


Modeling Earth's Atmosphere

The Science of Global Atmospheric Change:
Activity 3

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Modeling Earth's Atmosphere

This activity's objectives are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Physical Science. Modeling Earth's Atmosphere uses guided inquiry to provide introductory instruction related to Earth's atmosphere. Students will measure, model, infer, observe, and draw.

The following science concepts are addressed in this activity.

- The atmosphere consists of layers of gases surrounding the Earth.
- Each layer has different characteristics.

Student Worksheets

Student pages in the teacher's guide are provided in English and in Spanish.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Global Atmospheric Change Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

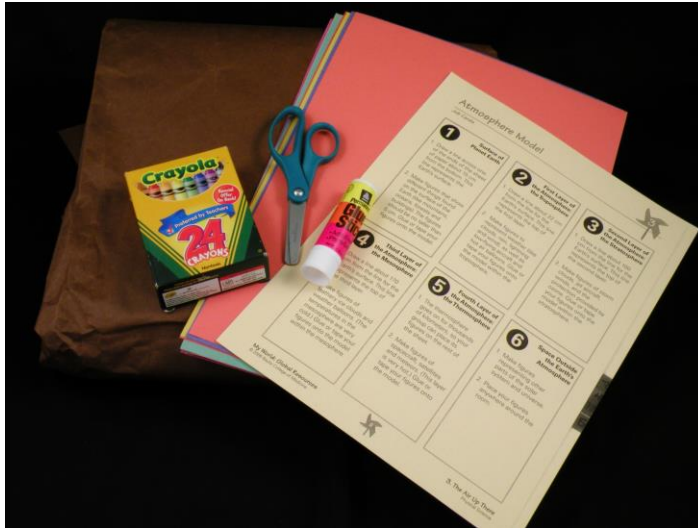
Photo courtesy of NASA.

Key Words

lesson, Earth, atmosphere, global change,

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Materials



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Materials

Have students work in groups of four.

Materials per Class

- One large sheet of white or brown wrapping or banner paper, approximately 1 m x 3 m in size.

Materials per Student Group

- 6 sheets of construction paper, assorted colors, 9 in. x 12 in.
- Crayons or colored markers
- Glue stick or a roll of tape
- Pair of scissors
- Job cards from “Atmosphere Model” student page

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Image Reference

Photo by Christopher Burnett © Baylor College of Medicine.

Key Words

materials list, materials needed,

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Science Safety Considerations

- Follow all instructions.
- Begin investigation only when instructed.
- Be careful with scissors.
- Report accidents.
- Wash hands thoroughly after the investigation.



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Science Safety Considerations

Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Safety first!

- Always school district and school science laboratory safety guidelines.
- Have a clear understanding of the investigation in advance.
- Practice any investigation with which you are not familiar before conducting it with the class.
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.

References

1. Dean R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. National Science Teachers Association.
2. Moreno N., and B. Tharp. (2011). *The Science of Global Atmospheric Change. Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Key Words

science, classroom, safety, lab, laboratory, rules, safety signs,

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What Surrounds the Earth?

- Have you ever seen pictures of astronauts in space?
- Why do astronauts wear space suits?
- Why don't we have to wear space suits on Earth?
- What protects Earth from very harmful sunrays?



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What Surrounds the Earth?

Ask the class, *Have you ever have seen pictures of astronauts in space? Why do astronauts wear special suits?* Mention that a space suit keeps astronauts warm, provides them with air to breathe and protects them from harmful rays from the sun.

Follow by asking if we need to wear space suits here on Earth. Help students to understand that the thin layer of gases surrounding Earth – the atmosphere – provides protection for all of the planet, just as space suits protect astronauts. Mention that, as a class, the students will create a small scale model of the Earth's protective layer of gases.

Image Reference

NASA (1984). Photo ID S84-27017. Retrieved 07-30-2010 from <http://en.wikipedia.org/wiki/File:Astronaut-EVA.jpg>

Reference

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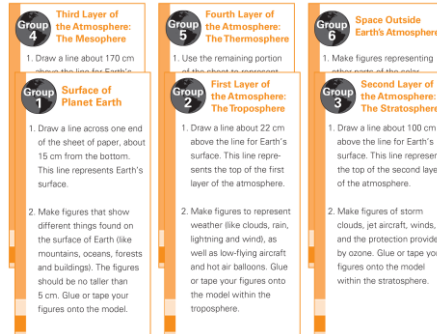
Key Words

lesson, Earth, atmosphere, global change, air, astronaut, Earth, sun, gas, planet,

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Let's Get Started

- Each group will receive a job card.
- Draw and decorate your section of the atmosphere model using the following scale: 2 cm = 1 km.
 - Group 1 – Plant Earth
 - Group 2 – Troposphere
 - Group 3 – Stratosphere
 - Group 4 – Mesosphere
 - Group 5 – Thermosphere
 - Group 6 – Outer Space



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Let's Get Started

In this activity, students will learn about Earth's atmosphere by creating a scale model of the gaseous layers that surround our planet. The class will be divided into six groups, with each group responsible for creating a different part of the model (i.e., a different layer of the atmosphere), which should be assembled and displayed on the floor or on the wall.

Students will learn that the atmosphere consists of several layers of gases surrounding the Earth, and that each layer has different characteristics.

Lay a sheet of brown or white paper (at least 2.5 meters long) on the floor, where students can work on it. Divide the class into six groups and give a Job card to each group. Groups will create and decorate the parts of the atmosphere model described on their cards. Discuss the scale of the model with the students (1 cm = 1/2 km; 2 cm = 1 km). Older students should measure and draw their own lines on the model.

You may want students to cut off the different sections of the model, so groups can work in separate locations of the classroom. (Groups 1 and 2 will work on the same section.) Once all work is completed, have groups label their layers on the model, tape the sections together, and display the model somewhere in the classroom.

•**Group 1 – Surface of Planet Earth:** Draws a vertical line about 15 cm from the bottom of the sheet of paper (this line represents the Earth's surface); creates features (mountains, forests, cities, etc.), using construction paper or other materials, and adds them to the model. Remind students that the features they create should be no more than 5 cm tall.

•**Group 2 – Troposphere:** Draws a line about 22 cm above the line made to represent Earth’s surface (22 cm represents the upper limit of the first layer); adds figures of weather phenomena (clouds, rain, lightning, etc.) as well as low-flying aircraft and hot air balloons.

•**Group 3 – Stratosphere:** Draws a line about 100 cm above the line made to represent Earth’s surface (100 cm represents the upper limit of the second layer); adds storm clouds, jet aircraft, wind, and a representation of the protection provided by ozone molecules present in this layer.

•**Group 4 – Mesosphere:** Draws a line about 170 cm above the line made to represent Earth’s surface (170 cm represents the upper limit of the third layer); adds figures of feathery ice clouds and weather balloons.

•**Group 5 – Thermosphere:** Adds spacecraft, satellites and meteors (shooting stars). The thermosphere continues for many thousands of kilometers beyond the mesosphere, so this group may use the remainder of the space on the sheet.

•**Group 6 – Space Outside Earth’s Atmosphere:** Creates figures representing other components of the solar system and universe, and places them in appropriate locations around the room.

Note: In the atmosphere model created by students, 1 cm represents 0.5 km. Based on these proportions, the diameter of the Earth would have to be drawn as approximately 25,000 cm. The sun would be positioned 300,000,000 cm away!

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Card illustrations by M.S. Young © Baylor College of Medicine.

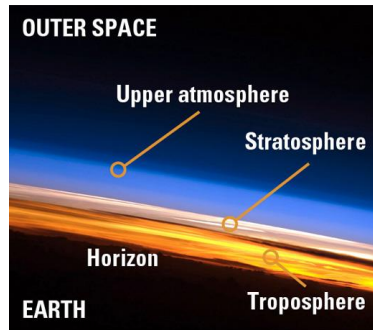
Key Words

lesson, Earth, atmosphere, planet Earth, troposphere, stratosphere, mesosphere, thermosphere, outer space, gas, gases,

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Let's Talk About It

- What features did you find on the surface of Earth?
- What atmosphere layer contains rain and lightning?
- What is the third layer of Earth's atmosphere?
- In what atmosphere layer did the Space Shuttle fly?



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Let's Talk About It

In this activity, students discover that Earth's atmosphere consists of several concentric layers of gases, each with different characteristics and component parts. Lead a class discussion about each layer, starting with Group 1 (Earth's surface). Have each group name the atmospheric layer it modeled and identify the objects typically found within that layer.

For example, Group 1 may have included mountains, rivers, trees, houses, animals, and cities located on Earth's surface. Meanwhile, Group 6 (outer space) may have drawn or added objects such as the moon, other planets of the solar system, etc.

When conducting the class discussion, expect a variety of answers and observations, and pose questions that encourage students to think. You might ask, What objects are found on the surface of Earth? What layer of the atmosphere contains rain and lightning? What are the third and fourth layers of Earth's atmosphere? *and In what atmosphere layer did the space shuttle fly?*

Notes

- In general, temperature decreases with altitude. Exceptions occur in layers where energy from the sun is absorbed.
- Reductions in the amount of ozone in the stratosphere are allowing more ultraviolet radiation (UV) from the sun to reach Earth's surface.
- The effects of some kinds of UV exposure are cumulative and may not show up for

many years.

- In humans, increased exposure to UV radiation (especially UV-B, with wavelengths between 290–320 nanometers) is linked to skin cancer, the development of cataracts and effects on the immune system.

- UV-B radiation also is toxic to plants, including crop plants, and phytoplankton, which forms the basis of marine food chains.

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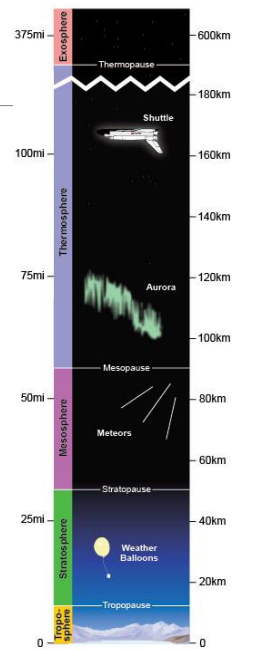
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The Science of the Atmosphere

- Air surrounding Earth is called the atmosphere.
- Earth's atmosphere has different layers.
 - Troposphere
 - Stratosphere
 - Mesosphere
 - Thermosphere
 - Exosphere (space outside of Earth's atmosphere)
- Each layer has a specific purpose and contains different objects.



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The Science of the Atmosphere

The air surrounding the Earth is known as the atmosphere. Earth's gravity holds gas molecules in the atmosphere relatively close to the planet's surface.

In this activity, students learned about the following properties of Earth's atmosphere.

- **The atmosphere consists of layers of gases surrounding the Earth.** It is mostly nitrogen (78%) and oxygen (20%). Life on Earth would not be possible without the atmosphere, which protects the surface from extremes of temperature and harmful radiation, and also provides essential water, carbon dioxide, oxygen, and nitrogen.
- **Each layer of the atmosphere has different characteristics.**
 1. **Troposphere:** The first layer of Earth's atmosphere contains clouds, rain, lightning, low-flying aircraft and hot-air balloons. Much of the pollution produced by burning wood and fossil fuels remains within the troposphere, and this is where greenhouse gases are found.
 2. **Stratosphere:** The second layer of Earth's atmosphere contains storm clouds, wind and jet airplanes. The stratosphere contains ozone molecules that provide protection from dangerous radiation by absorbing UV light

from the sun. For this reason, the stratosphere is warmer than the troposphere due to absorption of UV light by ozone in this layer.

3. Mesosphere: The third layer of Earth's atmosphere is very cold, and contains feathery ice clouds and weather balloons.
4. Thermosphere: The fourth layer of Earth's atmosphere contains spacecraft, satellites and meteors. Because it absorbs some forms of radiation, parts of the thermosphere are very hot.
5. Exosphere (space outside of Earth's atmosphere): Contains the rest of the solar system and universe.

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Image Reference


Illustration courtesy of NOAA. Public domain.
<http://www.srh.noaa.gov/jetstream/atmos/layers.htm>

Key Words

lesson, Earth, air, atmosphere, Earth, troposphere, stratosphere, mesosphere, thermosphere, exosphere, outer space,

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About Ozone

- Ozone (O₃): 
 - is a highly reactive gas molecule made of 3 oxygen atoms.
 - is found in the stratosphere.
 - Absorbs harmful UV radiation emitted by the sun.
- Approximate distance from Earth's surface of the atmosphere layers:
 - Troposphere: 11 km
 - Stratosphere: 11 km to 50 km (ozone)
 - Mesosphere: 50 km to 85 km
 - Thermosphere: 85 km to 3,200 km



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About Ozone

Ozone, a highly reactive gas molecule comprised of three oxygen atoms, is found naturally in the stratosphere. Although present only in tiny amounts, ozone is vital because it absorbs most of the harmful UV radiation emitted by the sun and prevents it from reaching Earth's surface.

Near the ground, ozone often is produced as a byproduct of burning fossil fuels. In this instance, ozone is very harmful. It can damage lungs and is harmful to other living things, such as plants.

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Key Words

Earth, air, atmosphere, ozone, O₃, troposphere, stratosphere, mesosphere, thermosphere, exosphere, UV radiation, sun, gas, oxygen,

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