Throughout the guide, teaching tips are in red.

Activity Description & Estimated Class Time

In this 50-minute activity, students use morning air pressure, wind direction, season, and a weather prediction wheel to predict weather for the afternoon.

Objectives

Students will demonstrate knowledge and understanding of the following ideas and content:

- The influence of air pressure, wind direction, and season on short term changes in local weather.

Students demonstrate this knowledge and understanding by monitoring barometer readings and wind direction and using this information to predict changes in the weather.

Correlations to North Carolina Science Standards

5.E.1.1 Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation and temperature) and patterns.

5.E.1.2 Predict upcoming weather events from weather data collected through observation and measurements.

Brief Science Background

Air pressure is the force exerted by the weight of the air above the earth's surface. At sea level the weight of a one inch square column of air that extends to the outer atmosphere is about 14.7 lbs. However, that force constantly changes based on the temperature and the amount of water vapor in the air. Local change in air pressure is a good indicator of how the weather is likely to change. In the US, we often measure air pressure with a barometer, which uses "inches of mercury" as its unit. Inches of mercury is the number of inches that air pressure pushes a column of mercury up into a tube containing a vacuum. Low pressure air is warmer and contains more water vapor. High pressure air is cooler, with less water vapor. Falling barometer readings indicate a change toward wetter weather. Rising readings indicate a change toward clearer weather. Steady readings indicate that the weather will stay the same for awhile. The record high air pressure was very cold, dry, heavy air over Mongolia in December 2001 - 32.06 inches of mercury. The record low air pressure was in Typhoon Tip in 1979 - 25.69 inches of mercury.

Wind directions are named using the cardinal direction that the wind is coming *from*. For example, a north wind comes *from* the north and blows toward the south. Wind direction strongly influences weather at ground level and high in the atmosphere. Seasons are also important because each season has its own pattern of weather, air pressure, and wind direction.

Part 1 — Weather Predictor (50 minutes)

Materials

Materials for the whole class

- access to the internet and the National Weather Service site that lists current weather data for the school location http://www.nws.noaa.gov/om/osd/portal.shtml.

Materials for groups of 2 students

- Weather Prediction Wheel
- Black Line Master BLM 1
- Science notebook (supplied by the teacher)

Preparation

1. Before class starts, measure (if a barometer, anemometer, and weather vane are available) or look up via internet and record the barometric pressure, wind speed and wind direction. The earlier in the day, the better. These factors for your location are at http://www.nws.noaa.gov/om/osd/portal.shtml. Select North Carolina, then select the nearest location under "Current Weather Conditions" and click "go." Use the altimeter reading for barometric pressure. **The weather predictor is most accurate when used with data from around 9am local time.**
2. Prepare for students to get a barometer reading, wind speed, and wind direction reading at the time of the class, preferably around 9 a.m. Again, these can be recorded from the Weather Underground web site or with instruments if available.
3. Either be ready to give out sets of Weather Prediction Wheel materials for each pair students to make the wheels (punch out cards, brass fastener), or pre-make a Weather Prediction Wheel for each pair. If students are going to assemble these, make an example as a model for them.
4. Make a Weather Prediction Wheel for yourself for demonstration purposes.

Procedure

1. Form teams of two and explain that each team will make a weather prediction for this afternoon.
2. Give a Weather Prediction Wheel to each pair of students and tell them they will use this highly technical scientific device to predict this afternoon's weather. Ask them to take a few minutes with the wheel to determine what data it requires to make the forecast. Ask them how they think the wheel might predict weather. **This will be difficult, but let them try. At best, they might notice that barometer readings, wind direction and something about rising, falling, or steady are important.**
3. Ask students to point the STEADY arrow on the middle wheel to West wind direction and keep it there. With the middle wheel in place, challenge teams to move the top wheel around until they find a prediction that would give rain and a prediction that would give clear weather. Have them call out the number and read the prediction. Ask what they notice about

these barometer readings. **This could be forecast # 10, 11, or 12. 22 or 23 are not possible with the STEADY arrow on West. The barometer readings tend to be high – 30 or above.**

4. Ask "What might STEADY refer to? Explain that STEADY is a condition where barometer readings are staying the same, not going up or down.

5. Explain that teams are free to move both wheels. One at a time, challenge them to set the wheels and record the settings in notebooks where the predictions are as follows:

   - the weather will get worse or rainy. **These are lower numbers in the barometer readings.**
   - the weather will clear this afternoon. **These are higher numbers in the barometer readings.**
   - it will get snowy this afternoon **This setting uses the winter arrow to point to a wind direction and have a low barometer reading.**
   - changeable weather with rain **Any forecast # between 2 and 6, or #s such as 25 or 27.**

6. To walk students through the procedure, first determine whether the barometer is STEADY, RISING, OR FALLING compared with the reading you took early this morning. Set the season as defined in the instructions: April 1 - September 30 is summer; October 1 - March 30 is winter. Post where all can see:

   - a fictitious current barometer reading (not today's data) within range (between 28 and 31 inches of mercury)
   - a fictitious wind direction (not today's).

   Set your own Weather Prediction Wheel to these numbers and determine the forecast # (but don't tell students).

7. Ask the class to make a forecast from this. Ask a team to use their number to read the forecast for the fictitious afternoon. Use this to determine whether teams are ready to read the wheels. **The teacher and students should all get the same number. Those who don't still need a little practice reading the wheels.**

8. When all teams are ready, post the following for the class to see:

   - the barometer reading you took early this morning
   - the actual current barometer reading
   - the wind direction

9. Give out BLM 1 *Weather Predictor Instructions.* Ask the class to follow these instructions and use their Weather Predictor Wheels to make a forecast for this afternoon. Ask them to first fill in the information on A through E on the top half of the instructions. When all teams have finished, ask a few teams to read their forecast for this afternoon.

10. As late in the school day as possible, compare the actual weather conditions with the weather that was predicted. If you have a few minutes, this might be a good time to briefly discuss weather forecasting.

Wrap-Up

1. Challenge students to generate a statement about what barometer readings mean in terms of predicting short term changes in the weather.
2. Explain that the barometer measures the pressure of the air in an area and that the H's and L's on the weather forecast are indicating areas where the air pressure is high or low. Connect this to 5.E.1.3 Big Picture Weather where air masses are discussed.

Answer Key

Students' statements about barometer readings should say that it matters whether the barometer is rising or falling. Rising means clearing weather, and falling means stormier weather is on the way. Low or high pressure by themselves do not predict. It is the change in barometric pressure that matters for forecasting weather.

BLM 1

Information to gather for the Weather Predictor

A. Record the barometer reading your teacher took earlier today. _____

B. Record a current barometer reading. _____

C. If the current barometer reading is the same as the earlier one, the barometer is "STEADY." If the current reading is a larger number, it is "RISING." If the current reading is a smaller number, it is "FALLING." Record steady, rising, or falling here. _____

D. Record the direction the wind is coming from. _____

E. If it is between April 1 and September 30, it is "summer." If it is between October 1 and March 30, it is "winter." Record the season here. _____

Using the Weather Predictor

1. See C, above, to determine if the barometer is STEADY, RISING, OR FALLING. Find the STEADY, RISING, and FALLING tabs on the middle wheel and Wind Directions at the bottom of the predictor. Position the STEADY, RISING, OR FALLING tab anywhere directly above Wind Directions.

2. See D, above, to find wind direction. See E. above to choose summer or winter. Turn the middle wheel to place the appropriate summer or winter arrow to point at the wind direction. Note: There is only one arrow on the STEADY tab.

3. See B, above, for the current barometer reading. Keeping the middle wheel in place, point the "Barometer Readings" arrow on the top wheel to the current barometer reading. Record the number you find in the "Forecast # Here" slot here. _____

4. In the table at the bottom, find the weather prediction for the forecast number.

Appendix

Common Student Preconceptions About This Topic

Most people are familiar with the fact that weather forecasts can be inaccurate. Few students know what information forecasters use to predict weather, and it might surprise them to learn that short term forecasts can be more accurate than long term ones.

Because we naturally think of pressure as something that presses, and because we do not ordinarily feel air pressure, few students have ideas about it. They do not naturally connect air pressure to pressure in their ears in an airplane or when climbing or descending a mountain. Even if this connection is made, the connection to weather remains abstract. They have to take the teacher's word that it exists. As a result, ideas such as high or low pressure have little meaning in terms of weather. At this stage, students do well to connect an L or an H on a weather map to a specific change in weather.