The Water Cycle
Lesson 2b: From Gas to Liquid

Grade 5	**Length of lesson:** 52 minutes	**Placement of lesson in unit:** 2b of 6 two-part lessons on the water cycle
Unit central questions: How does water change in the world around us? Does Earth ever run out of water?		**Lesson focus question:** Can you make water vapor in the air "reappear" as liquid water? Explain your thinking.
Main learning goal: Water changes state from a gas (water vapor) to a liquid when water vapor in the air loses energy (cools). This process is called *condensation*.		
Science content storyline: We know that water can change from a liquid to a gas (water vapor) when heat is added. Water can also change from a gas to a liquid when water vapor in the air loses energy (cools). This process is called *condensation*.		
Ideal student response to the focus question: When water vapor in the air loses energy (cools), it can change from a gas to a liquid. This is called *condensation*.		

Preparation

Materials Needed	**Ahead of Time**
• Science notebooks • Chart-paper diagram from lesson 1b (liquid → gas = evaporation) **(Save this for use again in lesson 3.)** • *Optional:* chart paper, markers	• Review the Water Cycle Content Background Document, especially sections 1.5, 1.6, 1.8, and 2.3. • Review the PowerPoint slides and modify them as you wish. • Review students' writings from the end of lesson 2a. Assess how many students are making claims related to (a) water vapor in the air, (b) coldness or cooling, (c) water leaking through the cup, or (d) water evaporating out of the cup and then falling down on the side of the cup. Ideal responses include (a) and (b). Responses (c) and (d) indicate that students are not yet thinking about water vapor in the air around the cup. • Choose three examples of student claims that represent common ideas they've written about. One example should include aspects of the ideal answer: Water droplets form when water vapor in the air loses energy (cools) because of the ice. This cooling makes the water vapor change state back to liquid water (the opposite of what we observed with the boiling water). • **Activity setup:** Students will be deciding which claim has the best evidence. Before the lesson, decide whether to have students present what they've written or to share it for them anonymously. • **Slide 8:** Decide whether you want students to do the optional writing/drawing task. (You may want to skip this task if time is running short.) • **Slide 9:** Will students write in pairs or individually? • *Optional:* Post a word bank with these terms to support students' written explanations: *liquid water*, *water vapor*, *gas*, *gains heat energy*, *loses heat energy*, *condensation*, *condenses*, *evaporation*, *evaporates*.

Lesson 2b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
4 min	**Unit central questions/link to previous lesson:** The teacher revisits the unit central questions and the two examples of water changes students have observed so far (the boiling water, and water forming on the outside of a cup of water that contains ice).	• Water changes from a liquid to a gas (water vapor) when heat energy is added. This process is called *evaporation*.
1 min	**Lesson focus question:** The teacher introduces the lesson focus question, *Can you make water vapor in the air "reappear" as liquid water? Explain your thinking.*	
10 min	**Setup for activity:** The class considers three different claims/evidence that students have written about why water droplets are forming on the outside of a cup of ice water. They think about which claim has the strongest evidence.	• Scientists consider which claim has the strongest evidence.
10 min	**Activity:** The teacher explains science ideas related to the two-cups experiment and interacts with students to construct a content representation of condensation.	• There is water vapor in the air, but we can't see it. We can make it "reappear" as liquid water by bringing it close to something cold (i.e., something with less heat energy). When the water vapor comes close to something cold, it loses heat energy (cools) and forms liquid-water droplets. This process is called *condensation*.
20 min	**Follow-up to activity:** Students work in pairs using science ideas about condensation to construct explanations about why liquid-water droplets formed on the outside of the cup of ice water. Several pairs share and are given feedback to improve their explanations.	• Water changes state from a gas (water vapor) to a liquid when the water vapor in the air loses energy (cools). This process is called *condensation*.
5 min	**Synthesize/summarize today's lesson:** Students synthesize key science ideas from the lesson and answer the lesson focus question. Then the teacher summarizes what students have learned so far about water changes.	• Water changes state from a gas (water vapor) to a liquid when the water vapor in the air loses energy (cools). This process is called *condensation*.
2 min	**Link to next lesson:** The teacher links science ideas to the next lesson.	

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4 min	**Unit Central Questions/ Link to Previous Lesson** **Synopsis:** The teacher revisits the unit central questions and the two examples of water changes students have observed so far (the boiling water, and water forming on the outside of a cup of water that contains ice). **Main science idea(s)**: • Water changes from a liquid to a gas (water vapor) when heat energy is added. This process is called *evaporation*.	Link science ideas to other science ideas.	**Show slides 1 and 2.** Remember the big questions we're exploring in this unit on the water cycle: *How does water change in the world all around us? Does Earth ever run out of water?* **Show slide 3.** We've observed two examples of water changes so far. First, we observed what happens when liquid water boils. We observed that the water level in the beaker went down after we boiled the water. What did we come up with as a scientific explanation for this? Why did the water level go down? Did the water disappear? **Turn and Talk:** Work with a partner on these questions. Try to agree on a claim, evidence, and reasoning using science ideas.  Photo courtesy of Pixabay.com	*Strong response:* **Claim:** When heated, some of the liquid water went into the air. **Evidence:** The liquid-water level went down, so that water must have gone somewhere. Also, we saw	

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				bubbles popping into the air at the top of the liquid water. **Reasoning with science ideas:** When the liquid water was heated, the water changed state from a liquid to a gas. The gas is called *water vapor*, and it went into the air. We can't see it, but it's there.	
			So the boiling-water experiment helped us understand that there is water vapor in the air, but we can't see it. Our second example of a water change was watching water droplets appear on a cup of water with ice but not on the cup of room-temperature water. Yesterday we came up with some claims and evidence to explain how these water droplets formed.		
1 min	**Lesson Focus Question** **Synopsis:** The teacher introduces the lesson focus question, *Can you make water vapor in the air "reappear" as liquid*	Set the purpose with a <u>focus question</u> or goal statement.	**Show slide 4.** Today we're going to finish our explanation of the two-cups experiment. This will help us answer our focus question, *Can you make water vapor in the*		

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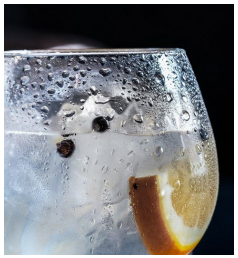
	water? Explain your thinking.		*air "reappear" as liquid water? Explain your thinking.* 		
10 min	**Setup for Activity** **Synopsis:** The class considers three different claims/evidence that students have written about why water droplets are forming on the outside of a cup of ice water. They think about which claim has the strongest evidence. **Main science idea(s):** • Scientists consider which claim has the strongest evidence.	Make explicit links between science ideas and activities **before** the activity. Engage students in communicating in scientific ways.	**Show slide 5.** Yesterday you wrote down your best ideas and came up with a claim to answer the question, *Why are water droplets forming on the outside of the cup of ice water?* Let's share several examples of your writing. As you listen, think about whether you agree or disagree with the claims you hear. Do you have any evidence to support the claims? Do you have evidence to challenge any of the claims? Our goal by the end of today is to reach an agreement about which claim has the strongest evidence to support it. **NOTE TO TEACHER**: *Share the three examples of student claim writing you selected, saving the strongest claim for last. Use the document camera to display the*	*Example of strong claim and evidence:* My claim is that the water vapor in the air turned back into liquid water when it got near the ice. My evidence is that we	*After each claim and evidence is read, pose these questions:* • Does anyone have additional evidence to support this claim? • Does anyone have evidence to

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			claims. **Option:** *If you think your students are ready for this, have the authors of each claim come up front and read what they wrote and then take comments, suggestions, and questions from the class. Otherwise, lead this discussion and let the authors remain anonymous.* We've looked at three claims and supporting evidence, and we've been excellent scientists, asking questions and sharing some disagreements. Now think about which of these three claims has the strongest evidence. **Student think time (1 min).** Now let's do a thumbs-up. Do you think claim 1 has the strongest supporting evidence? Claim 2? Claim 3? **NOTE TO TEACHER**: *Hopefully students will show consensus for a claim stating that water vapor in the air turns back into liquid water when it's cooled. If they don't, challenge them to listen to the science ideas you're going to introduce next, and tell them to*	know there is water vapor in the air from the boiling water. And the drops only formed on the cup that had ice. *Another example:* My claim is that the water leaked through the cold cup but not the other one. My evidence is that the drops only formed on the cold cup.	challenge or disagree with this claim?

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			consider whether these new ideas support their choice or make them want to change their minds.		
10 min	**Activity** **Synopsis:** The teacher explains science ideas related to the two-cups experiment and interacts with students to construct a content representation of condensation. **Main science idea(s):** • There is water vapor in the air, but we can't see it. We can make it "reappear" as liquid water by bringing it close to something cold (i.e., something with less heat energy). When the water vapor comes close to something cold, it loses heat energy (cools) and forms liquid-water droplets. This process is called *condensation*.	Make explicit links between science ideas and activities **during** the activity. Highlight key science ideas and focus question throughout.	Let's talk about how scientists would consider what is happening with our experiment with two cups of water. As you listen, think about the claims we just discussed. Do the new science ideas I introduce support your choice of the strongest claim and evidence? Or do these new ideas make you want to change your mind (something that scientists value and do all the time!). We learned that when liquid water evaporates, it turns into water vapor, a gas we can't see. This water vapor rises into the air. So right now, there is water vapor in the air throughout our classroom. In fact, there is water vapor in the air outside our classroom, in our homes, and just about everywhere we go. We just can't see it. Can the opposite happen? Can we see invisible water vapor "reappear" as liquid water? And do we see it happening in our experiment with the two cups of water? Let's think about the cup of ice water. Do you think the ice is cooling anything besides the water inside the cup?	It's cooling the air	

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			Right. The ice is cooling the air around the cup. And what do we know is in the air around the cup? We're going to use these ideas to add to our class diagram. We're also going to add some ideas about heat energy. **Show slide 6.** We learned from the boiling-water lessons that liquid water can change states from a liquid to a gas. Water in the form of a gas is called *water vapor*. The water vapor rises into the air, and we can't see it. Our experiment with the two cups helps us reason about whether the opposite can happen. Can water vapor in the air change from a gas to a liquid? Let's think about the air around the two cups. How would you compare the air around the ice-water cup to the air around the cup of water at room temperature? Yes, the air near the ice-water cup is colder. Or in scientific language, the air near the ice-water cup has *less heat*	around the cup. Water vapor! The air around the ice-water cup is colder.	

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			energy than the air near the room-temperature cup. When water vapor in the air comes close to the ice-water cup (cup B), it loses heat energy, or cools, and forms liquid-water droplets on the outside of the cup. This process is called *condensation*. **Show slide 7.** **NOTE TO TEACHER:** *Display the chart from lesson 1b (the evaporation diagram) showing liquid water changing to gas. Save the chart for use again in lesson 3.* Look in your notebooks for the diagram from lesson 1 that showed liquid water changing to gas in evaporation. **Turn and Talk:** How can we add condensation to our diagram? Pair up and talk with your partner about this question. **NOTE TO TEACHER:** *After the Turn and Talk, consider students' ideas for adding to the diagram, and help them develop a representation similar to this one:*		
		Select content representations and models matched to the learning goal and engage students in their use.			

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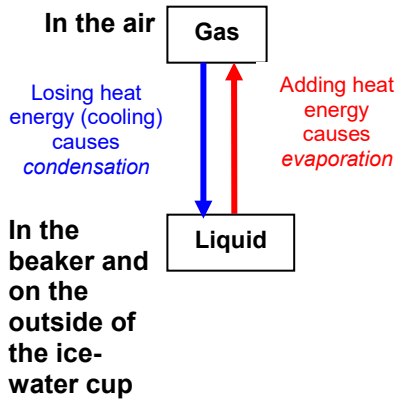
		Highlight key science ideas and focus question throughout.	 **Show slide 8.** Gas, or water vapor, changes to liquid water when the water vapor loses heat energy (cools). This process is called *condensation*. This is an important vocabulary word. **ELL support:** Post terms and definitions in an easily accessible place for ELL students to refer to. **Option:** Write the word *condensation* in your science notebooks, along with a drawing to show what it means. Did you understand what I meant when I said something has "lost heat energy"? What if you lose heat energy? How would you describe that?		

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			What might be another way of saying that there is less heat energy? Yes. So when something loses heat energy, it cools down. Scientists prefer to talk about gaining and losing heat energy; in everyday life, we usually talk about heating and cooling. We have more to learn about heat energy.	It's like you have less energy. Less heat energy. It's colder?	What kind of energy?
20 min	**Follow-Up to Activity** **Synopsis:** Students work in pairs using science ideas about condensation to construct explanations about why liquid-water droplets formed on the outside of the cup of ice water. Several pairs share and are given feedback to improve their explanations. **Main science idea(s):** • Water changes state from a gas (water vapor) to a liquid when the water vapor in the air loses energy (cools). This process is called *condensation*.	Make explicit links between science ideas and activities **after** the activity. Engage students in constructing explanations and arguments.	**Show slide 9.** Let's practice using these new ideas about condensation. Work with a partner to write a scientific explanation that uses the idea of condensation to explain why the water droplets formed on the outside of the cup of ice water. **Optional:** Instead of having students work on this with a partner, have them do this activity individually. The slide explains how to write a good scientific explanation. Let's review each step. **NOTE TO TEACHER**: *Walk students through the parts of a good*		

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			scientific explanation outlined on the slide. As you and your partner develop a scientific explanation for why water formed on the cup of ice water, follow the steps on the slide. Make a claim and provide evidence and reasoning using the science idea of condensation. In your reasoning, use words like *liquid water*, *water vapor*, *gas*, *heat energy*, and *condensation*. Be ready to share your ideas with the class. **Pairs work time.** **NOTE TO TEACHER:** *Give students about 5–10 minutes to work on their claims; then have about three pairs share their ideas. As they're working, circulate and be on the lookout for pairs you would like to share out at the end. Be sure to pick one pair with a strong (but not necessarily perfect) explanation, and one or two pairs who made a good start but could use some suggestions for improvement.* **Whole-class share-out.** **NOTE TO TEACHER:** *Use a document camera to show students'*		*Questions to ask during the share-out:* • How might this explanation be

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			written work. Let's hear what you came up with. I'm going to ask several pairs to share. I'd like everyone else to listen carefully and provide helpful feedback to improve the explanations. Be thinking about things you agree or disagree with, things you want to add, or questions you have.		improved? • How does your idea connect with the science idea of condensation? • Does anyone disagree with this explanation? Why?
5 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students synthesize key science ideas from the lesson and answer the lesson focus question. Then the teacher summarizes what students have learned so far about water changes. **Main science idea(s):** • Water changes state from a gas (water vapor) to a liquid when the water vapor in the air loses energy (cools). This process is called *condensation*.	Highlight key science ideas and focus question throughout. Engage students in making connections by synthesizing and summarizing key science ideas.	**Show slide 10.** Let's return to the focus question again: *Can you make water vapor in the air "reappear" as liquid water? Explain your thinking.* **NOTE TO TEACHER**: *If time is short, you can skip to the final phase, Link to Next Lesson.*  ***OPTIONAL Embedded Assessment Task*** I'm going to give you a minute to think about our focus question. Be ready to share a sentence that answers this question. Make sure to use science ideas in your response. On the slide is a sentence starter and a bank of words to use. **Sentence starter:** *Water vapor in*		

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			the air can reappear as liquid water if … **Word bank:** • Evaporates • Evaporation • Condenses • Condensation • Adds heat energy • Loses heat energy (cools) **Student think time (1 min).** **NOTE TO TEACHER**: *After the think time, call on students randomly (using equity sticks) to share their sentences. Remind those who are listening to ask questions and suggest ways to improve the responses. Call on as many students as time allows*. **Show slide 11.** So far we've learned two ways that	Engage students in communicating in scientific ways.	*Strong response:* Water vapor in the air can "reappear" as liquid water if it loses heat energy (cools). This is called *condensation*. *Even better but not expected:* Water vapor in the air can "reappear" as liquid water if it loses heat energy (cools) and has a surface to attach to. This is called *condensation*.	

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			water can change from one form to another. First, water can change from a liquid state to a gas or water-vapor state. This process is called *evaporation*. Adding heat energy can speed up this process. A second way water can change states is when water vapor in the air loses heat energy (cools) and "reappears" as liquid water. This process is called *condensation*.		
2 min	**Link to Next Lesson** **Synopsis:** The teacher links science ideas to the next lesson.	Link science ideas to other science ideas.	**Show slide 12.** In this unit, we've seen that water can change states when it gains or loses heat energy. Evaporation happens when water gains heat energy, and condensation happens when it loses heat energy. But how exactly does gaining or losing heat energy make water change states? Why is water sometimes a liquid, sometimes a solid, and sometimes a gas? These are the questions we'll explore next time.		