around</p>	<p>And what did you learn?</p> <p>Who can add something you learned about molecules?</p>

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		<p>probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p><i>help students move forward toward more-scientific understandings.</i></p>	<p>sometimes.</p> <p>I didn't know that matter could change.</p> <p>I learned that matter can melt and then get hard again.</p> <p>I think I already knew that things froze when they got cold and melted when they got hot, but I didn't know that all kinds of things that are usually solid can melt, too.</p> <p>I didn't know a penny could melt, or a rock. They seem like they're too solid to melt.</p>	<p>What else didn't you know about before?</p> <p>Can anyone add to this idea?</p> <p>Can you give me an example of something you didn't realize could melt?</p> <p>What do you mean by "too solid"?</p>

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				<p>Well, they're really hard—not like chocolate or butter. Those things are all kind of soft to begin with, and so it makes sense that they could melt. But a penny is really hard.</p> <p>Atoms and molecules don't change when the matter changes. They stay the same.</p> <p>I mean that the kind of matter stays the same. Like water is always water even when it changes from a solid to a liquid or from a liquid to a solid. The molecules just move differently when</p>	<p>What other ideas were new to you?</p> <p>What do you mean by “stay the same”? What happens to the atoms or molecules during freezing and melting?</p>

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				they freeze or melt.	
1 min	<p>Lesson Focus Questions</p> <p>Synopsis: The teacher introduces the focus questions, which are also the unit central questions: <i>What is matter made of? How can matter change?</i></p>	Set the purpose with a <u>focus question</u> or goal statement.	<p>Show slide 3.</p> <p>You've learned so much about matter in this unit!</p> <p>Since we're approaching the end of our lesson series, we're going to focus our attention on answering our unit central questions, <i>What is matter made of? How can matter change?</i> These questions also happen to be our focus questions for today.</p> <p>In our last lesson, you constructed scientific explanations for what happens when solid matter becomes liquid matter and liquid matter becomes solid matter.</p> <p>You also explained why you think these changes happen based on everything you've learned about how molecules move in a solid and a liquid and what happens when we add or remove heat.</p> <p>In this lesson, you'll show what you know about matter in a more creative way, and at the same time, you'll answer our focus questions and unit central questions.</p>		
7 min	<p>Setup for Activity</p> <p>Synopsis: Students share examples of how matter changes in their everyday lives. Then they imagine what they would see if</p>	Make explicit links between science ideas and activities before the	<p>Show slide 4.</p> <p>We've seen many examples of matter changing in this unit, haven't we? Like butter, chocolate, crayons, and water.</p>		

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	<p>they could fit inside matter that's undergoing a physical change.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i> that are too small to see. Molecules move in different ways in solids and liquids. Molecules in a solid vibrate in place, but molecules in a liquid move around more freely. When matter is heated, the molecules move faster; when heat is removed and the matter cools, the molecules move more slowly. 	activity.	<p>Show slide 5.</p> <p>Can you think of other examples of matter changing in the world around us? What changes in matter have you noticed in your everyday lives?</p> <p>Who can think of an example of matter changing that we haven't observed in class?</p> <p>Think-Pair-Share: Think about these questions for a minute and then share some examples with an elbow partner. Be prepared to share your examples with the class.</p> <p>Whole-class share-out: OK, who would like to share one of the examples you thought of? How have you seen matter changing in your everyday life?</p> <p>ELL support: During the lesson preview, let ELL students know that you'll be asking them to share their examples with the class. Give them an opportunity to practice brainstorming examples in advance. Then make sure to ask students to share their examples during the actual lesson.</p> <p>NOTE TO TEACHER: <i>Encourage students to share as many examples as they can in the time allotted. Then choose one or two examples and ask students to visualize or imagine what happens to the molecules in that kind of matter when a solid changes to a liquid or a liquid changes to a solid. In the following example, students are</i></p>	<p>When my mom made a grilled-cheese sandwich, the cheese melted and got all gooey.</p> <p>I had a bowl of ice cream that melted because I didn't eat it fast enough.</p> <p>My brother's popsicle melted when he left it outside.</p>	<p><i>Questions to ask:</i></p> <ul style="list-style-type: none"> What kind of change was this? Is this an example of solid matter changing to liquid matter or liquid matter changing to solid matter?

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		Ask questions to elicit student ideas and predictions.	<p><i>asked to imagine what happens to the molecules in a marshmallow that's toasting over an open fire, but the same line of questioning can be used with any of the other examples.</i></p> <p>ELL support: If ELL students aren't familiar with toasting marshmallows over an open fire, they may have a difficult time imagining what happens to the molecules. To make sure they can visualize the molecules, you may want to use another example (e.g., melting ice cream) that everyone will be familiar with.</p> <p>These are all great examples!</p> <p>Show slide 6.</p> <p>Now I want everyone to close your eyes and think about the marshmallow toasting over a fire. What happens to the part of the marshmallow that melts—the gooey inside part?</p> <p>Imagine you're small enough to fit inside that marshmallow. What would you see? What happens to the molecules as the marshmallow melts?</p> <p>As you imagine being inside that marshmallow, think about our focus questions, <i>What is matter</i></p>	<p>Sometimes my dad melts caramel on the stove and dips apples in caramel sauce. But the caramel gets hard again if we don't eat the apples right away.</p> <p>Our family went camping, and we toasted marshmallows over a fire. The middle part of my marshmallow melted, but the outside burned.</p> <p>I would see the molecules moving faster.</p>	Can you describe how the molecules

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		<p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p> <p>Highlight key science ideas and focus question throughout.</p>	<p><i>made of? How can matter change?</i></p> <p>What happens to the molecules <i>before</i> the change, <i>during</i> the change, and <i>after</i> the change?</p> <p>Next, you'll work in teams to answer the same questions for different kinds of matter.</p> <p>You'll need to use all of the science ideas you've been learning about. And you'll need to use your imagination!</p>	<p>Before the marshmallow started toasting over the fire, the molecules are just vibrating in place, like vrrrrrrrr.</p> <p>When the marshmallow heated up, the molecules move faster.</p> <p>When the marshmallow melts, the molecules stop vibrating and start moving around and sliding past each other.</p>	<p>move <i>before</i> they start heating up, <i>while</i> they're heating up, and <i>after</i> the inside of the marshmallow melts?</p>
15 min	Activity	Engage students in using and	How many of you read comic strips in a newspaper or a comic book?		

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	<p>Synopsis: The teacher shows students a few examples of cartoon strips from a local newspaper. Then students work together in teams to create comic strips that illustrate how different kinds of matter change.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> All matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change from a solid to a liquid when heat is added and the molecules move fast enough to flow around each other more freely. Matter can change from a liquid to a solid when heat is removed and the matter cools. When the molecules slow down enough, they form a rigid structure and vibrate in place. 	<p>applying new science ideas in a variety of ways and contexts.</p> <p>Select content representations and models matched to the learning goal and engage students in their use.</p> <p>Highlight key science ideas and focus question throughout.</p>	<p>Let's look at a few examples of comic strips and how they're constructed. Notice that each comic strip has a beginning, a middle, and an end.</p> <p>For today's activity, I'll assign each team a different kind of matter, and you'll create a comic strip that shows how the matter changes. Your comic strip should answer our focus questions, which are also our unit central questions: <i>What is matter made of? How can matter change?</i> So keep these questions in mind while you're creating your comic strip.</p> <p>ELL support: During the lesson preview, explain the comic-strip activity to ELL students. If they're not sure what's expected of them in the actual lesson, you may want to have them create comic strips ahead of time.</p> <p>NOTE TO TEACHER: <i>Divide the class into teams of three or four students. Then assign a different kind of matter to each team. You could assign matter from previous lessons, such as ice, butter, chocolate, or crayon pieces. Or you might assign some teams one of the examples from their everyday lives. You may want to have teams create a comic strip that only shows matter changing from a solid to a liquid (melting), or if students have a good understanding of the reversibility of changes in matter, you could have them show matter changing from a solid to a liquid and then back to a solid. For example, one team could create a comic strip showing ice changing to water and then back to ice, or they</i></p>		

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			<p><i>could show solid butter changing to melted butter and then back to solid butter.</i></p> <p><i>After assigning a different kind of matter to each team, distribute handout 5.1 (Changes in Matter—Before, During, and After) and read through the directions together.</i></p> <p>Show slide 7.</p> <p>First, I want you to discuss with your team what you know about your assigned example of matter. What is the matter made of? How can the matter change?</p> <p>Think about what happens to the atoms or molecules <i>before</i>, <i>during</i>, and <i>after</i> the matter changes. Use resources from other lessons to help you. Look at your science notebooks and handouts, as well as the charts and lists posted around our classroom.</p> <p>Discuss how you could help someone understand your example of matter changing by creating a comic strip to illustrate these changes.</p> <p>Notice that the comic strip on the handout has three panels. In the first panel, you'll show what the molecules are like <i>before</i> the matter changes. In the middle panel, you'll show what happens <i>during</i> the change. And in the last panel, you'll show what happens <i>after</i> the matter changes.</p> <p>Using colored pencils or pens, draw pictures, add</p>		

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			<p>words and arrows to label what’s going on, and write a caption in the smaller box at the bottom of each panel. You can even create talk bubbles to show the matter or the molecules talking!</p> <p>You can work together to create one comic strip as a team, or you can decide to have everyone create their own comic strips. Talk about it with your teammates and decide what you want to do. Even if each of you draws your own comic strip, you can still get ideas from your teammates.</p> <p>Since you’ll have only 10 minutes to complete your comic strips, you’ll need to work quickly. This isn’t an art project, so don’t spend all of your time drawing just one molecule in the first panel. Make a quick sketch of your ideas and move on to the next panel. I’ll help you keep track of the time to make sure you finish all three panels.</p> <p>NOTE TO TEACHER: <i>Circulate around the room as teams discuss their ideas and create their comic strips. Give teams a couple of minutes to decide how to proceed and whether to create a team comic strip or have everyone create their own. Help teams manage their time by giving them a signal every 3 minutes to move on to the next panel on the handout.</i></p> <p> Embedded Assessment Task</p> <p>NOTE TO TEACHER: <i>This activity can be used as an embedded assessment task. As teams share</i></p>		

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			<p><i>their ideas for creating the comic strips, listen for understandings of key science ideas about matter and the movement and arrangement of molecules in liquid and solid states. You can continue this assessment during the activity follow-up as teams exchange feedback and suggestions for improving one another's comic strips.</i></p>		
10 min	<p>Follow-Up to Activity</p> <p>Synopsis: Teams pair up to share their comic strips and exchange feedback and suggestions for improving them.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> All matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change from a solid to a liquid when heat is added and the molecules move fast enough to flow around each other more freely. Matter can change from a liquid to a solid when heat is removed and the matter cools. When the molecules slow down enough, they form a rigid structure and vibrate in place. 	<p>Make explicit links between science ideas and activities after the activity.</p> <p>Highlight key</p>	<p>Show slide 8.</p> <p>Now that you've created your comic strips, you'll pair up with another team to share your comics and give each other feedback. I'll assign the teams in a moment, but first let's talk about some guidelines.</p> <p>As you share your comic strips, try to help the other team understand the science ideas you're illustrating with your drawings and words.</p> <p>Listen carefully as members of the other team share their drawings and ideas and think of suggestions you could make to help them improve their comic strips or connect the science ideas from our lessons on matter.</p> <p>Ask yourself these questions as you listen:</p> <ul style="list-style-type: none"> Are the science ideas clear? Do the drawings help me understand the science ideas? How can the comic strip be improved? <p>Remember that your comic strips should answer</p>		

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		<p>science ideas and focus question throughout.</p> <p>Ask questions to probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p>our focus questions and unit central questions, <i>What is matter made of? How can matter change?</i></p> <p>This is your chance to get feedback that will help you develop your best answers to these questions.</p> <p>NOTE TO TEACHER: <i>Assign different teams to pair up and share their comic strips. Inform members of the presenting team that they have 2 minutes to share their drawings and ideas. After the presentation, members of the listening team will have 3 minutes to give feedback and suggestions for improving the comic strips. Then have the teams reverse roles.</i></p> <p>ELL support: You may want to assign teams so that ELL students with greater English proficiency can help students with less proficiency explain their ideas in English.</p> <p>NOTE TO TEACHER: <i>As teams share their comic strips and exchange feedback, circulate around the room and listen to students' conversations. Ask probe and challenge questions to clarify student thinking and help them connect their ideas to the unit central questions. Guide student thinking toward the ideal student response and the key ideas in the main learning goal (see overview page).</i></p>		
8 min	Synthesize/Summarize		Show slide 9.		

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	<p>Today's Lesson</p> <p>Synopsis: Students discuss with their teammates the feedback and suggestions they received. Then based on this feedback, they revise their comic strips to reflect their best answers to the unit central questions.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. Matter can change when heat is added or removed (when matter cools). Solid matter changes to liquid matter when heat is added and the molecules move fast enough to flow around more freely. Liquid matter changes to solid matter when heat is removed and the molecules slow enough to stick together and form a rigid structure that vibrates in place. The molecules themselves don't change; only their arrangement and motion 	<p>Engage students in making connections by synthesizing and summarizing key science ideas.</p>	<p>Now I'd like you to talk with your teammates about the feedback you received from the other team. How can you use the feedback and suggestions to improve your comic strips?</p> <p>As you consider how you might revise your comic strips, think about these questions:</p> <ul style="list-style-type: none"> Does my comic strip show what matter is made of and how it can change? Is there a better way to show what happens before, during, and after a change in matter? Are my drawings and descriptions clear? Have I used science words and ideas in my descriptions? Are they in the right places? Do I need to add any labels, captions, or talk bubbles? <p>Then revise your comic strips or create a new comic strip if you want to change your approach. Raise your hand if you think you'll need a new handout to make your changes.</p> <p>NOTE TO TEACHER: <i>As needed, distribute extra copies of handout 5.1 (Changes in Matter—Before, During, and After) to students who want to make revisions or create a new comic strip.</i></p> <p>Make sure your drawings and ideas answer each of our unit central questions: <i>What is matter made of? How can matter change?</i></p>		

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	change. The process of melting and freezing is reversible. Matter can change from a solid to a liquid and back to a solid again as heat is added or taken away.				
1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher announces that in the final lesson, students will share their revised comic strips with the class and answer the unit central questions.</p>	Link science ideas with other science ideas.	<p>Show slide 10.</p> <p>You've done some really creative scientific thinking today!</p> <p>Now that you've revised your comic strips, you'll have an opportunity to share them with the class next time and show how they answer our unit central questions.</p> <p>Are you ready to show what you know about matter?</p>		