Layers of the Earth's Atmosphere

Grade Range: Elementary School

Lesson Time: 40 minutes

Key Terms	
Altitude	Mesosphere
Atmosphere	Meteorite
Biosphere	Ozone layer
Density	Satellite
Exosphere	Stratosphere
Geosphere	Thermosphere
Hydrosphere	Troposphere

Resources
Layers of the Earth's Atmosphere Research Worksheet

Activity Overview

Even though we cannot see it—and usually do not give it a second thought—our atmosphere is vitally important for the survival of our planet. Let's explore each layer of the atmosphere and find out how they all play a role in protecting the living and nonliving things on our planet! In this activity, students will analyze the layers of the Earth's atmosphere to find out how they interact with Earth to affect the survival of the planet. Students will explore the gas composition, distance from the Earth's surface, temperature conditions, and objects found within each layer.

Essential Question

1. How do Earth's major systems interact?

Objectives

- Identify the layers of the Earth's atmosphere
- Describe how the atmosphere interacts with other Earth systems
- Use a model to describe how each layer of the atmosphere protects the Earth

Introduction

Prior to this activity, students should know the definitions and functions of each Earth system: the geosphere, biosphere, hydrosphere, and atmosphere. To start the activity, begin a discussion with students by asking, "If you had to live on another planet, how would you survive? What makes Earth so special that it is the only planet in our solar system containing living organisms?" Explain to the students that they will learn about each layer of the Earth's atmosphere and its role in protecting the living and nonliving things on Earth.

zSpace Activity

Activity Questions Provided in StudioA3

Answers may vary. Sample answers are provided below.

1. Have you ever wondered why there is life on Earth but not on other planets around us? Earth has special systems that work together to make this possible. Earth is organized into four spheres: the geosphere (ground), biosphere (life), hydrosphere (water), and atmosphere (air). It is important to understand how they interact with each other. Observe the African grassland model. Identify evidence of the four systems by attaching a label to each. Take a photo. What evidence did you see for each system?
   Photo: Geosphere points to part of the ground that is nonliving, biosphere points to a plant or animal, hydrosphere points to the watering hole, atmosphere points to the sky. The earth formations and ground are part of the geosphere, plants and animals are part of the biosphere, water is part of the hydrosphere, and the sky and clouds are part of the atmosphere.
2. This activity focuses on the atmosphere and how it interacts with Earth's other systems. What is the atmosphere? The atmosphere is a protective layer of gases that surrounds our planet. It keeps the temperature of Earth steady, protects us from the Sun's harmful rays, holds the oxygen we all need to survive, and separates us from outer space. Dissect the Earth to see the different layers of its atmosphere. Without these layers, life on Earth would not survive.
3. The layers of Earth's atmosphere interact as its gases circulate around the planet. The lowest layers interact with the surface of the Earth, and the highest layers interact with space. There are five layers in Earth's atmosphere. List them in order from the innermost to the outermost layer. Hint: Point to each layer to see its name.
   In order from the innermost to outermost layer, they are the troposphere, stratosphere, mesosphere, thermosphere, and exosphere.
4. Earth’s atmosphere can be compared to a greenhouse, which is a house made of glass or plastic that people grow plants in. A greenhouse stays warm throughout the year. When sunlight shines in, heat is trapped by the glass walls and warms the air inside it. It stays warm through the night, even when the Sun is not shining through. The average temperature of the Earth's surface is 59 degrees Fahrenheit. Without the greenhouse effect, the temperature would be 0 degrees Fahrenheit! Use the diagram to explain how the atmosphere acts like a greenhouse to control the Earth's temperature.
   When the Sun’s energy reaches Earth’s atmosphere during the day, the atmosphere traps most of the energy inside it like greenhouse walls do. The heat warms up the air. At night, some of the Sun’s energy is trapped inside the atmosphere, keeping the Earth warm.
5. Let's explore each layer of the atmosphere. The troposphere is the layer closest to the Earth. This layer is not wide but it is the most dense. It contains different gases, mostly nitrogen and oxygen. "Tropos" means change. It gets its name from weather that is constantly changing and mixing up the gases within this layer. What would happen to living things if this layer lacked oxygen?
   Without oxygen, Earth’s organisms could not survive. We need oxygen to breathe, and we create carbon dioxide for plants.
6. The biosphere is Earth’s system where life exists, either on land, in water, or in air. In the atmosphere, all living things are found in the troposphere. It contains the air that we breathe. Most clouds are found here and almost all weather occurs in this layer. The bottom of the troposphere is at Earth's surface and it extends about 10 km (6.2 mi) above sea level. We measure height starting at the surface of the sea. Place the correct models in the troposphere. Take a photo.
   Photo: The coyote, tree, eagle, and clouds are placed in the scene.

7. Mt. Everest is the tallest mountain in the world. It has 66% less oxygen at its peak than at sea level. There is less air pressure, or weight of air pressing down on the Earth. It takes mountain climbers 40 days to climb to the top because their bodies have to adjust! Air is also warmest at the bottom of the troposphere, but the temperature decreases as the altitude (height) increases. What evidence in this scene shows that the air is colder at a higher altitude?
   The snow at the top of the mountains shows that the air is colder at higher altitudes.
8. The next layer of Earth's atmosphere is the stratosphere. "Strat" means layer. This is where the ozone layer is found. The ozone layer helps protect us from the Sun's harmful rays. Dissect the stratosphere to find the ozone layer.
9. The ozone layer protects all life from the Sun's UV (ultraviolet) light, which can cause sunburn, skin cancer, and eye damage. In the 1980s, scientists discovered a "hole" in the ozone layer over Antarctica. It was caused by harmful chemicals that were used in sprays, foams, and coolants. Countries have since passed laws to keep these chemicals out of products, but the damage had already been done. Why is it important for us to protect the ozone layer?
   It is important for us to protect the ozone layer because it protects life on Earth from the Sun's harmful rays.
10. The stratosphere starts at about 10 km (6.2 mi) above sea level and extends to 50 km (31 mi). There are no storms here to mix up the air, so cold, heavy air is at the bottom and warm, light air is at the top. Most commercial jets fly in the lower stratosphere, above the clouds that are in the troposphere. Why do you think they fly here rather than in the troposphere?
    Jets fly in the stratosphere because there is less turbulence. They fly above the clouds, where weather occurs.
11. Have you ever seen a shooting star? This is actually a meteor burning up in the mesosphere, the next layer of the Earth's atmosphere. Meteors are bits of rock and ice ejected from meteorites, asteroids, or comets as they move in orbit around the Sun. About 10,000 tons of meteors fall towards the Earth each day! But not to worry, thanks to the mesosphere! Its gases cause friction and heat that burn up small meteors before they reach Earth's surface.
12. "Meso" means middle, and it lies between the stratosphere and the thermosphere. The mesosphere extends to about 85 km (53 mi) high. Dissect the layers of the atmosphere and observe the thickness of the mesosphere compared to that of the other layers. If the mesosphere did not burn up most meteors, how would this affect the geosphere (ground) or biosphere (life) on Earth?
    Meteors would hit Earth's surface, causing damage to land and living things.
13. The next layer is the thermosphere. "Thermo" means heat. The thermosphere absorbs a lot of radiation from the Sun, only allowing a small amount to reach Earth's surface. The temperature in this layer can reach up to 4,500 degrees Fahrenheit. However, if you were in the thermosphere you would be very cold because there are not enough gas molecules to transfer the heat to you! The thermosphere starts above the mesosphere and extends to 600 km (372 mi) high. Look closer to find an object that orbits the Earth in the thermosphere.
14. The International Space Station (ISS) is a satellite that has been orbiting Earth in the thermosphere since 1998. Many countries worked together to build and use it. It is a spacecraft, home to astronauts, a research laboratory, and an observatory. Scientists living on the ISS conduct many experiments in biology, physics, astronomy, and meteorology. Examine the ISS to locate an area where scientists work. Why is it important for scientists to conduct experiments in space? Hint: Turn on the labels.
    Scientists can discover important information by conducting experiments in space. They can study humans to find out how their health is affected by living in space, study plants to find how they react to living in space, and test technologies for space travel.

15. The exosphere is the outermost layer of Earth's atmosphere. "Exo" means outside. Notice how wide this layer is compared to the other layers in the atmosphere. It starts after the thermosphere and extends 10,000 km (6,200 mi) high! The exosphere separates the rest of the atmosphere from outer space. There is no air to breathe and it is very cold.
16. Most satellites orbit in the exosphere. They send and receive information to and from Earth. Satellites can be used for scientific research, weather observation, communications, earth observation, navigation, and military purposes. For example, weather satellites help scientists study weather patterns and forecast the weather. Television broadcasters and telephone companies also use satellites! How might life on Earth be different if we did not have satellites?
    Without satellites, we would not be able to predict the weather as accurately, we would not be able to collect as much information about the Earth, and the military would not have as much information with which to make decisions. We also would not have television, telephones, or the Internet.
17. As you have seen, each layer of the atmosphere plays an essential role in protecting the Earth and its systems. Match the models on the right to the correct layers on the left. Take a photo. Then choose a layer of the atmosphere and explain how it impacts an Earth system such as the geosphere, biosphere, or hydrosphere.
    Photo: The tree, frog, and rain cloud are matched to the troposphere; the plane and weather balloon to the stratosphere; the comet to the mesosphere; the ISS to the thermosphere; and the Dawn satellite to the exosphere. Some examples of impacts are: The troposphere impacts the biosphere because it contains the air we breathe. The troposphere impacts the hydrosphere because all weather occurs here. It can also affect the geosphere because severe weather can alter landforms. The stratosphere impacts the biosphere because the ozone protects our skin from the Sun's harmful rays. The mesosphere impacts the geosphere because it keeps space objects from hitting the Earth and causing damage. It also protects living organisms in the biosphere from these objects. The thermosphere and exosphere impact the geosphere by separating Earth from space. All of the spheres together impact the geosphere and biosphere by regulating Earth's temperature. This affects the formation of the Earth and the ability of living things to adapt to its environments.
18. Without the atmosphere it would be impossible for life to survive on Earth. It keeps our planet warm, protects us from the Sun's harmful rays, holds our oxygen, and protects us from objects in space. The next time you are outside, take a moment to think about how the atmosphere impacts everything around you!

Closing

Questions for Discussion

1. What are some things that you learned about the Earth's atmosphere?
    I learned that the Earth's atmosphere has five layers and that each layer has a different role in protecting the Earth.
2. What role does the atmosphere play in our survival?
    The atmosphere protects the Earth from the Sun's rays and particles in space. It also holds the oxygen we breathe and keeps the temperature of Earth's surface warm.

Differentiation

- Group students heterogeneously to allow students with a strong command of the English language to assist in reading or interpreting questions
- Provide a handout with a list of vocabulary terms and definitions that will appear in the activity
- Have students work as partners or in small groups

- Use text-to-speech if needed
- Enrichment: Students could find real-world problems involving the concept and design solutions to those problems
- Enrichment: Students could build models of concepts

References

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