GEOLAB

INTERPRET PRESSURE-TEMPERATURE RELATIONSHIPS

Background: **As you go up a mountain, both temperature and air pressure decrease. Temperature decreases as you get farther away from the atmosphere's heat source—Earth's surface. Pressure decreases as you ascend the mountain because there are fewer particles in the air above you. Pressure and temperature are also related through the expansion and compression of air, regardless of height.**

Question: *How does the expansion and compression of air affect temperature?*

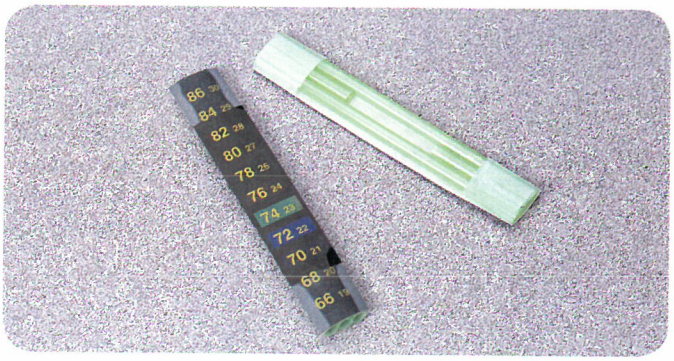
Materials

clean, clear, plastic 2-L bottle with cap
plastic straws
scissors
thin, liquid-crystal temperature strip
tape
watch or timer

Safety Precautions

Procedure

1. Read and complete the lab safety form.
2. Working with a partner, cut two pieces of straw, each the length of the temperature strip. Then cut two 2-cm pieces of straw. **WARNING:** ***Scissors pose a skin puncture or cut hazard.***
3. Lay the two long pieces on a table. Place the two shorter pieces within the space created by the longer pieces so that the four pieces form a support for the temperature strip as shown in the figure.
4. Tape the four pieces of straw together. Place the temperature strip lengthwise on the straws. Tape the strip to the straws.
5. Slide the temperature-strip-straw assembly into the clean, dry bottle. Screw the cap on tightly.
6. Place the sealed bottle on the table so that the temperature strip faces you and is easy to read. Do not handle the bottle any more than is necessary so that the temperature will not be affected by your hands.
7. Record the temperature of the air inside the bottle as indicated by the temperature strip.



8. Position the bottle so that half its length extends beyond the edge of the table. Placing one hand on each end of the bottle, push down on both ends so that the bottle bends in the middle. Hold the bottle this way for 2 min while your partner records the temperature every 15 s.
9. Release the pressure on the bottle. Observe and record the temperature every 15 s for the next 2 min.

Analyze and Conclude

1. **Interpret Data** What was the average temperature of the air inside the bottle as you applied pressure? How did this differ from the average temperature of the bottled air when you released the pressure?
2. **Graph** the temperature changes.
3. **Explain** how these temperature changes are related to changes in pressure.
4. **Predict** how the experiment would change if you took the cap off the bottle.
5. **Infer** Given your observations and what you know about the behavior of warm air, would you expect the air over an equatorial desert at midday to be characterized by high or low pressure?

WRITING in Earth Science

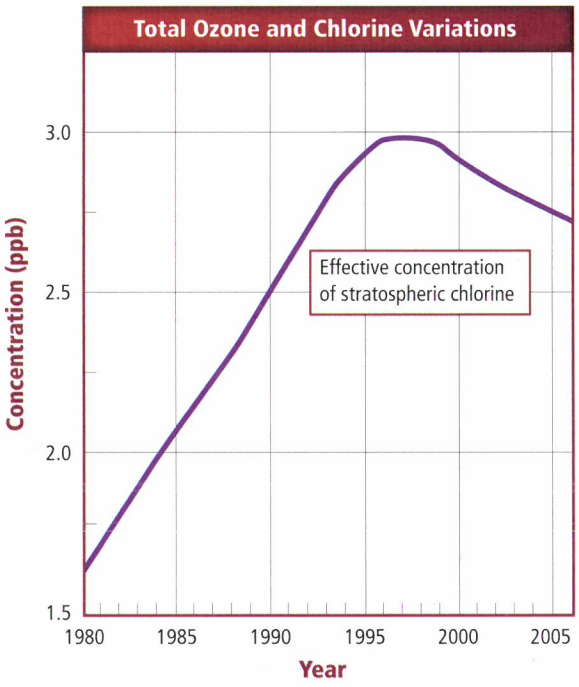
Research how pressure changes can affect the daily weather. Share your findings with your classmates. For more information on weather, visit glencoe.com.

Ozone Variation

Atoms, such as chlorine and bromine, when located in the stratosphere, can destroy ozone molecules. The decline in stratospheric ozone measured since the early 1980s might be showing signs of recovery due to a decrease in stratospheric chlorine.

Variations in ozone amounts The total amount of ozone in the atmosphere over Earth's surface varies with location and also changes with time. Total ozone increases with latitude, being low at the equator and highest in the polar regions. Ozone amounts also vary seasonally, usually decreasing from winter to summer. The largest seasonal changes occur at high latitudes, particularly in the polar regions.

The Antarctic ozone hole Over Antarctica, the lowest ozone amounts occur in early spring. Since the late 1970s, total ozone amounts in the spring have greatly decreased.



This decrease in springtime ozone over Antarctica is called the Antarctic ozone hole. The Antarctic ozone hole is caused by chlorofluorocarbons (CFCs) and the presence of polar stratospheric clouds (PSCs). These clouds form over Antarctica during the winter in the lower stratosphere. CFCs break down, producing molecules that contain chlorine atoms. These molecules undergo chemical reactions on ice crystals in the PSCs, producing chlorine and other compounds that destroy ozone.

The Montreal Protocol Satellite measurements beginning in the late 1970s also showed a decrease in global ozone amounts of several percent. Concerns over decreasing ozone led to the adoption of the Montreal Protocol in 1987. This international agreement requires countries to phase out the production and use of CFCs and similar chemicals. As a result, levels of chlorine and other ozone-destroying chemicals in the stratosphere have been declining since the late 1990s, as shown in the graph.

Signs of recovery? Between 1996 and 2006, the decrease in total ozone leveled off in most regions. Part of these changes might be due to natural causes, such as solar variability, as well as to the Montreal Protocol. Measurements over several more years will be needed to determine whether the ozone layer is recovering.

WRITING in Earth Science

Magazine Article Research how natural processes, such as volcanic eruptions, solar activity, and air movements affect ozone levels in the stratosphere. Write a magazine article that reports what you found. To learn more about the ozone layer, visit glencoe.com.