Lesson 3.4
Nutrients and Soil
Lesson Overview

Students analyze data and investigate by working with the *Ecosystem Restoration* Simulation to learn more about the effects of nutrients on plant growth. First, students receive an update from Natural Resources Rescue with data about the growth of plants in nutrient-rich soil and in nutrient-poor soil. Through analyzing these data, students see that plants in nutrient-poor soil do not add as much body matter. Students then investigate by using the Simulation to compare how nutrients in the soil help plants grow. Students observe that without nutrients in the soil, plants make food and add to their body matter much more slowly than when in nutrient-rich soil. Students record their ideas and, after investigating, they engage in a Shared Listening routine to make sense of their ideas and of the role of nutrients in an ecosystem. This lesson serves as a multimodal investigation of why plants need nutrients.

**Anchor Phenomenon:** The jaguars, sloths, and cecropia trees in a reforested section of a Costa Rican rain forest are not growing and thriving.

**Investigative Phenomenon:** When mushrooms are removed from an ecosystem, the plants become unhealthy.

**Students learn:**

- One way in which soils can be different is that they can be nutrient rich or nutrient poor.
- Plants do not make enough food molecules to grow and thrive when they don’t have access to the nutrients they need.
Students use the Simulation to investigate a new question about why plants need nutrients to grow.

**Instructional Guide**

1. **Introduce a new Investigation Question.** Point out the Investigation Question on the board.

   Now that we have seen the difference in plant growth between nutrient-rich soil and nutrient-poor soil, let's investigate further to figure out *How do nutrients in the soil help plants grow?*

2. **Introduce notebook pages.** Have students turn to pages 68–69, Investigating Plant Growth in the Simulation, in their notebooks. Review the instructions and the questions with the class. Let students know that as ecologists, their role is to observe the plants in the Simulation very closely during this activity.

3. **Designate pairs and distribute one digital device to each pair.** Let students know they will have about 15 minutes to use the Simulation and answer the questions in their notebooks. Remind students to discuss their observations and ideas as they work with their partners.

4. **On-the-Fly Assessment: Students discuss their observations of nutrients in an ecosystem.** As you circulate, listen for how students are understanding the role of nutrients in an ecosystem and how nutrients can affect other parts of an ecosystem.

5. **Circulate and assist as needed.** After about halfway through the 15-minute time period, provide the signal for students to switch Sim “drivers.”

6. **Students share responses.** Gather students’ attention. Call on a few students to share their responses to the questions in the notebook. Students should mention that when the nutrients were removed, the plant could not make as much food.
We have been investigating the different parts of an ecosystem and how they interact. In the Simulation, we see that when we remove decomposers, the plants can become unhealthy. What do you think the connection is between the decomposer and plant parts of an ecosystem? Why do the decomposers seem to affect the plants? [The decomposers put nutrients in the soil, which the plants use to help them make food.]

### Embedded Formative Assessment

**On-the-Fly Assessment 11: The Role of Nutrients in Plant Growth**

**Look for:** As pairs discuss their observations in the Simulation, listen for how students describe the role of nutrients in a system—in this case, the relationship between decomposers, nutrients, and plant growth. This is an opportunity for students to begin to apply their understanding of the crosscutting concept of Systems and System Models, especially in their ability to think of the nonliving parts of an ecosystem as an important part of a system. Do students notice that without nutrients in the soil, the plants in the ecosystem are not healthy? Do students notice that nutrients are the connection between decomposers and plants and that plants do not take in matter from decomposers directly? Do students understand that nutrients, although not living, play an important role in the growth of living things?

**Now what?** If students don’t seem to understand how removing the nutrients from the soil can affect the growth of the plants, return to the Simulation. Figure out the source of students’ misunderstanding. As they observe, are they simply not observing the creation of food matter in the plant and, instead, focusing their attention elsewhere? Or, are students not understanding what they are observing in the Simulation? Are they unclear on the representation of matter or nutrients? If students are focusing their attention somewhere besides the plants, replay the Simulation, remove decomposers, and direct students’ attention first to the absence of nutrients in the soil and then to the plants and the matter blocks inside. If students aren’t understanding what they are observing, refer to the matter blocks that students used in the Modeling How Animals Grow activity in Lesson 1.4 and the Food Web Model in Lesson 1.7 and point out the matter blocks in the plant. Point to the nutrients in the soil and have students observe how they disappear with the fungi. As you play the Simulation, lead a discussion about what is happening. First, have students explain what they observe happening in the plant. Then, talk students through what is happening, as needed, and correct any alternate conceptions.

### Teacher Support

**Rationale**

**Pedagogical Goals: Investigating Questions with the Simulation**

Simulations provide an environment in which students can explore to discover relationships and to investigate questions. In this lesson, students have a fair degree of independence as they use the Simulation to investigate what nutrients do for plants and why plants need nutrients to grow and thrive. This is a wonderful opportunity for students to figure out cause—and—effect relationships, as well as how the parts of an ecosystem interact. It is okay if students struggle to figure out the relationships—this is productive struggle. Your role should be to focus students on the question at hand and to let them construct their understanding of the relationships between organisms in an ecosystem themselves.
Possible Responses

Investigation Notebook
Investigating Plant Growth in the Simulation (pages 68–69)

How did you remove nutrients from the soil in the ecosystem?
I removed the decomposers. That made the nutrients go away, too.

Observe what happens to the plants when there are no nutrients. What did you observe?
The plants became unhealthy.

Add the nutrients back into the soil. What do you observe about the plants?
They become healthy again.

What do you notice about the food matter that plants make when they are healthy? How is that different from when they are unhealthy?
When there are no nutrients, the plants do not make as much plant food matter as when there are nutrients. This makes the plants unhealthy, because they are not getting enough food matter.

In the Simulation ecosystem, what is the connection between the plants and the mushrooms?
The plants need the mushrooms in order to be healthy because the mushrooms put nutrients in the soil, and the plants need nutrients to make enough food matter to grow and thrive.

Ecosystem Restoration Simulation

What students should do and notice: Students should remove the mushrooms from the ecosystem, which will result in the removal of nutrients from the soil. Students should notice that when there are no nutrients in the soil, the plants are unhealthy, but they remain alive. When students add nutrients back into the ecosystem, the plants will become healthy again. Students should notice that in the absence of soil nutrients, plants make less food matter. Students should conclude that the plants are unhealthy because they are unable to make enough food matter without nutrients. This helps students understand that plants need soil nutrients and, therefore, decomposers to help them make food molecules.
When there are **nutrients** in the soil, plants make more food matter.

When there are no **nutrients** in the soil, plants make less food matter.

Effect of nutrient removal on the ecosystem over time
Investigating Plant Growth in the Simulation

1. Change the ecosystem so the nutrients disappear from the soil.
2. Observe what happens to the plants in the ecosystem.
3. Answer the questions below, based on your observations.

How did you remove nutrients from the soil in the ecosystem?
___________________________________________________________________
___________________________________________________________________

Observe what happens to the plants when there are no nutrients. What did you observe?
___________________________________________________________________
___________________________________________________________________

Add the nutrients back into the soil. What do you observe about the plants?
___________________________________________________________________
___________________________________________________________________

What do you notice about the food matter that plants make when they are healthy? How is that different from when they are unhealthy?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Investigating Plant Growth in the Simulation (continued)

In the Simulation ecosystem, what is the connection between the plants and the mushrooms?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Investigating Plant Growth in the Simulation

Students use the Simulation to investigate a new question about why plants need nutrients to grow.

Instructional Guide

1. **Introduce a new Investigation Question.** Point out the Investigation Question on the board.

   Ahora que hemos visto la diferencia en el crecimiento de las plantas entre suelo rico en nutrientes y suelo pobre en nutrientes, investiguemos más a fondo para averiguar ¿Cómo ayudan los nutrientes en el suelo a crecer a las plantas?

2. **Introduce notebook pages.** Have students turn to pages 68–69, Investigating Plant Growth in the Simulation, in their notebooks. Review the instructions and the questions with the class. Let students know that as ecologists, their role is to observe the plants in the Simulation very closely during this activity.

3. **Designate pairs and distribute one digital device to each pair.** Let students know they will have about 15 minutes to use the Simulation and answer the questions in their notebooks. Remind students to discuss their observations and ideas as they work with their partners.

4. **On-the-Fly Assessment: Students discuss their observations of nutrients in an ecosystem.** As you circulate, listen for how students are understanding the role of nutrients in an ecosystem and how nutrients can affect other parts of an ecosystem.

5. **Circulate and assist as needed.** After about halfway through the 15-minute time period, provide the signal for students to switch Sim “drivers.”

6. **Students share responses.** Gather students’ attention. Call on a few students to share their responses to the questions in the notebook. Students should mention that when the nutrients were removed, the plant could not make as much food.
Embedded Formative Assessment

On-the-Fly Assessment 11: The Role of Nutrients in Plant Growth

Look for: As pairs discuss their observations in the Simulation, listen for how students describe the role of nutrients in a system—in this case, the relationship between decomposers, nutrients, and plant growth. This is an opportunity for students to begin to apply their understanding of the crosscutting concept of Systems and System Models, especially in their ability to think of the nonliving parts of an ecosystem as an important part of a system. Do students notice that without nutrients in the soil, the plants in the ecosystem are not healthy? Do students notice that nutrients are the connection between decomposers and plants and that plants do not take in matter from decomposers directly? Do students understand that nutrients, although not living, play an important role in the growth of living things?

Now what? If students don’t seem to understand how removing the nutrients from the soil can affect the growth of the plants, return to the Simulation. Figure out the source of students’ misunderstanding. As they observe, are they simply not observing the creation of food matter in the plant and, instead, focusing their attention elsewhere? Or, are students not understanding what they are observing in the Simulation? Are they unclear on the representation of matter or nutrients? If students are focusing their attention somewhere besides the plants, replay the Simulation, remove decomposers, and direct students’ attention first to the absence of nutrients in the soil and then to the plants and the matter blocks inside. If students aren’t understanding what they are observing, refer to the matter blocks that students used in the Modeling How Animals Grow activity in Lesson 1.4 and the Food Web Model in Lesson 1.7 and point out the matter blocks in the plant. Point to the nutrients in the soil and have students observe how they disappear with the fungi. As you play the Simulation, lead a discussion about what is happening. First, have students explain what they observe happening in the plant. Then, talk students through what is happening, as needed, and correct any alternate conceptions.

Teacher Support

Rationale

Pedagogical Goals: Investigating Questions with the Simulation

Simulations provide an environment in which students can explore to discover relationships and to investigate questions. In this lesson, students have a fair degree of independence as they use the Simulation to investigate what nutrients do for plants and why plants need nutrients to grow and thrive. This is a wonderful opportunity for students to figure out cause—and—effect relationships, as well as how the parts of an ecosystem interact. It is okay if students struggle to figure out the relationships—this is productive struggle. Your role should be to focus students on the question at hand and to let them construct their understanding of the relationships between organisms in an ecosystem themselves.
Investigation Notebook  
Investigating Plant Growth in the Simulation (pages 68–69)

How did you remove nutrients from the soil in the ecosystem?  
I removed the decomposers. That made the nutrients go away, too.

Observe what happens to the plants when there are no nutrients. What did you observe?  
The plants became unhealthy.

Add the nutrients back into the soil. What do you observe about the plants?  
They become healthy again.

What do you notice about the food matter that plants make when they are healthy? How is that different from when they are unhealthy?  
When there are no nutrients, the plants do not make as much plant food matter as when there are nutrients. This makes the plants unhealthy, because they are not getting enough food matter.

In the Simulation ecosystem, what is the connection between the plants and the mushrooms?  
The plants need the mushrooms in order to be healthy because the mushrooms put nutrients in the soil, and the plants need nutrients to make enough food matter to grow and thrive.

_Ecosystem Restoration_ Simulation

What students should do and notice: Students should remove the mushrooms from the ecosystem, which will result in the removal of nutrients from the soil. Students should notice that when there are no nutrients in the soil, the plants are unhealthy, but they remain alive. When students add nutrients back into the ecosystem, the plants will become healthy again. Students should notice that in the absence of soil nutrients, plants make less food matter. Students should conclude that the plants are unhealthy because they are unable to make enough food matter without nutrients. This helps students understand that plants need soil nutrients and, therefore, decomposers to help them make food molecules.
When there are **nutrients** in the soil, plants make more food matter.

When there are no **nutrients** in the soil, plants make less food matter.

**Effect of nutrient removal on the ecosystem over time**
Investigar el crecimiento de las plantas en la simulación

1. Cambia el ecosistema de modo que los nutrientes desaparezcan del suelo.
2. Observa lo que les sucede a las plantas en el ecosistema.
3. Responde las preguntas siguientes basándote en tus observaciones.

¿Cómo quitaste nutrientes del suelo en el ecosistema?
___________________________________________________________________
___________________________________________________________________

Observa lo que les sucede a las plantas cuando no hay nutrientes. ¿Qué observas?
___________________________________________________________________
___________________________________________________________________

Vuelve a agregar los nutrientes al suelo. ¿Qué observas acerca de las plantas?
___________________________________________________________________
___________________________________________________________________

¿Qué notas acerca de la materia de alimento que producen las plantas cuando están saludables? ¿De qué manera es diferente eso a lo que pasa cuando no están saludables?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Investigar el crecimiento de las plantas en la simulación (continuación)

En el ecosistema de la simulación, ¿cuál es la conexión entre las plantas y los hongos?

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________