

2007

Structure of the Atmosphere

STORM Project

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Activity 3
Structure of the Atmosphere
Level 2

<http://www.uni.edu/storm/activities/level2/index.shtml>

National Science Education Standards: As a result of activities in grades 5-8, all students should develop an understanding of: abilities necessary to do scientific inquiry, properties and changes of properties in matter, understandings about science and technology, and structure of the earth system.

Materials: construction paper, metric ruler, scissors, glue, graph (coordinate) paper, STORM website <http://www.uni.edu/storm/activities/level2/act3.shtml>.

Engage:

Have students look at a picture of Mt. Everest or any other high mountain that is snow-covered all year. As they look at the picture, have them reflect on the following questions.

1. Why is there always snow on the top of very high mountains like Mt. Everest?
2. What are some factors that prevent the average person from climbing to the top of Mt. Everest?
3. Why do your ears pop when you change elevation, such as when traveling in hilly terrain or riding an elevator in a tall building?

Explore:

Access the activity web page and obtain weather balloon (radiosonde) data for a location near you. Click on “Available Stations”, then click on the city closest to your location. Have students click on that city, and then print off the data. Have students create a graph showing atmosphere temperature vs. altitude. If they are plotting by hand, have them use every 5th value. Then connect all the data points. Using their graphs, students should answer the following questions:

1. Describe the general trend of the plotted points.
2. How do the temperature changes at the bottom of your graph compare to the temperature changes at the top of your plot?

Explain:

Discuss the layers of the atmosphere as students complete the following model.

The ranges of distance above earth’s surface for each layer is: troposphere – 0 to anywhere between 8 and 18 km; stratosphere – top of the troposphere to 50 km, with the ozone layer from 20 to 30 km; mesosphere – 50 to 80 km; and the thermosphere – 80 to 200 km. Thickness of the atmospheric layers varies due to latitude and seasons. Between each layer are border areas called the tropopause, the stratopause, the mesopause, and the thermopause.

Model Procedure:

Use different colors of construction paper to denote each layer of the atmosphere. Glue the strips together as you discuss each layer. Students should measure the thickness of the strips so that they will reflect actual measurements.

- a. Troposphere – 15 mm
- b. Stratosphere – 45 mm
- c. Mesosphere – 35 mm
- d. Thermosphere – 89.5 mm

In the graph completed in the explore section, students should have found that as altitude increases, temperature decreases until you reach the tropopause. The tropopause is the boundary between the troposphere and the stratosphere. As you increase in altitude in the stratosphere, your temperature increases as well. The stratosphere is where the ozone layer is located. The ozone layer protects us from the sun’s ultraviolet radiation.

Extend:

At the activity website, access the available stations again. Have the students find the altitude of the tropopause for the following cities.

CITY	ALTITUDE
1. Miami, FL	_____ m
2. Minneapolis, MN	_____ m
3. Anchorage, AK	_____ m

Have students compare the altitudes of the tropopause for each of the cities.

- 1. Make an analysis of the data for your geographic area compared to the cities above.
- 2. What pattern do you observe occurring in the tropopause altitudes?
- 3. What atmospheric factors could create these patterns?

Evaluate:

- 1. Collect and evaluate student sheet, graph, and atmospheric model.
- 2. Have students write a lab report with data analysis and conclusions.

For Further Inquiry:

Ask your students, “What effect would the time of day, or a change in the season have on these patterns?” Challenge them to design an investigation to answer this or any other question they might have about temperatures throughout the lower atmosphere.

Structure of the Atmosphere
Student Sheet

Engage:

Look at a picture of Mt. Everest. As you look at the picture reflect on the following questions.

1. Why is there always snow on the top of very high mountains like Mt. Everest?

2. What are some factors that prevent the average person from climbing to the top of Mt. Everest?

3. Why do your ears pop when you change elevation, such as when traveling in hilly terrain or riding an elevator in a tall building?

Explore:

At the activity website, <http://www.uni.edu/storm/activities/level2/>, obtain weather balloon (radiosonde) data for a location near you. Create a graph showing temperature vs. altitude. If you are plotting by hand use every 5th value then connect all the data points. Using your graph, answer the following questions.

1. Describe the general trend of the plotted points (is there a change in slope anywhere?).

2. How do the temperature changes at the bottom of you plot compare to the temperature changes at the top of your plot?

Explain:

Complete the following atmospheric model on a blank sheet of paper during your discussion as directed by your teacher.

Model Procedure:

Use different colors of construction paper to denote each layer of the atmosphere. Glue the strips together as you discuss each layer. Measure the thickness of the strips so that they will reflect actual measurements.

- a. Troposphere – 15 mm
- b. Stratosphere – 45 mm
- c. Mesosphere – 35 mm
- d. Thermosphere – 89.5 mm

Extend:

At the activity website, <http://www.uni.edu/storm/activities/level2/>, access the current radiosonde data again. Find the altitude of the tropopause for the following cities.

CITY	ALTITUDE
1. Miami, FL	_____ m
2. Minneapolis, MN	_____ m
3. Anchorage, AK	_____ m

Compare the altitudes of the tropopause for each of the cities and answer the following questions.

1. Make an analysis of the data for your geographic area compared to the cities above.

2. What pattern do you observe occurring in the tropopause altitudes?

3. What atmospheric factors could create these patterns?

4. What effect would a change in the season have on these patterns?

5. What effect would the time of day have on the altitude of the tropopause?

6. Hypothesize if the same reading would result if they were taken at corresponding latitudes in the southern hemisphere. Explain your results.
