Lesson 4.1
Investigating the Movement of Water Vapor
Lesson Overview

In this lesson, students begin to consider the Chapter 4 Question: *Why is there more water vapor high up over West Ferris than East Ferris?* First, the class reviews what they know about why West Ferris receives more rain than East Ferris. Students then use *The Earth System* Simulation to discover what factors can affect how water vapor moves to different areas in the atmosphere. By comparing different landscapes and adjusting wind settings, students observe that the wind and a tall mountain affect the movement of water vapor. They continue to gather information about this idea by creating a physical model of a mountain and wind. The lesson ends with students comparing how water vapor would move across two landscapes, then reflecting on how a mountain and the wind can affect rainfall. The purpose of this lesson is for students to discover that water vapor moves in the direction of the wind and that a mountain can direct the wind upward, moving water vapor higher in the atmosphere.

**Anchor Phenomenon:** One side of Ferris Island has a water shortage and the other does not.  
**Investigative Phenomenon:** One side of a mountain can get more rain than the other side

**Students learn:**

- Wind and mountains affect the movement of water vapor in the atmosphere.
- When the wind blows toward a mountain, the mountain can direct the wind upward, moving water vapor higher in the atmosphere.
Investigating Water Vapor in the Sim

Students use *The Earth System* Simulation to investigate what factors can influence the movement of water vapor in the atmosphere.

Instructional Guide

1. **Introduce the Sim activity.** Explain that pairs will use the Sim to investigate how water vapor gets to different areas in the atmosphere. Remind students that water vapor comes from bodies of water, and explain that pairs will choose from Sim landscapes with similar bodies of water (Landscapes 1–6).

2. **Introduce notebook page 65.** Have student turn to page 65, Investigating the Movement of Water Vapor, in their notebooks. Review the instructions.

   Your goal is to use the Sim to investigate how water vapor gets to different areas in the atmosphere, then answer the questions.

   - **Goal:** Use the Sim to investigate how water vapor gets to different areas in the atmosphere, then answer the question below.
   - **Step 1:** Choose Landscape 1, 2, 3, 4, 5, or 6.
   - **Step 2:** In RUN, check that the Water Molecules toggle is ON.
   - **Step 3:** Observe the movement of the water vapor.
   - **Step 4:** Talk with your partner about which factors you might change to affect the movement of water vapor.
   - **Step 5:** Press ANALYZE, then replay and press on a molecule of water vapor to more closely observe its movement.
   - **Step 6:** Choose a different landscape and repeat steps 2–5.

3. **Designate pairs and distribute digital devices.** Distribute one digital device to each pair of students and direct them to *The Earth System* Simulation. As needed, remind students of the Guidelines for Using Apps.
4. **On-the-Fly Assessment: Students investigate in the Sim.** Circulate as students work with the Sim. As you circulate, notice how students are testing different factors that might affect water vapor movement.

5. **Project The Earth System Simulation as students share their findings.** Project the Student Apps Page and select The Earth System and then the Simulation. Have students share what they found out and what landscapes they looked at. Project the landscape and show the factors as they describe them. Point out how the water vapor is moving.

- **What are the factors that can affect the movement of water vapor?**

Accept all answers. Some students have likely discovered that wind and mountains affect water vapor.

6. **Students investigate further in the Sim.** Have students go back to the Sim to see how the wind and a tall mountain can affect the movement of water vapor. Encourage students to select landscapes with very different sized mountains (e.g., Landscapes 1 and 3, or Landscapes 4 and 6) to emphasize their effect.

7. **Debrief the investigation.** Have students share what they discovered.

- **Did you notice anything else that affects the movement of water vapor in the atmosphere?**

  [The wind and tall mountains can affect the movement of water vapor. Water vapor moves in the direction that wind is blowing.]

Encourage students to describe how they think wind and mountains can affect the movement of water vapor. Explain that they will continue gathering more information about the effect of wind and mountains in the next activity.

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**Embedded Formative Assessment**

**On-the-Fly Assessment 9: Investigating the Movement of Water Vapor in the Sim**

**Look for:** Observing students as they carry out their investigations is an opportunity to informally assess how they engage with the practice of testing variables during investigations. To conduct an investigation, students should not randomly choose and change variables, but should instead thoughtfully create different setups that can produce different results. Do you notice students first changing one variable (such as wind direction), and waiting to notice the results before changing another variable (such as the landscape)?

**Now what?** If students are not testing variables, lead a guided conversation to help them make a plan for what they want to test. Ask them which variables they think are important for creating a pattern of uneven rainfall, and ask them what setup in the Sim might produce this pattern. Then ask them how they might test this, and guide them toward changing one variable at a time and observing results.
Teacher Support

Rationale

Pedagogical Goals: Purpose of the Sim Investigation
The purpose of this Sim activity is for students to use different features in *The Earth System* Simulation to discover factors that can affect the movement of water vapor: wind and tall mountains. Giving students time to explore on their own first allows students autonomy to construct ideas themselves without teacher direction. Then, directing students to compare specific landscapes encourages them to home in on the differences in water vapor movement depending on differences across landscapes (i.e., the size of the mountain). Only in Landscapes 3 and 6, where there is a tall mountain, they will see the water vapor turn upward when it hits the mountain.

Possible Responses

**Investigation Notebook**

**Investigating the Movement of Water Vapor** *(page 65)*

Based on what you observed in the Sim, what factors affect how water vapor moves to different areas in the atmosphere?
The wind and mountains can make water vapor move to different areas in the atmosphere.

**The Earth System Simulation**

**What students should do and notice:** Students should investigate which factors affect the motion of water vapor in the atmosphere. Students should test different landscapes and vary the wind direction. Students should notice that when the wind blows toward a tall mountain, it is redirected upward.
Investigating the Movement of Water Vapor

Use the Sim to investigate how water vapor gets to different areas in the atmosphere, then answer the question below.

1. Choose Landscape 1, 2, 3, 4, 5, or 6.
2. In RUN, check that the Water Molecules toggle is ON.
3. Observe the movement of the water vapor.
4. Talk with your partner about which factors you might change to affect the movement of water vapor.
5. Press ANALYZE, then replay and press on a molecule of water vapor to more closely observe its movement.
6. Choose a different landscape and repeat steps 2–5.

Based on what you observed in the Sim, what factors affect how water vapor moves to different areas in the atmosphere?

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Students use The Earth System Simulation to investigate what factors can influence the movement of water vapor in the atmosphere.

Instructional Guide

1. **Introduce the Sim activity.** Explain that pairs will use the Sim to investigate how water vapor gets to different areas in the atmosphere. Remind students that water vapor comes from bodies of water, and explain that pairs will choose from Sim landscapes with similar bodies of water (Landscapes 1–6).

2. **Introduce notebook page 65.** Have students turn to page 65, Investigating the Movement of Water Vapor, in their notebooks. Review the instructions.

   - Su objetivo es usar la Simulación para investigar cómo llega el vapor de agua a diferentes áreas en la atmósfera, luego responder las preguntas.
   - Goal: Use the Sim to investigate how water vapor gets to different areas in the atmosphere, then answer the question below.
   - Step 1: Choose Landscape 1, 2, 3, 4, 5, or 6.
   - Step 2: In Run, check that the Water Molecules toggle is ON.
   - Step 3: Observe the movement of the water vapor.
   - Step 4: Talk with your partner about which factors you might change to affect the movement of water vapor.
   - Step 5: Press ANALYZE, then replay and press on a molecule of water vapor to more closely observe its movement.
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3. **Designate pairs and distribute digital devices.** Distribute one digital device to each pair of students and direct them to The Earth System Simulation. As needed, remind students of the Guidelines for Using Apps.
4. **On-the-Fly Assessment: Students investigate in the Sim.** Circulate as students work with the Sim. As you circulate, notice how students are testing different factors that might affect water vapor movement.

5. **Project the Earth System Simulation as students share their findings.** Project the Student Apps Page and select The Earth System and then the Simulation. Have students share what they found out and what landscapes they looked at. Project the landscape and show the factors as they describe them. Point out how the water vapor is moving.

   ¿Cuáles son los factores que pueden afectar el movimiento del vapor de agua?

   Accept all answers. Some students have likely discovered that wind and mountains affect water vapor.

6. **Students investigate further in the Sim.** Have students go back to the Sim to see how the wind and a tall mountain can affect the movement of water vapor. Encourage students to select landscapes with very different sized mountains (e.g., Landscapes 1 and 3, or Landscapes 4 and 6) to emphasize their effect.

7. **Debrief the investigation.** Have students share what they discovered.

   ¿Notaron algo más que afecte el movimiento del vapor de agua en la atmósfera?
   [El viento y las montañas altas pueden afectar el movimiento del vapor de agua. El vapor de agua se mueve en la dirección en la que está soplando el viento].

   Encourage students to describe how they think wind and mountains can affect the movement of water vapor. Explain that they will continue gathering more information about the effect of wind and mountains in the next activity.

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**Embedded Formative Assessment**

**On-the-Fly Assessment 9: Investigating the Movement of Water Vapor in the Sim**

**Look for:** Observing students as they carry out their investigations is an opportunity to informally assess how they engage with the practice of testing variables during investigations. To conduct an investigation, students should not randomly choose and change variables, but should instead thoughtfully create different setups that can produce different results. Do you notice students first changing one variable (such as wind direction), and waiting to notice the results before changing another variable (such as the landscape)?

**Now what?** If students are not testing variables, lead a guided conversation to help them make a plan for what they want to test. Ask them which variables they think are important for creating a pattern of uneven rainfall, and ask them what setup in the Sim might produce this pattern. Then ask them how they might test this, and guide them toward changing one variable at a time and observing results.
Teacher Support

Rationale

Pedagogical Goals: Purpose of the Sim Investigation
The purpose of this Sim activity is for students to use different features in *The Earth System* Simulation to discover factors that can affect the movement of water vapor: wind and tall mountains. Giving students time to explore on their own first allows students autonomy to construct ideas themselves without teacher direction. Then, directing students to compare specific landscapes encourages them to home in on the differences in water vapor movement depending on differences across landscapes (i.e., the size of the mountain). Only in Landscapes 3 and 6, where there is a tall mountain, they will see the water vapor turn upward when it hits the mountain.

Possible Responses

Investigation Notebook

*Investigating the Movement of Water Vapor* (page 65)

Based on what you observed in the Sim, what factors affect how water vapor moves to different areas in the atmosphere?
The wind and mountains can make water vapor move to different areas in the atmosphere.

*The Earth System* Simulation

What students should do and notice: Students should investigate which factors affect the motion of water vapor in the atmosphere. Students should test different landscapes and vary the wind direction. Students should notice that when the wind blows toward a tall mountain, it is redirected upward.
Investigar el movimiento del vapor de agua

Usa la simulación para investigar cómo llega el vapor de agua a diferentes áreas en la atmósfera, y luego responde la pregunta debajo.

1. Elige el paisaje 1, 2, 3, 4, 5 o 6.
2. En la opción RUN (accionar), chequea que el interruptor de Water Molecules (moléculas de agua) esté ON (encendido).
3. Observa el movimiento del vapor de agua.
4. Habla con tu compañero/a sobre qué factores podrían cambiar para afectar el movimiento del vapor de agua.
5. Oprime ANALYZE (analizar). Luego vuelve a repetir la simulación y oprime sobre una molécula de vapor de agua para observar su movimiento más de cerca.
6. Elige un paisaje diferente y repite los pasos 2 a 5.

Basándote en lo que observaste en la simulación, ¿qué factores afectan cómo se mueve el vapor de agua a diferentes áreas en la atmósfera?

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El sistema Tierra—Lección 4.1
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