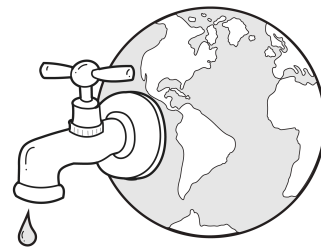


Lesson 4: Freshwater and Groundwater

☐ Getting Started

Imagine turning on your faucet, and nothing comes out. No water to drink. No water to cook with. No water to grow food. Even though Earth has a lot of water, only a small amount is freshwater that people can actually use. And that water is not spread evenly across the planet. In this lesson, you'll investigate where freshwater is stored, how it moves underground, and how people use it. As you explore, you'll begin to understand why access to water can shape how and where people live and why protecting it matters.



Stuff You Need

- *Water: The Story of the Hydrosphere, Second Edition* by Lynne Z. Petkovic, M.Ed., J.D.
- blue food coloring (kit)
- crayons, colored pencils, or markers
- eye dropper (kit)
- large clear cups (kit)
- modeling clay (kit)
- pebbles (kit)
- sand (kit)
- sponge (kit)

Ideas to Think About

- How do energy and Earth's systems work together to move and store freshwater?

Things to Know

- **Groundwater** is water contained in the open spaces (pores) found in soil and/or rock.
- A **permeable layer** is a layer through which water flows or passes easily (for example, limestone).
- An **impermeable layer** is a layer through which water does not flow or pass (for example, granite).
- An **aquifer** is an underground layer of rock or soil that stores and holds groundwater between particles.
- The **zone of saturation** is the zone found in an aquifer that has all the pores filled with water.
- The **water table** is the top surface of the zone of saturation. It may be above or under ground.

- The **zone of aeration** is an area of an aquifer where the pores are partially filled with water and partially filled with air.
- **Runoff** is the water from rain or melting snow that flows over the land and into rivers, lakes, or oceans.
- Growth of living organisms like animals and humans and population increases are limited by access to water.
- Freshwater moves through the ground and is stored in underground reservoirs that support ecosystems and human life.

☐ Reading and Questions

Read Chapter 4 in the book *Water: The Story of the Hydrosphere*. Then, answer the questions.

1. What is groundwater?

2. How does an aquifer form, and why is it important?

3. Why is it important to protect groundwater resources such as the Ogallala Aquifer?

Activities

☐ Activity 1: Build Your Own Water Table Model

When rain falls to the ground, it doesn't all follow the same path. Some water flows across the land. Some soaks deep into the ground. Some gets stored underground for long periods of time. Even though you can't always see it, water is constantly

moving through Earth's systems—both above and below the surface. These movements are driven by two powerful forces:

- energy from the Sun
- gravity pulling water downward

In this activity, you will build a model to explore how freshwater moves through land and underground systems.



Groundwater and Aquifers

www.beyondthepage.com/link/13335/

You can use the diagram in the following website as a reference.

Complete the following steps:

Create the Model Base

1. Start by adding a layer of clay to the bottom of the clear plastic cup. This represents the impermeable layer (bedrock) that water cannot pass through.
2. Next, add a layer of gravel on top of the clay, covering the entire bottom of the container. This represents the permeable layer where water can move through.
3. On top of the gravel, add a layer of sand, leaving some space at the top of the container. This layer also represents permeable material, but with smaller pores.
4. Now, gently tilt your container so one side is slightly higher than the other. This represents land with a slope, like a hill or hillside.
5. Place a small sponge on top to represent a vegetation layer that absorbs some water before it seeps underground.
6. Take a moment to observe your model. Even though it looks simple, it represents different layers of Earth where water can move, collect, or be blocked.

Add Water to Create a Water Table

1. Mix a few drops of food coloring into a cup of water to make the movement of water easier to observe. Use a dropper or pour a small amount of water onto the top of the jar, over the sponge layer.
2. The water in the sand and gravel represents the zone of saturation (where the soil and rock are completely filled with water), and the top of the water level represents the water table.
3. Notice the Zone of Aeration: The area above the water table where the sand remains dry represents the zone of aeration (where air fills most of the pores).

You may notice water soaking downward through the sand and gravel. This is similar to how groundwater forms. You may also see water begin to collect above the clay layer. Because the clay does not allow water to pass through easily, water builds up on top of it. This represents the **water table**. On the surface, some water may move downhill. This is called **runoff**, and it happens when water cannot soak into the ground fast enough. Even though you are working with a small model, these same processes happen across Earth every day.

These movements are all part of a larger system driven by energy from the Sun and the force of gravity—constantly cycling water through Earth's surface and below it. Now, using your observations from building this model, complete the "Water Table Model" Activity Page.

☐ **Activity 2: Freshwater Withdrawals**

Every day, people around the world depend on freshwater. We use it to drink, grow food, produce energy, and support entire communities. But even though water is constantly cycling through Earth's systems, it is not always available where or when people need it. So how do humans get the water they use?

In this activity, you will explore where freshwater comes from and how people use it. As you watch, think about how access to water can affect the way people live, and pause the video to answer the questions on the "Freshwater Withdrawals" Activity Page. Then, read the article after the video to answer the questions in Part 2 of the activity page.



Water Sources and Its Importance

www.beyondthepage.com/link/13336/



10 Drought-Tolerant Crops to Plant Amid Water Scarcity

www.beyondthepage.com/link/13343/

Wrapping Up

In this lesson, you explored how freshwater moves through Earth's systems and how people depend on it every day. You also saw that water is not always available where it's needed, which can affect both people and the environment. Next, you'll explore how water supports life as you learn about aquatic ecosystems.

Movement of Freshwater Through Earth's Systems



Develop Your Model

Scientists often use drawings to represent systems they cannot fully see. On your Activity Page, draw a model of your freshwater system. In your drawing, include:

- ☐ Rain falling onto the land
- ☐ Water soaking into the ground (groundwater)
- ☐ Water flowing across the surface (runoff)
- ☐ Arrows showing water moving downward and sideways
- ☐ A label showing gravity pulling water downward
- ☐ A label showing the Sun as the energy source that drives the water cycle



Add These Labels to Your Model

As you build your model, be sure to include and label the following parts:

- ☐ Permeable layer (where water can pass through easily)
- ☐ Impermeable layer (where water cannot pass through)
- ☐ Aquifer (where groundwater is stored)
- ☐ Zone of saturation (where all spaces are filled with water)
- ☐ Water table (the top of the saturated zone)
- ☐ Zone of aeration (where spaces contain both air and water)



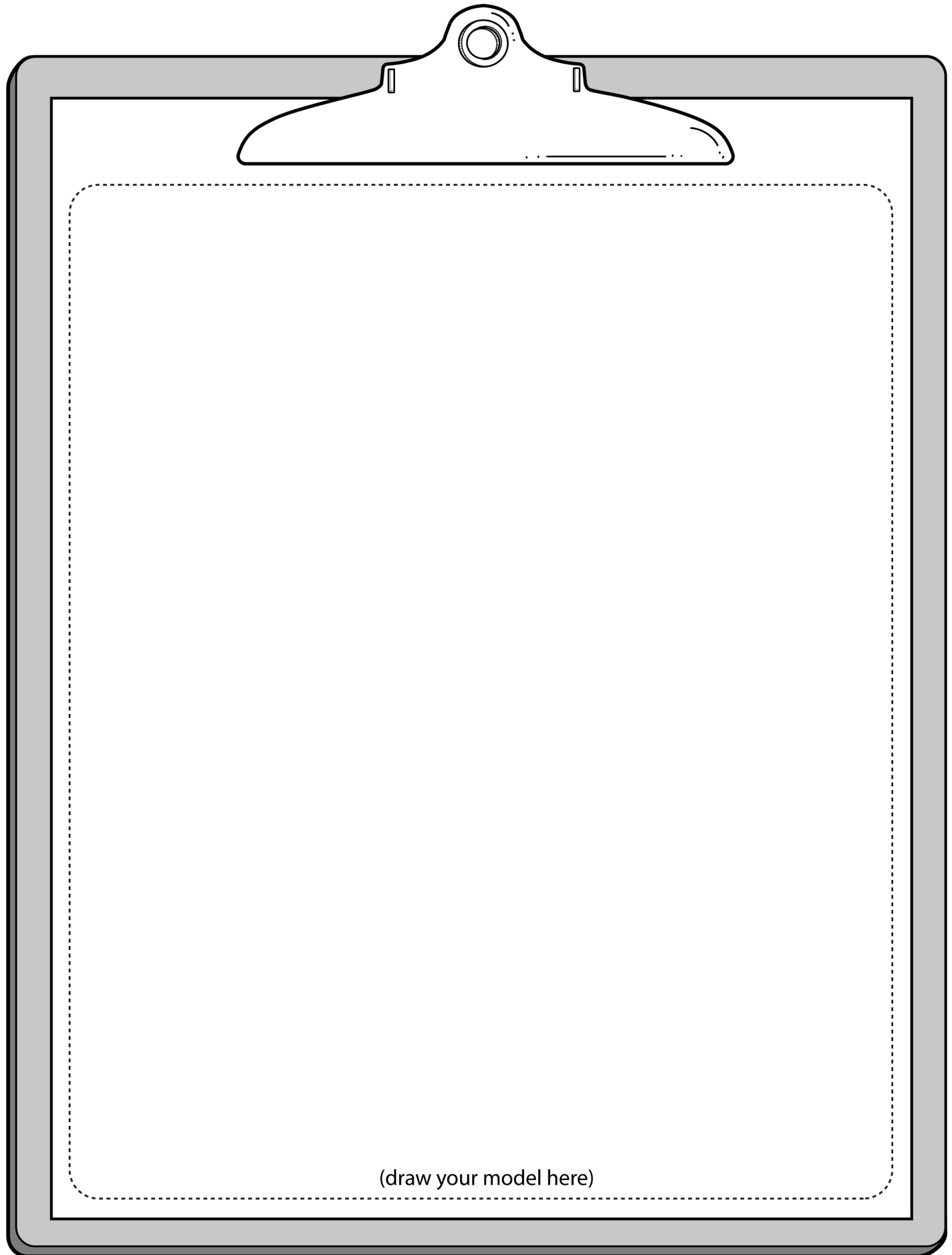
Final Step: Make Meaning

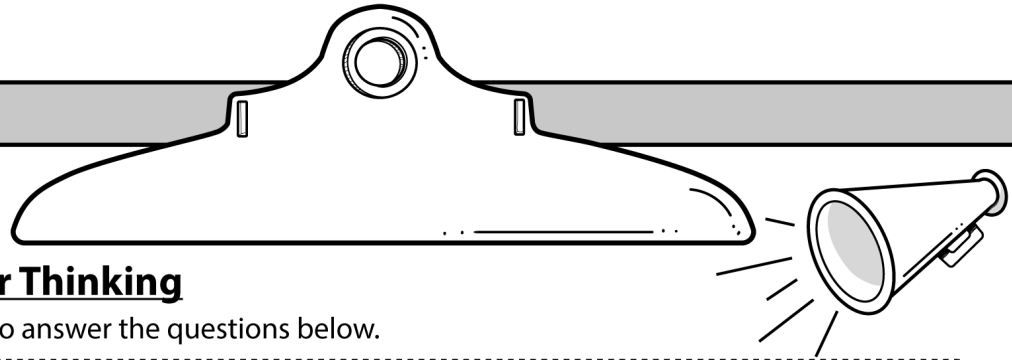
Your drawing should not just show parts—it should explain how the system works. Use arrows and labels to show how:

- ☐ Water moves through different layers
- ☐ Some water becomes stored underground
- ☐ Some water flows across the surface



Be sure your model clearly shows how water moves through Earth's systems.



**Explain Your Thinking**

Use your model to answer the questions below.

1. How does gravity cause water to move in your model? _____

2. How does energy from the Sun help move water through Earth's systems? _____

3. What are two different paths water can take after it falls as rain? _____

4. Why might groundwater be found in some places but not others? _____

Extension: Thinking About Water Resources

Imagine two areas receive the same amount of rainfall. One area has sandy soil, and the other has hard rock close to the surface.

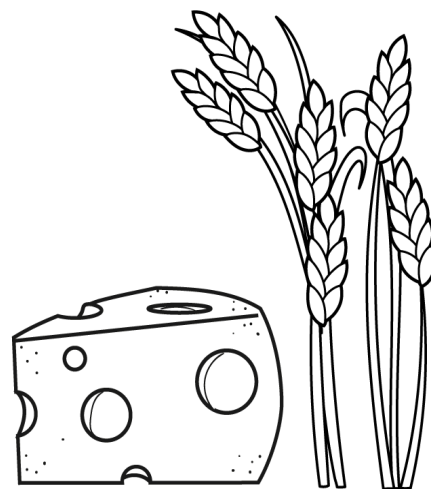
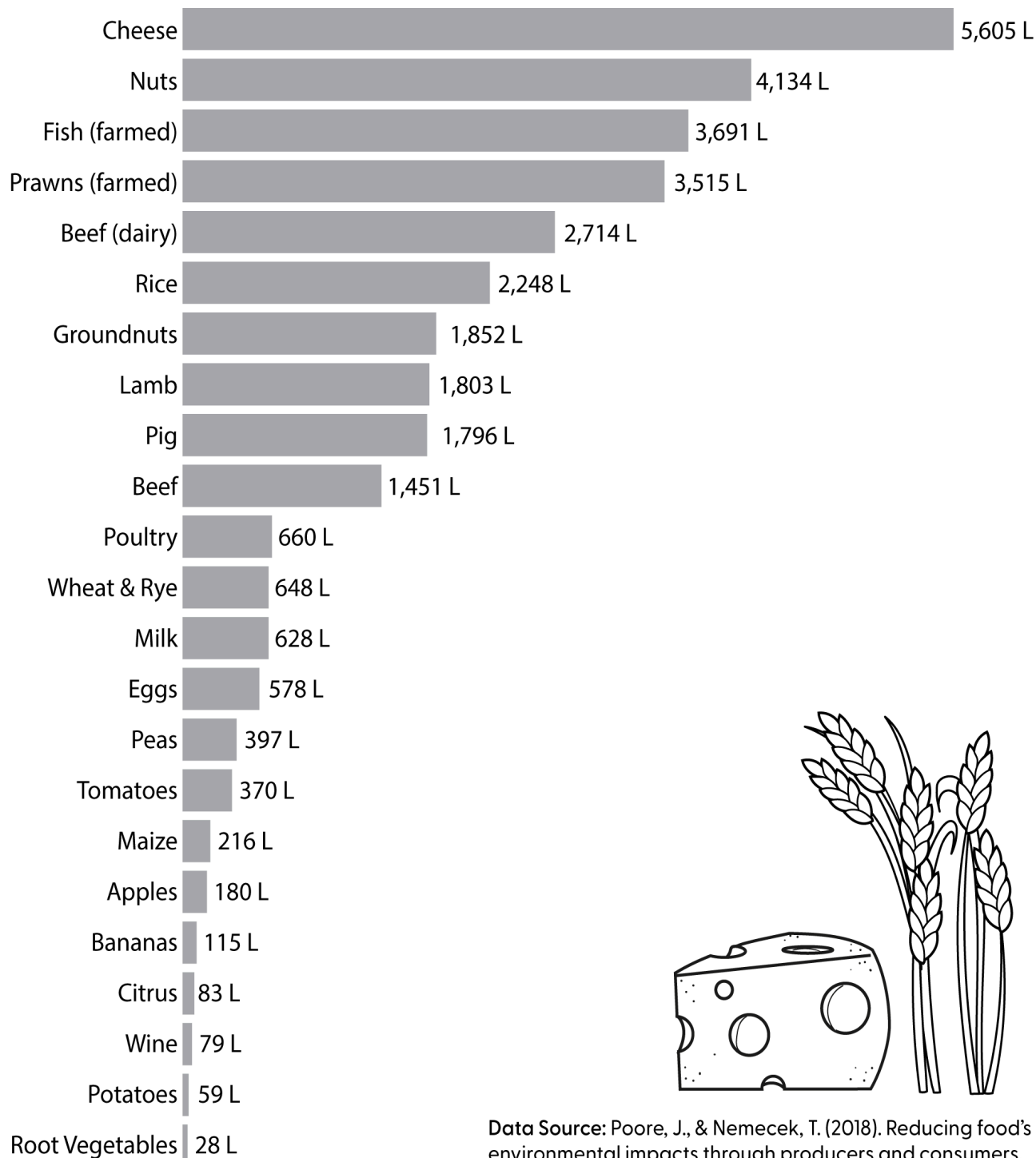
5. Which area would likely have more groundwater? Why? _____

6. How might this affect people living in each area? _____

Freshwater Withdrawals

Water Needed to Produce Food

(liters per kilogram of food product)



Data Source: Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science. – processed by Our World in Data

Part 1: Video Questions As you watch, pause the video to answer the questions below.

1. Why is surface water important? _____

2. Why is groundwater important? _____

3. What are some challenges to water sustainability? _____

Part 2: Use the article and chart on page 1 to answer the following questions.

4. What pattern do you notice in the amount of water needed to produce different types of food shown in the chart?

5. According to the article, what is a drought-tolerant crop, and why might it be useful in areas with limited freshwater?

6. How could growing drought-tolerant crops help reduce pressure on freshwater resources such as rivers and groundwater?

Lesson 4: Freshwater and Groundwater

Getting Started

✿ Ideas to Think About

- How do energy and Earth's systems work together to move and store freshwater?

📖 Things to Know

- **Groundwater** is water contained in the open spaces (pores) found in soil and/or rock.
- A **permeable layer** is a layer through which water flows or passes easily (for example, limestone).
- An **impermeable layer** is a layer through which water does not flow or pass (for example, granite).
- An **aquifer** is an underground layer of rock or soil that stores and holds groundwater between particles.
- The **zone of saturation** is the zone found in an aquifer that has all the pores filled with water.
- The **water table** is the top surface of the zone of saturation. It may be above or under ground.
- The **zone of aeration** is an area of an aquifer where the pores are partially filled with water and partially filled with air.
- **Runoff** is the water from rain or melting snow that flows over the land and into rivers, lakes, or oceans.
- Growth of living organisms like animals and humans and population increases are limited by access to water.
- Freshwater moves through the ground and is stored in underground reservoirs that support ecosystems and human life.

Reading and Questions

1. What is groundwater?

Groundwater is water contained in the open spaces (pores) found in soil and rock beneath Earth's surface.

2. How does an aquifer form, and why is it important?

An aquifer forms when groundwater collects in underground layers of rock, sand, gravel, or soil. Aquifers are important because they store freshwater that people use for drinking, farming, and daily life.

3. Why is it important to protect groundwater resources such as the Ogallala Aquifer?

Groundwater resources are important because they provide freshwater for people, agriculture, and ecosystems. If water is removed faster than it can be naturally replaced, supplies can decrease over time. Protecting aquifers helps ensure that freshwater remains available for future generations.

🎯 Skills

- Develop and use a model to describe how water moves through Earth's systems driven by energy from the Sun and gravity. (MS-ESS2-4)
- Construct an explanation based on evidence for how groundwater and surface water are distributed and used. (MS-ESS3-1)
- Develop and use a model to describe how water moves through permeable and impermeable layers underground. (Science & Engineering Practice)
- Plan and carry out an investigation to observe how water moves through soil and rock layers. (Science & Engineering Practice)

- Analyze and interpret data to identify patterns in freshwater use and resource distribution. (Science & Engineering Practice)
- Construct explanations to describe how human use of water impacts freshwater systems and availability. (Science & Engineering Practice)
- Explain the structure of the hydrosphere including water distribution on Earth, local river basin, and local water availability.
- Construct a scientific explanation based on evidence for how the uneven distributions of Earth's groundwater resources are the result of past and current geoscience processes.
- Analyze evidence to explain observations, make inferences and predictions, and develop the relationship between evidence and explanation.
- Observe, collect, organize, and analyze data.
- Use oral and written language to communicate findings.
- Use technologies and information systems to research, disseminate findings to others, gather, visualize, and analyze data.

Introducing the Lesson

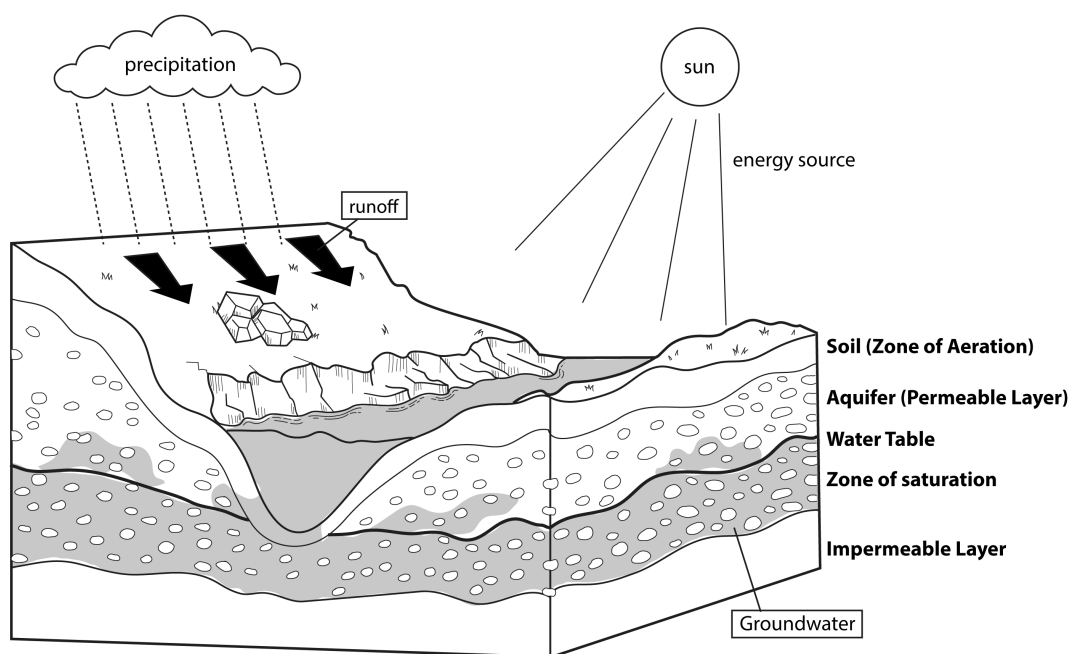
In this lesson, your child explores where freshwater is found and how it moves through both surface and underground systems. He builds a model to understand how groundwater is stored and how forces like gravity and energy from the Sun drive water movement. He also examines how people use freshwater, analyzes patterns in water use, and considers how access to water can affect communities and the environment.

Activities

Activity 1: Build Your Own Water Table Model

In this activity, your child builds a model to explore how freshwater moves through land and underground systems. He observes how water flows, soaks into the ground, and is stored in layers, and connects these movements to gravity and energy from the Sun.

Answer Key:



1. How does gravity cause water to move in your model? Gravity pulls water downward into the ground and causes it to flow downhill across the surface.
2. How does energy from the Sun help move water through Earth's systems? The Sun provides energy that causes evaporation, which keeps water moving through the water cycle.
3. What are two different paths water can take after it falls as rain? Water can soak into the ground as groundwater or flow over the land as runoff.
4. Why might groundwater be found in some places but not others? Groundwater depends on the type of soil and rock. Permeable materials allow water to soak in and collect, while impermeable layers prevent water from entering or storing.
5. Which area would likely have more groundwater? Why? The area with sandy soil would likely have more groundwater because sand allows water to soak in and be stored underground.
6. How might this affect people living in each area? People in the sandy area may have easier access to groundwater for drinking and farming, while people in the rocky area may have less water available and need other sources.

Activity 2: Freshwater Withdrawals

In this activity, your child watches a video and explores how different types of food affect water use and the environment through a chart analysis. He investigates how varying water needs for crops can impact local ecosystems and wildlife. Discuss the importance of managing water resources wisely and consider potential solutions to minimize environmental effects. It would be beneficial to talk with your child about ways to apply these concepts in real life, such as water-saving practices at home or in the community.

Answer Key:

1. Answers will vary but may include that surface water is crucial for meeting various needs, including drinking water, irrigation, and industrial use. It also provides habitats for aquatic organisms, supports biodiversity, and contributes to the beauty of landscapes.
2. Answers will vary but may include providing drinking water, sustaining streams and wetlands during dry periods, and supporting the growth of vegetation.
3. climate change, population growth, and pollution
4. Answers will vary. Your child may notice that:
 - *Animal and dairy products generally require much more water than fruits and vegetables.
 - *Cheese requires the most water of any food shown on the chart.
 - *Foods that grow underground, such as root vegetables and potatoes, tend to require less water.
 - *Some crops, such as nuts and rice, require large amounts of water compared to many fruits and vegetables.
 - *Fruits and vegetables generally require less water than meat and dairy products.
 - *There is a wide range in the amount of water needed to produce different foods.
5. A drought-tolerant crop is a plant that can grow with less water than many other crops. These crops are useful in areas with limited freshwater because they can continue to produce food even during dry conditions and require less irrigation.
6. Growing drought-tolerant crops can reduce the amount of water farmers need for irrigation. This helps conserve water in rivers, lakes, and groundwater systems, leaving more freshwater available for people, wildlife, and ecosystems.

Wrapping Up

In this lesson, your child explored how freshwater moves through surface and underground systems and why it is an essential resource. He also examined how water use and availability can impact people, ecosystems, and communities.

Questions to Discuss

- Where can freshwater be found on Earth? Answer: Freshwater can be found in rivers, lakes, and underground as groundwater in aquifers.
- How does your groundwater model help explain where water comes from when we use wells? Answer: The model shows that water is stored underground in aquifers. Wells access this groundwater, which collects in permeable layers above impermeable rock.
- Why might access to freshwater affect where people live and how communities grow? Answer: People need water for drinking, farming, and daily life. Areas with more available freshwater can support larger populations, while areas with limited water may struggle to support people and ecosystems.

Things to Review

- Review the vocabulary words in "Things to Know."