4. Would air pressure be greater on a beach or on the top of a mountain? Discuss why.
5. Scientists are very interested in studying the atmosphere of Venus, which is made mostly of carbon dioxide. Surface temperatures there are extremely hot due to the greenhouse effect. How can studying another planet help us understand problems on the Earth?

Follow-up Activities

- Is air "thicker" at sea level or on a mountaintop? In small groups, determine how much the air weighs: Blow up and seal a balloon, measure and weigh it. Record all observations. Deflate the balloon and weigh it. Subtract deflated weight from inflated weight to find the air's weight. Find the volume of air measured by filling up the balloon with water to the same size as before and measuring the amount of water used. Determine the density of the air by dividing volume into mass (Density=mass/volume). Now discuss the factors that can change the air's density in the atmosphere, for example, altitude or humidity.
- Have students investigate the "jet stream," explaining how/why it moves throughout the year and the impact it has on life on our planet.
- Research temperature changes in the different layers of the atmosphere and have students create posters with graphs that show and explain the temperature ranges in each layer.
- Have groups of students research the atmospheres of different planets and present a report or skit based on these "unfriendly atmospheres."
- Find a number of photographic images of auroras. Research the myths sometimes associated with auroras and draw auroras with art supplies. Write stories to accompany the artwork. Then study auroras more scientifically, determining what chemicals cause the varying colors of the spectacle.

Internet Resources

- **windows.engin.umich.edu/cgi-bin/tour_def?link=/earth/Atmosphere/overview.html**
  This student and teacher-friendly "Windows to the Universe" Web site is an excellent resource for information on the atmosphere and includes a rich array of documents, including images, movies, animations and data sets that explore the Earth and Space sciences.
- **kids.earth.nasa.gov/air.htm**
  This site contains activities for students studying the Earth's atmosphere, with opportunities to investigate the ozone and examine the importance of air pressure to everything on Earth.

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- **www.exploratorium.edu/learning_studio/auroras/index.html**
  The Exploratorium offers a self-guided lesson on auroras with links to lessons and images that showcase the ionosphere.
- **www.enchantedlearning.com/subjects/astronomy/planets/earth/Atmosphere.shtml**
  This Zoom Astronomy site does a great job describing the atmosphere and how its different layers influence life on Earth.

Suggested Print Resources

- Miller, Christina. *Air Alert: Rescuing the Earth's Atmosphere.* Atheneum, New York, NY; 1996.
- Rauzon, Marc. *The Sky's the Limit: All About the Atmosphere.* Millbrook Press, Brookfield, CT; 1999.
- Sheperd, Donna W. *Auroras: Light Shows in the Night Sky.* Franklin Watts, Inc., New York , NY; 1996.

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TITLES

- ASTRONOMY
- EARTH
- EARTH'S ATMOSPHERE
- MOON
- PLANETS & THE SOLAR SYSTEM
- SPACE EXPLORATION
- STARS
- SUN
- UNIVERSE

TEACHER'S GUIDE

SPACE SCIENCE IN ACTION™

Earth's Atmosphere

Grades 5–8

Students in grade 5-8 classrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers for these grades need all the help they can get! This guide has been designed to help science teachers in grades 5-8 by providing a brief synopsis of the program, pre-viewing and follow-up questions, activities, vocabulary and additional resources.

Before Viewing: Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create a "Everything We Think We Know About…" list. You may also wish to preview key vocabulary words and have students raise additional questions that they hope will be answered.

After Viewing: Have your students share information that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts that they put on their "Everything We Think We Know About…" list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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Program Summary

Malcolm and Stanley — a pair of comical, would-be astronauts — prepare themselves for the "call from NASA" by reviewing everything they know about the Earth's atmosphere. In anticipation of landing the mission of their dreams, the duo examines the importance of the atmosphere, discussing the factors that make the Earth's atmosphere unique in comparison to the other planets in our solar system. The main components of the air are discussed, emphasizing that although air molecules are invisible, they still have weight and take up space. Stanley teaches Malcolm about the importance of air pressure in the Earth's atmosphere, and an investigation illustrates the effects of heat and cold on the air pressure inside a balloon. A homemade barometer is created to measure the changing air pressure. Oxygen is just one of the important things that the atmosphere provides, along with our changing weather and protection from harmful ultraviolet rays and space debris. The different layers of the atmosphere are also reviewed. In addition, Wayne Wright, a scientist from NASA, takes students on a hunt for severe weather.

Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

air — The mixture of invisible odorless gases that surrounds the Earth.

atmosphere — The layers of gases that surround a planetary object. The Earth's atmosphere is comprised mostly of nitrogen and oxygen gases.

air pressure — The force that air exerts on the Earth's surface and anything on it; also called atmospheric pressure, usually measured in "millibars" or "inches of mercury."

barometer — An instrument that measures air pressure at any given moment in a particular place.

troposphere — The lowest, densest layer of the atmosphere that begins at the Earth's surface and rises to about 12 km; weather occurs in this layer. Temperature decreases with altitude in this layer.

jet stream — A band of high speed, high altitude winds usually found in the Earth's lower stratosphere. This strong current of air is due to pressure changes and is responsible for pushing weather systems around the world.

stratosphere — The second layer of the Earth's atmosphere that extends from the top of the troposphere to approximately 50 km above the Earth and includes the ozone layer. Temperature increases slightly with altitude in this layer.

ultraviolet rays — Invisible energy waves from the sun that are potentially harmful.

ozone layer — A protective layer of active oxygen gas (ozone) found primarily in the Earth's stratosphere that absorbs many of the suns harmful ultraviolet rays.

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CFCs — (Chlorofluorocarbons). Chemicals containing chlorine, fluorine and carbon that are used in refrigeration, packaging and aerosol sprays. These chemicals can break down the protective ozone layer in the stratosphere and cause damage to living things.

mesosphere — The third layer of the Earth's atmosphere, from about 50 km up to 85 km, that protects us from objects such as meteoroids. The average temperature is lowest in this layer.

shooting star — An intense flash of moving light that is caused by small bits of rock and debris crashing into the atmosphere and burning up in the mesosphere; also called a meteor.

thermosphere — The highest layer of the Earth's atmosphere, which goes from about 85 km all the way up to 1280 km, where it merges with outer space. This includes the ionosphere and the exosphere where the space shuttle and satellites usually orbit.

ionosphere — The bottom layer of the thermosphere, from about 85 km up to 640 km, in which the sun's radiation becomes electrically charged. The temperature increases with height in this region and can get up to 2,000 degrees Celsius.

aurora — A glow in the planet's ionosphere caused by charged particles from the sun.

exosphere — The upper layer of the thermosphere, from 640 km up to where it merges with outer space at about 1280 km, where the air is extremely thin and satellites orbit.

photosynthesis — The process by which green plants create breathable oxygen and sugars from sunlight, air and water.

condensation — The conversion of matter from a vapor state to liquid.

evaporation — The conversion of liquid matter to vapor.

precipitation — Water vapor that has condensed and fallen from the clouds as rain, sleet, hail or snow.

Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About…" for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

1. What do we mean when we say "air"?
2. What is the Earth's atmosphere made of?
3. Does air have weight?
4. Does every planet have an atmosphere?
5. How does air pressure affect us?

After the class has completed their "Everything We Think We Know About…" list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

1. What is the atmosphere?
2. Why do we need the atmosphere?
3. How is our atmosphere unique in comparison to other planets?
4. About how much air does an average person breathe every day?
5. What is air pressure and how is it measured?
6. How does air pressure affect the environment?
7. Why aren't we crushed or flattened as a result of air pressure?
8. What does the balloon-barometer measure?
9. What gases make up the air we breathe?
10. What is the role of carbon dioxide in the atmosphere?
11. Compare the Earth's atmosphere to the atmosphere on Venus.
12. The show stated, "If we didn't have an atmosphere, Earth would resemble our moon." Why is that true?
13. How does the air pressure change at different altitudes?
14. Identify the different layers of the atmosphere.
15. Explain why the seasons change.
16. What causes weather changes?
17. Why do scientists fly into hurricanes?
18. What is the "ozone layer?" How does it help protect living things?
19. How has the Earth's atmosphere changed since it was first formed?
20. How do green plants change the atmosphere?
21. Explain how humans are impacting the Earth's atmosphere.

Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their "Everything We Think We Know About…" list. It might also be helpful to review the list by marking each entry with a "+" or "-" to show which facts were correct and which were incorrect.

Discussions that ensue from thought-provoking questions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion questions.

1. Describe how the atmosphere would be different on Earth if there was no gravity.
2. Could life exist on Earth if there was no atmosphere?
3. During hurricane season, people keep an eye on the barometer. Discuss how measuring the air pressure help predict storms?

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