The Water Cycle
Lesson 4b: Using Molecules to Explain Evaporation and Condensation in a System

<table>
<tr><td>Grade 5</td><td>Length of lesson: 50 minutes</td><td>Placement of lesson in unit: 4b of 6 two-part lessons on the water cycle</td></tr>
<tr><td colspan="2">Unit central questions: How does water change in the world around us? Does Earth ever run out of water?</td><td>Lesson focus question: How can ideas about water molecules help us explain evaporation and condensation in a system?</td></tr>
<tr><td colspan="3">Main learning goal: Changes in the energy (motion) of molecules help explain how water changes states during evaporation and condensation within an open system.</td></tr>
<tr><td colspan="3">Science content storyline: Water molecules move differently when they’re in different states (liquid, solid, and gas). We can use this idea to explain what is happening during the processes of evaporation and condensation in an open distillation system. In a liquid state, water molecules in a flask sitting on a hot plate are loosely attracted to each other and can slip and slide past one another. As these water molecules absorb energy from the hot plate, they move faster. Fast-moving water molecules at the surface of the liquid can escape into the air (evaporation) and spread out in the flask as individual gas molecules (water vapor). As the water-vapor molecules move to the top of the flask and into the tubing, the surrounding air is much cooler. The fast-moving water-vapor molecules lose heat energy to the cooler air and slow down. As they slow, they’re attracted to other slower-moving water molecules to form droplets of liquid water near the top of the flask and in the tubing (condensation). Some of the droplets of condensed water slide down the tubing into the test tube (precipitation). Some of the fast-moving water molecules in the gaseous state escape out of the system through the opening at the top of the test tube. In this system, molecules move back and forth between liquid and gaseous states through evaporation and condensation. Some of the water in the flask ends up in the test tube, and some of it ends up escaping into the air (out of the system).</td></tr>
<tr><td colspan="3">Ideal student response to the focus question: When liquid water absorbs heat, the molecules gain energy and move faster. Eventually they move so fast they break away from each other and fly off by themselves into the air as individual gas molecules (water vapor). This is evaporation. When water-vapor molecules in the air lose heat energy (cool), they slow down and join up with other molecules to form droplets of liquid water. This process is called condensation.</td></tr>
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Preparation

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Materials Needed

- Science notebooks
- Water-changes-system demonstration
  - 1 hot plate (from lesson 1a)
  - 1/4" × 170" × 20' PVC tubing (Approximately 24", cut to size as needed)
  - Size 7 rubber stopper, cored 1/4" to fit tubing
  - 500 ml glass/Pyrex Erlenmeyer flask
  - 500 ml glass/Pyrex beaker (from lesson 1a)
  - Six 25 ml glass test tubes
  - Water to fill Erlenmeyer flask
  - 1 oven mitt
- 1 dry-erase marker (to mark beginning water level on flask)
- 2 different-colored pens or pencils (for each student)

Student Handouts and Teacher Masters

- 4.2 Water-Changes System (1 per student)
- 4.3 Water-Changes System (Teacher Master)

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Ahead of Time

- Review the Water Cycle Content Background Document: part 2 introduction and sections 2.1–2.7. Pay special attention to section 2.7, which describes the water-changes-system demonstration (distillation).
- Review the PowerPoint slides and modify them as you wish.
- At least a day before the lesson, set up and run the water-changes demonstration. Determine how long it will take to boil the water and run the demonstration, as well as what students will observe.
- Post these words where students can see them: *liquid water*, *water vapor*, *molecules*, *gain energy*, *lose energy*, *evaporation*, and *condensation*. Students will use these words in the activity follow-up and the lesson summary.

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Lesson 4b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
10 min	**Link to previous lesson:** The teacher leads a role-play to illustrate key ideas about how water molecules are arranged and move in the solid, liquid, and gaseous states.	• **In the solid state,** water molecules are linked to one another in a rigid pattern. They vibrate in place, but they can't move away from each other. • **In the liquid state,** water molecules are loosely connected, allowing individual molecules to slip and slide past one another. • **In the gaseous state (water vapor),** water molecules break away from each other (move apart) and spread throughout the air.
4 min	**Lesson focus question:** Students discuss the focus question from the previous lesson and review the progress they've made so far in developing an answer. Then the teacher introduces the new focus question, *How can ideas about water molecules help us explain evaporation and condensation in a system?*	• Evaporation and condensation occur because of changes in the energy, movement, and arrangement of water molecules. • Evaporation occurs when water molecules in the liquid state gain heat energy, speed up, break away from other water molecules, and escape into the air as individual water-vapor (gas) molecules. • Condensation occurs when water-vapor molecules in the air lose heat energy (cool), slow down, and are attracted to each other to form liquid-water droplets.
5 min	**Setup for activity:** The teacher introduces the water-changes-system setup and shows students a diagram of the system.	
15 min	**Activity:** Students observe what is happening in the water-changes system. Then they label a diagram to show where water molecules in different states occur in the system and add drawings to the diagram.	• **In the flask:** Evaporation occurs when liquid water is heated, causing water molecules to gain energy and move faster. Fast-moving water molecules escape the surface of the liquid and spread out into the air as individual water-vapor molecules (gas). Some water molecules near the bottom of the flask gain enough heat energy that they turn to water vapor, forming bubbles that rise to the surface and pop, releasing the water vapor into the air. • **In the tubing:** As individual water-vapor molecules move away from the hot plate (heat source), some lose heat energy and condense—that is, they slow down and join together, forming droplets of liquid water. • **In the test tube:** When larger drops of water form near the end of the tubing, the liquid water falls into the test tube, modeling precipitation. Water-vapor molecules that haven't cooled travel through the test tube and escape the system. These individual molecules eventually condense when they encounter the cool air above the test tube, forming steam.
10 min	**Follow-up to activity:** In a whole-class discussion, students review and analyze what happened in the water-changes system. If time allows, they observe that the amount of water in the test tube is less than the amount that was originally in the flask, and the idea of an open system is introduced.	
5 min	**Synthesize/summarize today's lesson:** Students write and share summary statements.	• During evaporation, water molecules in the liquid state gain energy, move faster, break away from other molecules, and escape into the air as water vapor (gas). • During condensation, water-vapor molecules lose energy (cool), slow down, and join together to form liquid-water droplets. • We observed that both of these processes can occur in one system.
1 min	**Link to next lesson:** The teacher links science ideas to the next lesson.	

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10 min	**Link to Previous Lesson** **Synopsis:** The teacher leads a role-play to illustrate key ideas about how water molecules are arranged and move in the solid, liquid, and gaseous states. **Main science idea(s):** • **In the solid state**, water molecules are linked to one another in a rigid pattern. They vibrate in place, but they can't move away from each other. • **In the liquid state,** water molecules are loosely connected, allowing individual molecules to slip and slide past one another. • **In the gaseous state (water vapor),** water molecules break away from each other (move apart) and spread throughout the air.	Link science ideas to other science ideas. Select content representations and models matched to the learning goal and engage students in their use.	**Show slide 1.** In the last two lessons, we watched a simulation that showed how molecules move, and we learned some new ideas about how water molecules are arranged, and how they move differently when they're in solid, liquid, and gaseous states. To review these ideas, let's demonstrate in a role-play how water molecules are arranged and how they move in solid, liquid, and gaseous states. **NOTE TO TEACHER:** *Have a group of 6–8 students stand at the front of the room.* **Show slide 2.** What state of water is shown on this slide, and how do you know? How could you act like water molecules in a solid state?	It's the solid state because all the molecules are touching each other and are held in place in a pattern. Stand next to each other in a locked pattern.	

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			To show that movement, what might you do? **NOTE TO TEACHER**: *Decide how you want your student water molecules to connect to each other in the solid state (e.g., shoulder to shoulder or holding hands).* Each of you is now **one** water molecule in a solid (ice) state. To show your connection to one another, stand shoulder to shoulder *[or hold hands]*. OK, start acting like water molecules in the solid state! **CONTENT NOTE TO TEACHER:** *In the solid state, water molecules are farther apart than in the liquid state. Water is unusual in this regard, since in most solids, molecules are closer together. If the role-play doesn't show the pattern on the slide accurately, it isn't essential to address the problem at this point. Emphasize that the molecules are held tightly together in a rigid structure and vibrate in place but don't move.* **Whole-class discussion:** OK, let's stop the role-play and talk about it.	Stand still instead of walking around. Vibrate in place. Shiver or shake a little bit in place.	

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			What did our role-play show about water molecules in the solid state?	The molecules are linked together. The water molecules can't move around. They vibrate in place.	
			In what ways was this model **inaccurate**? That is, how were our own water molecules different from real water molecules in the solid state?	Real molecules are much smaller. I think real water molecules in the solid state are arranged in a specific pattern. Our pattern was kind of messy.	
			Show slide 3. Let's look at the next diagram. What state of water is shown on this slide? How do you know?	It's the liquid state because the molecules are touching each other, but they aren't locked in a pattern. They can move around. The molecules slide past each other.	Can you say more about that?

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			How could you act like water molecules in the liquid state? To show that movement, how close should you stay to other water molecules? **NOTE TO TEACHER**: *Decide how you want your student water molecules to connect to each other in the liquid state.* To show your connection to each other as water molecules in the liquid state, gently touch shoulder to shoulder *[or briefly touch hand to hand]* as you move around. OK, start acting like water molecules in the liquid state! **Whole-class discussion:** Let's stop the role-play at this point and talk about it. What did our role-play show about water molecules in the liquid state?	The molecules don't move as fast as they do in the gas state. Walk around but stay kind of close to other water molecules. We have to kind of keep touching each other but keep moving around. The liquid-water molecules move around in different directions and slide	

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				past each other. They keep close to other water molecules, but they aren't locked in place.	
			In what ways was this model **inaccurate**? How were our water molecules different from real water molecules in the liquid state?	Real water molecules don't have shoulders *[or hands]* that touch. Real molecules are much smaller.	
			Show slide 4. Now let's look at one more diagram. What state of water is shown in this slide? How do you know?	Gas! Because the water molecules are spread apart. The water molecules aren't touching each other. They might bump into each other as they're moving around.	How is that different from water molecules in the liquid state?
				In the liquid state, water molecules are	

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				always touching each other as they move around. Water-vapor molecules only touch when they bump into each other.	
			How could you act like water molecules in the gaseous state?	Move apart from each other. Move faster. Move in all different directions.	
			OK, start acting like water-vapor molecules! **Whole-class discussion:** Now let's stop and talk about the role-play.		
			What did our role-play show about water molecules in the gaseous state?	Water-vapor molecules move faster and farther apart. They aren't touching each other all the time. They can move anywhere!	
			In what ways was this model **inaccurate**? How were our water molecules different from real water molecules in the gaseous state?	Real water molecules	

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			CONTENT NOTE TO TEACHER: *In fact, water-vapor molecules would be spread much farther apart than can be represented in this role-play. But this isn't essential for students to know.* Would real water molecules in the gaseous state stay on the floor of the room? Thank you, water molecules! You can sit down.	are much smaller. No, they would go anywhere in the room, even up to the ceiling.	
4 min	**Lesson Focus Question** **Synopsis:** Students discuss the focus question from the previous lesson and review the progress they've made so far in developing an answer. Then the teacher introduces the new focus question: *How can ideas about water molecules help us explain evaporation and condensation in a system?* **Main science idea(s):** • Evaporation and condensation occur	Highlight key science ideas and focus question throughout.	**Show slide 5.** Last time, we talked about what all this molecular movement has to do with evaporation and condensation. Our focus question yesterday was *How can ideas about water molecules help us explain evaporation and condensation?* **NOTE TO TEACHER:** *Make sure students can see the posted focus question from last time.* **Turn and Talk (1 min):** Talk with an elbow partner about how you can explain evaporation and condensation in terms of the movement of water molecules.		

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	because of changes in the energy, movement, and arrangement of water molecules. • Evaporation occurs when water molecules in the liquid state gain heat energy, speed up, break away from other water molecules, and escape into the air as individual water-vapor (gas) molecules. • Condensation occurs when water-vapor molecules in the air lose heat energy (cool), slow down, and are attracted to each other to form liquid-water droplets.		**Whole-class share-out:** What did you come up with? Let's hear from several pairs.	*Sample dialogue with one pair of students:* In evaporation, liquid water boils *[Misconception: Evaporation can happen without liquid water boiling.]*, and the molecules at the top of the water get more energy and start moving faster and faster, and then they can break apart *[possible misconception]* and go into the air. I want to add on. You can't see the molecules once they're in the air. I have a clarification question. Do you mean that evaporation happens only when something boils? Because a puddle evaporates, but it doesn't boil.	Anyone have a clarification question? Do you want to add to or disagree with any of that? Anyone disagree? I have a clarification question. What do you

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					mean when you say the water molecules "break apart"?
				The hydrogen "ears" of the water molecules break apart from the oxygen and go into the air. *[Misconception]*	Anyone disagree?
			What about the movement of water molecules during condensation?	When water molecules that are bouncing around in the air as water vapor get close to the cold glass, they start slowing down and join together to form liquid-water droplets.	Anyone disagree with any of that or have anything to add? Any clarification questions to ask?
				I want to add that water molecules in the gas state slow down because they lose heat energy when they cool.	
				I want to add something too. It doesn't always have to happen on a cold glass.	What do you mean by "it"?

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		Set the purpose with a <u>focus question</u> or goal statement.	**Show slide 6.** Great discussion! Today we're going to continue exploring the focus question from last time: *How can ideas about water molecules help us explain evaporation and condensation?* But this time we'll add the words *in a system* to the question as we investigate evaporation and condensation. **NOTE TO TEACHER:** *Point to the setup showing the water-changes system.* So our focus question for today is *How can ideas about water molecules help us explain evaporation and condensation* ***in a system***. Write this question in your science notebooks and draw a box around it. **NOTE TO TEACHER:** *Post the new focus question where students can see and refer to it throughout the lesson.*		
5 min	**Setup for Activity** **Synopsis:** The teacher introduces the water-		**NOTES TO TEACHER:** • *Pass out the Water-Changes System handout (handout 4.2) and introduce the setup.*		

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	changes-system setup and shows students a diagram of the system.	Make explicit links between science ideas and activities **before** the activity. Select content representations and models matched to the learning goal and engage students in their use.	• *Make sure the hot plate is on and the water has already heated and started to evaporate when you get to this point in the lesson.* • *Make sure all students can see the water-changes-system demonstration.* We're going to examine this system as a way of thinking about how water changes states and moves when it's heated and cooled. This system or model will show us how *both* evaporation and condensation occur in one system; that is, how water molecules move back and forth between evaporation and condensation as they are heated and cooled in a system. First, I'm going to use a marker to indicate the starting water level in the flask. Now take a minute to look at the diagram of this system on your handouts and compare it with the system I've set up in front of the classroom. What are the different parts of this system?	• A flask. • A hot plate. • Liquid water. • Tubing.	

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			Where do you think heating will occur? Where do you think cooling will occur? **NOTE TO TEACHER**: *Help students recognize that the tubing will be cooler than the bottom of the flask.*	• A test tube. • A beaker. On the hot plate In the beaker. In the test tube? In the aquarium tubing. Maybe at the top of the flask?	Anywhere else? Anywhere else that will be cooler than the bottom of the flask?
15 min	**Activity** **Synopsis:** Students observe what is happening in the water-changes system. Then they label a diagram to show where water molecules in different states occur in the system and add drawings to the diagram. **Main science idea(s):** • **In the flask:** Evaporation occurs when liquid water is heated, causing water molecules to gain	Make explicit links between science ideas and activities **during** the activity.	**Show slide 7.** Let's see what's happening in this system. What do you observe? **NOTE TO TEACHER:** *Make sure everyone is making the desired observations.*	*Desired observations:* • Water boils (bubbles form). • Some liquid-water droplets appear on the top part of the flask (inside) and on the insides of the tubing. • Some liquid water drips into the test tube at the end. • The water level in the flask gradually	

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	energy and move faster. Fast-moving water molecules escape the surface of the liquid and spread out into the air as individual water-vapor molecules (gas). Some water molecules near the bottom of the flask gain enough heat energy that they turn to water vapor, forming bubbles that rise to the surface and pop, releasing the water vapor into the air. • **In the tubing:** As individual water-vapor molecules move away from the hot plate (heat source), some lose heat energy and condense—that is, they slow down and join together, forming droplets of liquid water. • **In the test tube:** When larger drops of water form near the end of the tubing, the liquid water falls into the test tube, modeling precipitation. Water-vapor molecules that haven't cooled travel	Engage students in analyzing and interpreting data and observations.	**Show slide 8.** **Pairs:** Now I'd like you to work in pairs on three questions: 1. What's happening in the flask? 2. What's happening in the aquarium tubing? 3. What's happening at the other end of the setup where the test tube is? Use what you know about how water molecules move and are arranged in different states of matter, and what you know about evaporation and condensation. Pay attention to what is happening at the beginning, middle, and end of this setup. **Show slide 9.** While you're working, make these changes on your handout diagrams: 1. Label where the different states of	goes down. • Steam might form above the opening of the test tube. [*This is liquid water that has condensed.*]	

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	through the test tube and escape the system. These individual molecules eventually condense when they encounter the cool air above the test tube, forming steam.	Ask questions to challenge student thinking.	water occur. 2. Draw six to eight water molecules representing each of the states you labeled. 3. Label all the places where evaporation and condensation must be happening. **Pairs work on the questions (10 min).** **NOTE TO TEACHER:** *Following are some challenge questions you might ask as pairs work together. After 5 minutes, tell students how far along they should be.* 1. What's happening in the flask? (What's happening with the molecules? What's happening with energy? Is any evaporation or condensation taking place?)	The water in the flask is boiling. Evaporation is happening. The molecules in the liquid are escaping into the air as water vapor. The water molecules in the liquid state are	Can you use the word *molecules* in your description of what's happening? Say more about that. Why or how do you think that is happening? How are the molecules moving?

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				gaining energy from the hot plate and moving faster and faster until they escape from the other molecules and go into the air.	
				There's also water at the top of the flask in the form of drops.	How do you think those drops got there?
				The boiling water popped, and some of the water landed on the top of the flask. *[Misconception]*	Do you agree with your partner?
				No. I think that's condensation.	Say more. Talk about what's happening with the molecules.
				The molecules evaporated into the air in the flask. So the water molecules were moving all freely in the air, but then up at the top of the flask, it was cooler, so they cooled, slowed down, and joined together to form liquid drops.	
			2. What's happening in the aquarium tubing?		

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			(What's happening with the molecules? What's happening with energy? Is any evaporation or condensation taking place?)	The tubing is mostly clear, but there are some drops that make it foggy. Drops of water are forming at the end of the tubing because the heat pushes them down the tube. *[Misconception]* No. I don't think the heat pushed the water drops down the tube. I think the heat evaporated the water in the flask into the air, and then this water vapor traveled down the tube. But then the water vapor met cooler air at the end of the tubing, so the water molecules in the air slowed down and came back together to form liquid-water drops. That's *condensation*.	Why are there tiny drops in the tubing? Were those drops there when we started the activity (before we turned on the hot plate)? Where did they come from? Do you agree with your partner?

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			What's happening at the other end of the setup where the test tube is? (What's happening with the molecules? What's happening with energy? Is there any evaporation or condensation?)	I think there is water vapor in the tubing. Because the tubing is clear in some places, and you can't see water vapor. And I think it's there because the water vapor from inside the flask traveled into the tubing. There's water in the test tube. It's dropping from the tubing into the test tube like rain.	What evidence do you have that there is water vapor in the tubing?
10 min	**Follow-Up to Activity** **Synopsis:** In a whole-class discussion, students review and analyze what happened in the water-changes system. If time allows, they observe that the amount of water in the test tube is less than the amount that was originally in the flask, and the idea of an open system is introduced.	Make explicit links between science ideas and activities **after** the activity. Engage students in constructing explanations and arguments.	**Show slide 10.** Let's discuss what happened in different parts of the water-changes system—the flask, the tubing, and the test tube—during the demonstration. I'd like you to use these words as you share your observations and ideas. *[Point to the word list posted somewhere in the room.]* • Liquid water • Water vapor		

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	Main science idea(s): • **In the flask:** Evaporation occurs when liquid water is heated, causing water molecules to gain energy and move faster. Fast-moving water molecules escape the surface of the liquid and spread out into the air as individual water-vapor molecules (gas). Some water molecules near the bottom of the flask gain enough heat energy that they turn to water vapor, forming bubbles that rise to the surface and pop, releasing the water vapor into the air. • **In the tubing:** As individual water-vapor molecules move away from the hot plate (heat source), some lose heat energy and condense—that is, they slow down and join together, forming droplets of liquid water. • **In the test tube:** When larger drops of water	Engage students in communicating in scientific ways. Ask questions to probe ideas and predictions. Ask questions to challenge student thinking.	• Molecules • Gaining energy • Losing energy • Evaporation • Condensation Listen to each other's ideas and give feedback. Think about questions to ask, things you want to add, things you agree or disagree with, and things to improve. As we're talking, you should make changes to your diagrams in a different color ink or pencil. **NOTE TO TEACHER:** *Students should use complete sentences and be able to express scientifically accurate ideas. Ask probe and challenge questions to encourage students to fully explain their understandings.*	*Example of complete sentence:* Water is being evaporated into water vapor, and it moves through the tubing, where it goes into the test tube.	*Challenge questions:* What makes the water evaporate? What do you mean by "evaporated"? How do you know the water goes through the tubing? How does the water move through the tubing? What do we know about water molecules

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	form near the end of the tubing, the liquid water falls into the test tube, modeling precipitation. Water-vapor molecules that haven't cooled travel through the test tube and escape. These individual molecules eventually condense when they encounter the cool air above the test tube, forming steam.		**Show slide 11.** 1. Where should we label things as liquid or water vapor (gas)?	*Accurate answers include the following:* • Liquid in the flask. • Water vapor in the bubbles. • Water vapor in the flask above the liquid. • Liquid water forming on the inside walls at the top of the flask. • Liquid water throughout the tubing. • Water vapor in the tubing. • Liquid water in the test tube. • Water vapor above the liquid in the test tube. • Liquid water as	in the gaseous state and how they move? You said, "It goes into the test tube." Does the water go into the test tube as water vapor? Why would water droplets reappear?

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				"steam" above the test tube.	
			2. Where is evaporation occurring?	At the surface of the water in the flask. In the boiling water. I mean in the bubbles of the boiling water. Water vapor.	Clarify what you mean by "in the boiling water." What are the bubbles?
			3. What happens to water molecules during evaporation?	Evaporation is happening at the top of the boiling water. The hot plate heats up the liquid-water molecules, so they move faster and farther apart. Liquid-water molecules gain enough heat energy from the hot plate to rise from the bottom of the flask as bubbles of water vapor and then escape	Why is evaporation happening at the top? What causes them to move faster?

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				the surface of the water.	
			4. Where is condensation occurring?	Condensation is happening in the top part of the flask. It's happening in the tubing, too.	What causes this?
			5. What happens to water molecules during condensation?	Water-vapor molecules slow down and clump together to make liquid water. They lose heat energy or cool as they move farther away from the hot plate. The water-vapor molecules slow down and move together to form liquid water droplets.	What happens to energy of the water molecules? Can you say more about why liquid water reappears?
			6. Where are water molecules gaining or losing energy? Where is water being heated or cooled?	The water in the flask is being heated.	What happens to the

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					energy of the water molecules in the flask?
				The water molecules are gaining heat energy.	
				Wherever we see liquid water reappearing near the top of the flask and in the tubing, the water vapor is cooling off.	
					What does "cooling off" mean?
				It means the water molecules are losing heat energy.	
				Water in the bottom of the flask is being heated. Those water molecules are gaining energy.	
					Are all of the water molecules at the bottom of the flask gaining energy, or just some of them?
				All of the water molecules in the flask are gaining energy, but the ones closest to the heat source gain more.	
				The water vapor in the tubing is cooling. The water molecules are losing energy as they	

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				move away from the hot plate.	Is there evidence of molecules losing heat energy anywhere else besides the tubing?
				Steam is forming from water vapor cooling above the test tube.	
			Show slide 12. **NOTE TO TEACHER:** *If time is short, delay this discussion until lesson 6b.* Look at the line we marked on the flask to show the water level at the beginning of our demonstration. What do you notice about the water level in the flask?	There is less water than at the beginning.	
			What does that mean? What happened? Did the water disappear? **NOTE TO TEACHER:** *Don't spend time probing student thinking at this point.* If I pour the water from the test tube back into the flask, do you think the water level will come back up to original line? Why or why not?	No, the water didn't disappear. It just changed state and moved up in the tubing and then to the test tube.	

Time	Phase of Lesson and How the Science Content Storyline Develops	STeLLA Strategy	Teacher Talk and Questions	Anticipated Student Responses	Possible Probe/Challenge Questions
			Turn and Talk: Talk about this with a partner. What do you predict and why? **Whole-group discussion:** How many of you predict that the water will come up to the original line? How many think it will be lower than the original line? What is your reasoning? **NOTE TO TEACHER:** *Use the oven mitt to hold the test tube. Pour the water into the flask and have students make observations.* *The volume in the flask isn't the same as it was at the beginning because not all of the water molecules traveled through the tubing and into the test tube. Some water molecules condensed on the flask or tubing walls, and some escaped into the air as water vapor (gas).* Why do you think the water doesn't come up to the original line?	It will come really close because most of the water in the beaker went through the tubing and back into the test tube. A little bit is still in the tubing. I don't think the water will come back up to the original line because maybe some of it escaped into the air as water vapor we can't see. Some of the water is still in the tubing or on the inside neck of the flask. Some of the water escaped from the test tube as water vapor and steam.	

Time	Phase of Lesson and How the Science Content Storyline Develops	STeLLA Strategy	Teacher Talk and Questions	Anticipated Student Responses	Possible Probe/Challenge Questions
			This distillation system is called an *open system* because some of the water can escape into the air outside the system. In a future lesson, we're going to compare this open system to a closed system where the water can't escape.	Water vapor passed through the tubing and test tube; then it condensed again as steam above the test tube as it cooled.	What evidence do you have of this?
5 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students write and share summary statements. **Main science idea(s):** • During evaporation, water molecules in the liquid state gain energy, move faster, break away from other molecules, and escape into the air as water vapor (gas). • During condensation, water-vapor molecules lose energy (cool), slow down, and join together to form liquid-water droplets.	Highlight key science ideas and focus question throughout.	**Show slide 13.** Our focus question today is *How can ideas about water molecules help us explain evaporation and condensation in a system?* I want you to think of a sentence that uses at least three of the words on the slide to explain something that happened in the system we observed today. Then I'm going to use the equity sticks and call on as many of you as we have time for to share your sentences. **Word list:** • Liquid water • Water vapor (gas) • Molecules • Gain energy		

Time	Phase of Lesson and How the Science Content Storyline Develops	STeLLA Strategy	Teacher Talk and Questions	Anticipated Student Responses	Possible Probe/Challenge Questions
	• We observed that both of these processes can occur in one system.		• Lose energy • Evaporation • Condensation **Student think time (1 min).** **Whole-class share-out:** Now I'll call on some of you to share your sentences. **NOTE TO TEACHER:** *Ask probe questions if student sentences need clarification, and make sure that incorrect statements are challenged/corrected.* **Show slide 14.** So today we used new ideas about molecules from the water-changes-system demonstration to answer our focus question, *How can ideas about water molecules help us explain evaporation and condensation in a system.* Let's review the ideas on the slide.		
1 min	**Link to Next Lesson** **Synopsis:** The teacher links science ideas to the next lesson.	Link science ideas to other science ideas.	**Show slide 15.** Tomorrow we'll use these new ideas about evaporation and condensation to explain various things we observe happening around us in our everyday lives.		