

Properties of Matter

Lesson 3a: What Is Matter Made Of?

Grade 2	Length of lesson: 47 minutes	Placement of lesson in unit: 3a 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 liquid water made of? What is solid water (ice) made of?
Main learning goal: The atoms or molecules that make up a particular kind of matter are the same whether the matter is in a solid form, such as ice, or a liquid form, such as liquid water.		
Science content storyline: All matter is made up of very small pieces. Atoms are the smallest pieces of matter. When atoms combine, they form molecules, which are also very small pieces of matter. Each kind of matter, such as water, is made up of a particular arrangement of atoms or molecules. These atoms or molecules are the same whether the matter is in a solid form (ice) or in a liquid form (liquid water). Because atoms and molecules are too small to see, models can give us an idea of what real matter is made of.		
Ideal student response to the focus questions: Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i> . If we could shrink small enough to fit inside the matter, we would see that each kind of matter has a different arrangement of atoms or molecules. Water has two atoms of hydrogen and one atom of oxygen. These molecules are the same in ice and liquid water. We can use a Lego-brick model to show what matter is made of.		

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 of the book) • For each group of 4 students: <ul style="list-style-type: none"> • Lego bricks (10 red, 2 × 4"; 20 white, 2 × 2") • Small, sealable plastic sandwich bag (for Lego bricks) • Water in a plastic cup • Ice cubes in a plastic cup <p>Student Handouts</p> <ul style="list-style-type: none"> • 3.1 Lego Model (laminated, 1 per group) 	<p>Ahead of Time</p> <ul style="list-style-type: none"> • Review the content background document. • Laminate handout 3.1 (Lego Model), since students will use it in multiple lessons. • Place ice cubes and water in cups just before the lesson begins. Place each set of Lego bricks (10 red and 20 white bricks per group) in a sealable plastic sandwich bag. Each group will use the bricks to create water molecules. • Some students may not be familiar with the basic science ideas, such as hydrogen, oxygen, atoms, and molecules, presented in this lesson, so be prepared to provide additional support. Students may also think of molecules and atoms as “ingredients” (like flour and sugar) rather than the basic building blocks of matter. • 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 vocabulary terms in the lesson plan to introduce ahead of time, including <i>scale</i>, <i>hydrogen</i>, <i>oxygen</i>, <i>atom</i>, <i>molecule</i>, <i>model</i>, <i>microscope</i>, and the abbreviation H₂O. 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.
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Lesson 3a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
5 min	Link to previous lesson: The teacher engages students in a review of what causes matter to change from a solid to a liquid and then back to a solid again.	<ul style="list-style-type: none"> Matter in its solid form can become a liquid when heat is added. This is called <i>melting</i>. Matter in its liquid form can become a solid when heat is removed and the liquid matter cools.
1 min	Lesson focus questions: The teacher reviews the unit central questions, <i>What is matter made of? How can matter change?</i> Then the teacher introduces the focus questions, <i>What is liquid water made of? What is solid water (ice) made of?</i>	
5 min	Setup for activity: Students predict what they might see if they were small enough to fit inside a drop of water. Then the teacher introduces students to the concepts of molecules and atoms by reading about a drop of water.	<ul style="list-style-type: none"> All matter is made up of very small pieces. Atoms are the smallest pieces of matter. When atoms combine, they form molecules, which are also very small pieces of matter. Each kind of matter in our world is made up of a particular arrangement of atoms or molecules.
10 min	Activity: The teacher introduces a Lego-brick model to represent water molecules. Then students construct models of water molecules using Lego bricks.	<ul style="list-style-type: none"> All matter is made up of very small pieces. Atoms are the smallest pieces of matter. When atoms combine, they form molecules, which are also very small pieces of matter. Each kind of matter, such as water, is made up of a particular arrangement of atoms or molecules. Because atoms and molecules are too small to see, we can use a model to get an idea of what real matter is made of.
15 min	Follow-up to activity: Working in small groups, students observe a cup of water and a cup of ice and think about whether the molecules in these substances are the same or different. Then they use their Lego-brick models to show how they think water molecules might be arranged in solid and liquid states.	<ul style="list-style-type: none"> Each kind of matter, such as water, is made up of a particular arrangement of atoms or molecules. These atoms or molecules are the same whether the matter is in a solid form (ice) or in a liquid form (liquid water). Because atoms and molecules are too small to see, we can use a model to get an idea of what real matter is made of.
10 min	Synthesize/summarize today's lesson: The teacher reviews the focus questions, <i>What is liquid water made of? What is solid water (ice) made of?</i> Then students draw pictures to show what they think liquid water and solid water (ice) are made of.	<ul style="list-style-type: none"> Matter is made up of very small pieces called <i>atoms</i> and <i>molecules</i>. If we could shrink small enough to fit inside different kinds of matter, we would see that each kind has a different arrangement of atoms or molecules. A water molecule has two atoms of hydrogen and one atom of oxygen. These molecules are the same in ice and liquid water. We can use a Lego-brick model to show what matter is made of.
1 min	Link to next lesson: The teacher announces that in the next lesson, students will explore the arrangement and movement of water molecules in a solid state and a liquid state.	

Time	Phase of Lesson and How the Science Content Storyline Develops	STeLLA Strategy	Teacher Talk and Questions	Anticipated Student Responses	Possible Probe/Challenge Questions
5 min	<p>Link to Previous Lesson</p> <p>Synopsis: The teacher engages students in a review of what causes matter to change from a solid to a liquid and then back to a solid again.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • Matter in its solid form can become a liquid when heat is added. This is called <i>melting</i>. Matter in its liquid form can become a solid when heat is removed and the liquid matter cools. 	Link science ideas to other science ideas.	<p>Show slide 1.</p> <p>In our last lesson, we talked about matter in a solid form and a liquid form, and you used words and pictures to create sentences describing how matter can change from one form to another.</p> <p>Let’s review the sentences you created.</p> <p>NOTE TO TEACHER: <i>Draw students’ attention to the sentences you recorded on chart paper during the previous lesson. Also have them look at the sentences they wrote in their science notebooks. Give students a minute to review and revise their sentences. Then have them read their sentences aloud.</i></p> <p>ELL support: During the lesson preview, give ELL students an opportunity to review and revise their sentences.</p> <p>Show slide 2.</p> <p>What did we learn last time about what causes matter to change from a solid to a liquid or from a liquid to a solid?</p>	<p>To make something melt, you have to add heat.</p> <p>You have to add heat to change</p>	<p>What do you mean by “melt”? How is that related to a solid or a liquid?</p>

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		<p>Highlight key science ideas and focus question throughout.</p>	<p>Show slide 3.</p> <p>Remember that scientists talk about how <i>heat</i> causes matter to change. <i>Adding heat</i> changes a solid to a liquid, and <i>removing heat</i> changes a liquid to a solid. So if the matter is warmer, it has <i>more heat</i>, and if the matter is cooler, it has <i>less heat</i>.</p>	<p>matter from a solid to a liquid.</p> <p>You have to add cold.</p> <p>You have to put the liquid near something cold. When we took the melted chocolate away from the heat and put it on a cold table, it changed back to a solid.</p> <p>Yes. For matter to change from a liquid to a solid, it needs to have less heat.</p>	<p>OK. What causes matter to change from liquid to a solid?</p> <p>Tell us more about adding cold.</p> <p>Do you think that taking away heat has anything to do with changing a liquid to a solid?</p>

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			<p>Today we'll take a closer look at what matter is made of.</p> <p>Do you think that solid matter, like ice, is made of the same or different stuff as liquid matter, like liquid water?</p> <p>Let's find out!</p>		
1 min	<p>Lesson Focus Questions</p> <p>Synopsis: The teacher reviews the unit central questions, <i>What is matter made of? How can matter change?</i> Then the teacher introduces the focus questions, <i>What is liquid water made of? What is solid water (ice) made of?</i></p>	Set the purpose with a <u>focus question</u> or goal statement.	<p>Show slide 4.</p> <p>In this lesson, we'll continue thinking about our unit central questions, <i>What is matter made of? How can matter change?</i></p> <p>Over the past few days, we've learned a lot about matter and how it can change. Today we'll see if we can figure out whether solids and liquids are made of the same kind of matter.</p> <p>Show slide 5.</p> <p>Our focus questions for this lesson are <i>What is liquid water made of? What is solid water (ice) made of?</i></p> <p>Write these focus 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</i></p>		

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			<i>throughout the lesson.</i>		
5 min	<p>Setup for Activity</p> <p>Synopsis: Students predict what they might see if they were small enough to fit inside a drop of water. Then the teacher introduces students to the concepts of molecules and atoms by reading about a drop of water.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> All matter is made up of very small pieces. Atoms are the smallest pieces of matter. When atoms combine, they form molecules, which are also very small pieces of matter. Each kind of matter in our world is made up of a particular arrangement of atoms or molecules. 	<p>Make explicit links between science ideas and activities before the activity.</p> <p>Ask questions to elicit student ideas and predictions.</p>	<p>Show slide 6.</p> <p>Today we'll explore a kind of matter you're already very familiar with: water!</p> <p>What do you think you might see if you could shrink small enough to fit inside a tiny drop of water? Would the solid water and the liquid water look the same at this size or scale?</p> <p>Turn and Talk (2 min): Talk about these questions with an elbow partner and then write your predictions and ideas in your science notebooks. Be prepared to share your ideas with the class.</p> <p>ELL support: Preview these questions with ELL students. Also make sure they understand what the term <i>scale</i> means in this context, since they may be familiar with a different meaning.</p> <p>Whole-class share-out: So what do you think you'd see if you could fit inside a tiny drop of water? Would the solid water and liquid water look the same at this size or scale?</p>	<p>I don't think I'd see anything at all. It would be just like swimming in a pool. The water is clear, so you don't really see it.</p>	<p>What ideas do others have?</p>

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		Summarize key science ideas.	<p>Next, I'm going to read a page from a book called <i>A Drop of Water</i>. Listen carefully to how the author describes a drop of water.</p> <p>NOTE TO TEACHER: <i>Show the picture on page 7 of A Drop of Water and read that page aloud to students.</i></p> <p>Show slide 7.</p> <p>So according to this book, a drop of water is made up of very tiny particles called <i>molecules</i>. There are more than three hundred trillion molecules in the smallest droplet of water on the head of this pin.</p> <p>Look at the bottom corner of this page. This is the actual size of the pin, so this tiny drop of water must be very, very, <i>very</i> small.</p>	<p>I think water is made up of tiny bits, but I don't know what they would look like.</p> <p>Tiny bits are very small pieces of water, and when you put lots of them together, they make a drop of water.</p>	<p>What do you mean by "tiny bits"?</p>

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			A molecule of water is so tiny that we would never be able to see it, not even under a microscope! The atoms that make up matter are just as small.		
10 min	<p>Activity</p> <p>Synopsis: The teacher introduces a Lego-brick model to represent water molecules. Then students construct models of water molecules using Lego bricks.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> All matter is made up of very small pieces. Atoms are the smallest pieces of matter. When atoms combine, they form molecules, which are also very small pieces of matter. Each kind of matter, such as water, is made up of a particular arrangement of atoms or molecules. Because atoms and molecules are too small to see, we can use a model to get an idea of what real matter is made of. 	<p>Select content representations and models matched to the learning goal and engage students in their use.</p> <p>Make explicit links between science ideas and activities during the activity.</p>	<p>Since we can't see atoms or molecules, we'll use a model of a water molecule to help us find out more about matter.</p> <p>NOTE TO TEACHER: <i>Distribute handout 3.1 (Lego Model) and give students about 30 seconds to read about the model before discussing it.</i></p> <p>ELL support: This model may be difficult for ELL students to understand if they aren't familiar with the components (i.e., hydrogen and oxygen) or what atoms and molecules are. Make sure to preview the model and its components with students in advance so they'll be able to participate fully in the activity.</p> <p>This handout describes the Lego model we'll be using in today's investigation. Read the information on the handout silently, and then we'll talk about it.</p> <p>Look at the top row of the handout. Who can tell me what one Lego brick represents?</p> <p>NOTE TO TEACHER: <i>Hold up a red Lego brick so that everyone can see it.</i></p> <p>That's right! One Lego brick represents an atom.</p>	An atom!	

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		Highlight key science ideas and focus question throughout.	<p>Does it matter which Lego brick I hold up?</p> <p>Now look at the second row on our handout. What do these pictures show?</p> <p>NOTE TO TEACHER: <i>Make sure students recognize that any Lego brick represents an atom, regardless of color or size.</i></p> <p>Yes! The pictures show different kinds of atoms. There are many different kinds of atoms in the world, but for today's investigation, we'll focus on two kinds of atoms that combine to make a water molecule: hydrogen and oxygen.</p> <p>Look at the third row on our handout. What happens if we combine more than one Lego brick?</p> <p>Scientists call any combination of different atoms a <i>molecule</i>.</p> <p>Notice that a molecule of water has three atoms—two hydrogen atoms and one oxygen atom. Whenever you put these atoms together, you get water.</p> <p>Have you ever heard someone call water H_2O? It's called H_2O because it has two atoms of hydrogen and one atom of oxygen. The white Legos represent the hydrogen atoms, and the red Lego represents the oxygen atom.</p>	<p>Yes! Only the red bricks are atoms.</p> <p>Different kinds of atoms!</p> <p>We get a molecule!</p>	<p>Does anyone else agree? Disagree?</p>

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		Highlight key science ideas and focus question throughout.	<p>Now let's review the parts of our Lego model. What do we call one Lego brick? <i>[Hold up one Lego brick.]</i></p> <p>And what do we get when we combine two or more Lego bricks? <i>[Hold up a water molecule.]</i></p> <p>Do you think that atoms and molecules really look like Lego bricks?</p> <p>That's right! Models aren't exactly like the real thing, but they help us understand more about things that are too small for us to see, like atoms and molecules.</p> <p>NOTE TO TEACHER: <i>Divide the class into groups of four students and give each group a plastic bag of Lego bricks. Students will use the bricks to create their own models of water molecules.</i></p> <p>Show slide 8.</p> <p>To help us answer our focus questions, <i>What is liquid water made of? What is solid water (ice) made of?</i> we're going to build some water molecules.</p> <p>In your small groups, I want you to build 10 water molecules like the one on your handout. Take the Lego bricks out of the bag and use them to build your molecules.</p>	<p>An atom!</p> <p>A molecule!</p> <p>No!</p>	

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			<p>Make sure to look at the picture of a water molecule on your handout if you need help. When your group has built all 10 of your water molecules, have one teammate raise his or her hand to let me know.</p> <p>NOTE TO TEACHER: <i>As groups are building their water molecules, circulate around the room and assist as needed. Ask students what the Lego bricks represent and encourage them to use their handouts to help them build their water molecules.</i></p>		
15 min	<p>Follow-Up to Activity</p> <p>Synopsis: Working in small groups, students observe a cup of water and a cup of ice and think about whether the molecules in these substances are the same or different. Then they use their Lego-brick models to show how they think water molecules might be arranged in solid and liquid states.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Each kind of matter, such as water, is made up of a particular arrangement of atoms or molecules. These atoms or 	<p>Select content representations and models matched to the learning goal and engage students in their use.</p> <p>Make explicit links between science ideas and activities after the activity.</p>	<p>Now I'd like one member of each group to come to our supply table and pick up one cup of water and one cup of ice. Take the cups back to your group and arrange them so that everyone can see them.</p> <p>Show slide 9.</p> <p>Look carefully at the liquid water and the ice cubes and think about how they're the same and different.</p> <p>Then talk about the questions on the slide and record your group's answers in your science notebooks.</p> <ol style="list-style-type: none"> Are the molecules in liquid water the same as the molecules in ice cubes? Why do you think so? How do you think the molecules are arranged or "put together" in the liquid 		

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	<p>molecules are the same whether the matter is in a solid form (ice) or in a liquid form (liquid water). Because atoms and molecules are too small to see, we can use a model to get an idea of what real matter is made of.</p>		<p>water and the ice cubes? Are they arranged in the same way or in a different way?</p> <p>As you explain your ideas to your teammates, move your Lego water molecules around to show what you're thinking. Be prepared to share your ideas with the class in our next lesson.</p> <p>ELL support: Preview these questions with ELL students, making sure they understand them and have an opportunity to practice answering them before the actual lesson.</p> <p>NOTE TO TEACHER: <i>Circulate among the groups as they work on the questions. You may need to show one question at a time on the slide so that students don't become distracted or confused. At this point, don't correct students if they separate the atoms in their Lego water molecules. Other students might correct them, but allow students to express their ideas about whether the molecules in liquid water and ice are arranged differently. Take notes as student express their ideas so you can address them in the following lessons.</i></p> <p><i>Note that in lesson 4b, students will construct a scientific explanation and present scientific arguments about the role of heat in the arrangement and movement of molecules in solids and liquids. In this lesson, students begin to develop understandings of molecules based on evidence from the model. Most students won't have clear understandings at this time, so pay</i></p>		

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		Ask questions to probe student ideas and predictions.	<p><i>attention to where they are in their thinking and give them time to express their ideas and learn from one another. Now is not the time to correct their thinking or give them the “right” answer; however, it is appropriate to probe student thinking to find out more about their ideas. Allow their thinking to develop throughout the next three lessons.</i></p> <p><i>If time allows, invite a few students to share their ideas, especially if some students are unsure of the answer to the first question on the slide. You’ll have an opportunity to assess students’ understandings when they answer the focus questions in the synthesize/summarize phase.</i></p>		
10 min	<p>Synthesize/Summarize Today’s Lesson</p> <p>Synopsis: The teacher reviews the focus questions, <i>What is liquid water made of? What is solid water (ice) made of?</i> Then students draw pictures to show what they think liquid water and solid water (ice) are made of.</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>. If we could shrink small 	<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p> <p>Engage</p>	<p>Show slide 10.</p> <p>Before we end today’s lesson, let’s revisit our focus questions: <i>What is liquid water made of? What is solid water (ice) made of?</i></p> <p>I’d like you to illustrate your answers to these questions by drawing pictures in your science notebooks.</p> <p> Embedded Assessment Task</p> <p>At the top of one page, write the words <i>Liquid Water</i>, and at the top of the next page, write the words <i>Solid Water</i>.</p>		

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	<p>enough to fit inside different kinds of matter, we would see that each kind has a different arrangement of atoms or molecules. Water has two atoms of hydrogen and one atom of oxygen. These molecules are the same in ice and liquid water. We can use a Lego-brick model to show what matter is made of.</p>	<p>students in making connections by synthesizing and summarizing key science ideas.</p>	<p>On the first page, draw a picture that shows what you think liquid water is made of. Then on the second page, draw a picture that shows what you think solid water or ice is made of.</p> <p>Use your Lego-model handout as a resource if you need help.</p> <p>At the beginning of our next lesson, I'll ask some of you to share your drawings and explain what you think liquid and solid water are made of.</p> <p>NOTE TO TEACHER: <i>Circulate around the room as students work on their drawings. Select three or four sets of drawings, with each student's permission, to display on a document reader during the next lesson. Try to select drawings that show different ideas of what ice and water are made of and how the water molecules might be organized. At least two of the drawings should clearly show that both water and ice are made up of water molecules.</i></p>		
1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher announces that in the next lesson, students will explore the arrangement and movement of water molecules in a solid state and a liquid state.</p>	<p>Link science ideas with other science ideas.</p>	<p>Show slide 11.</p> <p>In our next lesson, we'll use our Lego models again. This time we'll think about how the molecules in liquid water and solid water are arranged and how they move.</p> <p>Do you think they're arranged and move in the same ways or different ways?</p> <p>We'll explore these ideas next time.</p>		