Lesson 1  Spherical Earth

Scan Lesson 1. Read the lesson titles and bold words. Look at the pictures. Identify three facts that you discovered about Earth’s systems or formation. Write these facts in your Science Journal.

Main Idea

Describing Earth
I found this on page  __________.

Details

Draw  Earth as seen from space.

I found this on page  __________.

Compare  Earth systems. Then explain how these systems work together.

<table>
<thead>
<tr>
<th>Atmosphere</th>
<th>Description:</th>
<th></th>
<th>Biosphere</th>
<th>Description:</th>
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Earth’s four systems exchange ________________ and ________________. The ________________ provides oxygen, the ________________ provides the water, and the ________________ provides the organisms in the biosphere a place to live and elements needed for their survival.
Key Concepts

- What are Earth’s major systems and how do they interact?
- Why does Earth have a spherical shape?

Study Coach

Summarize Main Ideas As you read, write one sentence to summarize the main idea in each paragraph. Where bold words appear, use them in your sentences.

Visual Check

1. Describe What shape is Earth?

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you’ve read this lesson, reread the statements to see if you have changed your mind.

<table>
<thead>
<tr>
<th>Before</th>
<th>Statement</th>
<th>After</th>
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<tbody>
<tr>
<td>1.</td>
<td>People have always known that Earth is round.</td>
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<tr>
<td>2.</td>
<td>Earth’s hydrosphere is made of hydrogen gas.</td>
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Read to Learn

Describing Earth

How did people learn about the shape and size of Earth? Earth is too large to see all of it at one time. People studied the parts of Earth that they could see. Then they used what they learned to figure out what they couldn’t see.

People once believed that Earth was a flat disk with land in the center and water at the edges. Later they used clues, such as Earth’s shadow on the Moon during an eclipse, to learn Earth’s real shape.

The Size and Shape of Earth

Scientists now can get a good view of Earth using satellites. They have found that Earth is a sphere, but not a perfect one. A sphere is shaped like a ball, with all points on the surface at an equal distance from the center. The image to the right shows that Earth has a bulge around the equator and is somewhat flattened at the poles. The distance around Earth is 13,000 km. This measurement is Earth’s diameter. Earth is the largest of the four rocky planets closest to the Sun.
**Earth Systems**

Earth is large and complex. It is hard to study all of Earth at once. To make studying Earth easier, scientists describe four Earth systems. They are the atmosphere, the hydrosphere, the geosphere, and the biosphere, as shown in the concept web below. Each system is different, but they interact, or act together. They exchange matter and energy.

**The Atmosphere, the Hydrosphere, and the Cryosphere**

The atmosphere is Earth’s outermost system. It is the layer of gases that surrounds Earth. The atmosphere is a mixture of nitrogen, oxygen, carbon dioxide, and small amounts of other gases. This layer is about 100 km thick.

The hydrosphere is Earth’s water. This water is on the surface of Earth, underground, and in the atmosphere. The hydrosphere has three kinds of water: salt water, freshwater, and ice. Most of the water in the hydrosphere is in salty oceans. Freshwater is in rivers, lakes, and underground. Some water is frozen in glaciers and polar ice sheets.

Water is always moving between the atmosphere and the hydrosphere. This movement is an example of how Earth’s systems interact. This exchange of matter and energy makes life on Earth possible.

**The Geosphere and the Biosphere**

The geosphere is Earth’s entire solid body. It contains a thin layer of soil and sediments that cover a rocky center. The geosphere is the largest Earth system.

The biosphere includes all living organisms on Earth. Organisms in the biosphere live within the atmosphere, the hydrosphere, and the geosphere. They interact with all the systems.

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**Think it Over**

2. **Apply** Which is part of the hydrosphere? (Circle the correct answer.)
   a. a pebble
   b. a river
   c. carbon dioxide

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**Key Concept Check**

3. **Name** the major Earth systems.

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**Visual Check**

4. **Identify** Circle the system on the concept web that scientists would study to learn how animals interact.
How did Earth form?

Earth formed about 4.6 billion years ago (bya), along with the Sun and the rest of our solar system. Materials from a large cloud of gas and dust came together to form the Sun and all the planets. To understand how this happened, you first need to know how gravity works.

The Influence of Gravity

Gravity is the force that every object exerts on every other object because of their masses. The more mass either object has, or the closer together they are, the stronger the gravitational force.

Gravity is the force that holds you and all other objects here on Earth. All objects that are on or near Earth are pulled toward Earth’s center by gravity. When you throw a softball into the air, it comes right back down. It returns to Earth because Earth has more mass than any other object near you. Because it has more mass, Earth has a stronger gravitational force on you and the softball than any other objects do.

The Solar Nebula

Gravity had a major role in the formation of our solar system. As you can see in the picture below, the solar system formed from a cloud of gas, ice, and dust called a nebula. Gravity pulled the gas, ice, and dust closer together. The nebula got smaller and flattened into a disk. Then the disk began to turn. The materials in the center of the disk became denser, and a star—our Sun—was formed.

After the Sun formed, the rest of the material began to come together into planets. Earth, one of those planets, formed as gravity pulled small particles together. When the particles bumped together, they stuck to each other. They became larger objects with more mass and therefore more gravity. They attracted still more particles. Over time, enough matter collected and formed Earth.
**Early Earth**

The young planet Earth was uneven, not shaped like a sphere. How did Earth become the sphere we know today? When Earth grew large enough, it began to produce thermal energy, or heat, in its core. The rocks of the planet became hot and soft enough to flow. Gravity pulled in the bumps that stuck out from the planet. The rock flowed and Earth became spherical in shape.

**The Formation of Earth’s Layers**

The thermal energy from Earth’s core had another important effect on the planet. The thermal energy caused different materials to separate into layers. Before it became hot, Earth was a mixture of solid particles. The thermal energy melted some of this material. The material flowed into separate layers of different materials. These layers were affected by density and gravity.

**The Role of Density** The different materials in young Earth formed layers based on their densities. *Density* is the amount of mass in a material per unit volume. The following equation is used to mathematically find density:

\[ D = \frac{m}{V} \]

\( D \) is the density of the material, \( m \) is the mass of the material, and \( V \) is the volume of the material. If two materials have the same volume, the denser material will have more mass.

**The Role of Gravity** Remember that there is a stronger gravitational force between Earth and a denser object than there is between Earth and a less-dense object. Imagine that you drop a piece of wood and a brick that are the same size into a pan of water. The two objects have different densities. The wood will float because it is less dense than water. The brick will sink to the bottom because it is denser than water.

When ancient Earth started melting, the densest materials sank and formed the innermost layer of Earth. The least-dense materials stayed at the surface and formed the outermost layer. The materials with densities in between formed layers. The three major layers of the geosphere are shown here.

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**Key Concept Check**

7. State How did Earth develop its spherical shape?

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**Math Skills**

To calculate density, divide the mass by the volume. The unit for density is a unit of mass, such as g, divided by a unit of volume, such as cm\(^3\). The density of aluminum is 27 g/10 cm\(^3\) = 2.7 g/cm\(^3\).

8. Solve One-Step Equations An iron cube with a volume of 10 cm\(^3\) has a mass of 78 g. What is the density of the iron?

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**Visual Check**

9. Apply Why are the most-dense materials in the bottom layer?
Mini Glossary

density: the amount of mass in a material per unit volume

gEOSphere: Earth's entire solid body

Gravity: the force that every object exerts on every other object because of their masses

Sphere: a ball shape with all points on its surface at an equal distance from the center

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that describes one of the effects of gravity on Earth as a young planet.

2. In the table below, write Earth's systems in the left column. In the right column, write what each system is made up of.

<table>
<thead>
<tr>
<th>Earth Systems</th>
<th>Composition</th>
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<td>1.</td>
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3. How did writing down the main idea of each paragraph help you understand the ideas in the lesson?
How did Earth form?

Model the strength of gravitational force between two objects. Draw arrows of different thicknesses to indicate the strength of the gravitational force exerted by the objects in each pair.

Object A has a greater mass than Object B.

Objects C and D have the same mass.

Sequence the early events in the formation of the solar system.

A cloud of gas, ice, and dust called a

__________

pulled the materials closer together.

The nebula

__________

and flattened into a

__________.

The disk began to

__________

, and the materials in the middle became

__________.

Gravity pulled the remaining bits of material together, forming

__________.
**Main Idea**

I found this on page ________.

**Details**

Sequence the events that formed early Earth.

The newly formed Earth grew ________ enough to generate ________

became soft enough to ________

Gravity pulled in the irregular bumps, and ________

The Formation of Earth’s Layers

I found this on page ________.

Draw and label the geosphere. Use these terms:

- least dense
- middle layer
- most dense

Organize information about how the layers of the geosphere formed.

The densest material ____________________________.

The least dense material __________________________.

The materials with intermediate densities __________________________

Connect It  Apply what you have learned about the formation of Earth to describe how gravity influenced the formation of the planet Mars.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

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