Highs and Lows

Target Grade Levels
Sixth - Eighth

Time
One Class Period

Materials
- teacher-made/student-made signs indicating “High” or “Low”
- balloons
- scissors or pins

Knowledge and Skills (TEKS)
- Language Arts:
  - Uses writing as a tool for research, for example, leaning logs, posters, timelines, outlines, and summaries.
- Science:
  - Organize, analyze, evaluate, make inferences, predict trends from direct and indirect evidence.

Overview
The movement of air masses can be confusing and difficult for students to conceptualize. This activity aids in the understanding of high and low pressure behavior, vacuums, and molecular structure.

Background Information
The formation of ground-level ozone is a photochemical process that requires energy in the form of ultraviolet radiation to complete the chemical process that turns pollutants (nitrogen oxides and volatile organic compounds) into ozone. In forecasting Air Quality Health Alert days the meteorologists must be very attentive to high and low pressure systems that are associated with destructive weather conditions.

Typically, high-pressure systems bring high temperatures and clear skies to areas, creating the potential for high amounts of ultraviolet radiation, which enhances ground-level ozone production. Low-pressure systems, associated with cloudy skies and rain, are not at all conducive to ground-level ozone formation and can help dissipate amounts of the pollutant already in the air.

Knowing why and when areas experience systems of high and low pressure is very important to both weather forecasting and air quality concerns.

Procedure
1) Vocabulary

a) aneroid barometer
b) cumulonimbus
c) ground-level ozone
d) stratus
e) cirrus
f) cumulus
g) hurricane
h) tornado
i) jet stream
j) anvil cloud
k) photochemical
l) ultraviolet radiation

2) Activities

a) Read the background information to the class and tell them to imagine that all of the students in every class in the school were tightly packed into their classroom with standing room only.

i) Tell them that all doors and windows are closed. The heat they would feel is indicative of a high-pressure area.

ii) Now, imagine that no one is in the hall outside the classroom. It is completely empty and is indicative of a low-pressure area.

iii) If someone opened the door, where would the students in the classroom want to go? Out the door! Yes, that is exactly what happens with pressure systems. High pressure always seeks to move to low-pressure areas.

iv) Discuss the activity at the doorway. Would the flow be slow and easy or fast and furious?

b) Now imagine that some students are moving from right to left, or in a counterclockwise direction in the hallway. As the students moved out of the classroom, they were allowed to exit only by moving left to right or clockwise direction. Ask for ideas about what might happen. There could be pile ups (clouds); bumping and rubbing friction (lightning) may occur if everyone was not moving in one direction. Explain the following facts:

i) Geographic areas, caught between high and low pressure systems, often experience violent storms as areas of high pressure seek to relieve pressure by moving toward the low pressure area, causing cumulonimbus clouds that produce lightning, thunder, heavy rains, hail, strong winds, and tornadoes. Cumulonimbus clouds are the tallest of all clouds and can span all cloud layers and extend above 60,000 feet. They usually have large, anvil-shaped tops which form because of the stronger winds at those higher levels of atmosphere.

ii) Divide the students in pairs. Have each pair blow up balloons leaving a peak in the top of the balloon. The first student ties the end and holds the balloon securely. They have just made a cumulonimbus cloud. The second student will then prick the peak of the balloon (anvil cloud) with a pin as the first student, simultaneously, releases the balloon. This activity represents the behavior of a cumulonimbus cloud, with the peak of the balloon representing the part of the cloud that becomes the anvil that occurs when the jet stream passes over. This action could cause a tornado like the one they just experienced.

c) Students may actively participate by wearing signs indicating they are part of the high or low pressure area. They would then move in the clockwise or counter-clockwise direction. Other students could represent the front that occurs where they meet.

3) Review
   Discuss results and relate results back to cloud formation and behavior.

4) Evaluation
   Have students create a “Clouds and Weather Diary” in which they sketch and name the clouds they see each day, whether the clouds were moving and, if so, in what direction, record surface wind direction, record the high and low temperature for the day, any precipitation that occurred, and other general weather observations. Then, for each day’s entry, students should draw conclusions about how the clouds observed are related to that day’s other weather observations and make a prediction for the next day’s clouds based on the televised weather report. The length of this diary is up to the teacher.

5) Extension
   a) Use newspaper weather maps to give students practice in predicting the weather.
   b) Allow students to examine an aneroid barometer, used to measure air pressure.
   c) Design a map with an imaginary area showing highs and lows. Each student must predict the weather for the spot marked “X” on the map and explain in a paragraph, using the correct vocabulary, why he/she believes this prediction to be correct.
   d) Students will decide which areas of the map experienced conditions conducive to ozone formation and explain what the conditions were and how they contributed.
   e) Have students describe things they and their families can do to reduce the threat of ground-level ozone in high pressure systems.

Adapted from: “Ozone Action! Let's Clear the Air Educational Activities 6th Grade - 8th Grade” *West Michigan Clean Air Coalition.* www.wmcac.org/grades6-8.pdf.