

# Weather Activities for High School Students Using Davis Instruments

## Teacher's Notes

The following activities allow the student to collect and analyze data, determine relationships between two or more elements of weather, and apply this information to local conditions. Activities will be presented with options within the lesson that allow the teacher to determine which skills will be included.

## Part I: Air Masses on the Move

The teacher will need to provide readings for at least seven days, to include the following: temperature, relative humidity, wind direction, wind speed, barometric pressure, tendency, and precipitation.

### Suggestions

1. Provide data directly from the weather monitor at approximately the same time each day. To allow for Saturday and Sunday, provide data for the following Monday and Tuesday. Students may record data on the provided chart each day, graph data each day, or do both.
2. Provide data each day for a week from the WeatherLink<sup>®</sup> software. If students need practice with graphing skills, they can receive data in chart form and complete their own graph. If students need further practice reading graphs, they can receive data in graph form and complete the provided chart or a teacher-made chart.
3. If students are ready for weather analysis, they may use the week's worth of data provided by the teacher or generated by the student and move to the question section of the lesson.

### Purpose

The student will compare and contrast readings for at least one week to look for indications that one or more air masses are moving through the area. Because the properties of an air mass largely influence the weather at the surface, detecting its movement helps to understand and predict the weather. As the boundary of an air mass (a front) moves through an area, students may note changes in surface conditions by observing distinct changes in the data. Because air masses generally move across the country in about five days, the passing of the air mass can usually be observed by collecting data for seven days.

### Materials

1. Data (as suggested above) for at least one week
2. Graph paper (for Suggestions 1 and 2)
3. Chart, the one provided with this lesson or teacher-made (for Suggestions 1 and 2)
4. Ruler, markers (optional)

### Procedure

1. Introduce lesson to coincide with teaching the following: air masses, frontal boundaries, station models, or surface maps.
2. Distribute data collected and direct students to follow procedures outlined from Suggestion 1, 2, or 3 listed above.

## Air Masses on the Move

An **air mass** is a huge body of air, covering up to several thousand square kilometers. The temperature and humidity at any altitude (a horizontal layer) will be similar throughout the air mass. As they move across the country, they determine much of our surface weather. Determining their speed and direction of motion is a large part of predicting the weather. In the following activity, you will use the data collected from the Davis Instruments weather station at your site to determine the presence of an air mass as it moves through your area.

### Materials

1. Weather readings for at least one week
2. Graphing or charting materials as directed by teacher
3. Student Question and Answer sheets (which follow)

### Procedure

Have the following readings available for analysis as you complete the following section: **temperature, relative humidity, wind direction, wind speed, barometric pressure, tendency, and precipitation**. Be sure to note changes that occur and continue for a day or more. Look for signs of storms or precipitation, as this might indicate the boundary between two air masses, which is called a **front**. After studying the data, complete the following questions below.

1. Look at the data for **temperature** and **humidity**. At any time during your data collection period, do you notice a definite change in temperature and humidity, such as warmer and more humid or colder and drier? Explain what pattern you observe and give the date of any specific changes.

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2. Look at the data for **wind direction** and **wind speed**. At any time during the period, do you notice a change in wind direction or speed? Explain the pattern observed and state the date of the change.

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3. Did any change in **wind direction** or **speed** occur at the same time as a change in **temperature**? (Ex: wind shifting to the south and the temperature rising) Explain whether or not this occurred.

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4. Barometric pressure is usually **lower** at the boundary of two air masses and **higher** at the middle of an air mass that passes through an area. At any time did the barometric pressure rise or fall **more than .25 in.** of mercury? Explain what happened to the barometric pressure during this time period.

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5. If the barometer is falling (air is rising...), sometimes enough moisture rises with this less-dense air, and precipitation occurs. Was there any precipitation during this time period? If so, explain when it occurred and how much fell.

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6. From studying your answers for 1-5, can you find a day on which an air mass boundary (a front) passed through your area? This may be marked by a drop in pressure, a wind shift, a temperature change, and possible precipitation. Explain why you think a frontal boundary passed through your area or not.

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7. Now review your answers and your data to determine whether the center of an air mass passed through your area or nearby. This might be marked by a rise in pressure, strong steady winds, lower humidity, and lack of precipitation. Explain why you think a new air mass moved through your area during this time.

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**Weather Station Data for the Week of \_\_\_\_\_**

Date	Time	Temperature	Humidity	Wind Direction	Wind Speed	Air Pressure	Tendency	Precipitation

**Temperature** in °C or °F, as directed by teacher

**Relative Humidity** in %, indicating % of moisture in the air with 100% being saturated

**Wind Direction** standard directions such as: N, NE, ENE, etc.

**Wind Speed** in miles/hr, knots, kilometers/hr, or meters/second as directed by teacher

**Barometric Pressure** inches (in.), millimeters (mm), millibars (mb), or hectopascals (hPa) as directed by teacher

**Tendency** is rising, falling, or steady, indicating changes in air pressure, updated every 15 minutes

**Precipitation** in inches or millimeters, as directed by teacher

## Part II: Daily Weather Changes

The teacher will need to provide readings for at least one 24-hour period, to include the following: temperature, relative humidity, wind direction, wind speed, barometric pressure, tendency, and precipitation.

### Suggestions

1. Provide data in chart form with hourly readings for one or more 24-hour periods. Have students graph **temperature, relative humidity, wind speed, barometric pressure, tendency, and precipitation**. Students will use the chart and graphs to the changes and patterns that occur.
2. Provide data in graph form for students who have mastered graphing skills and are ready for data analysis. Wind direction combined with wind speed on one graph may require teacher direction for easier student interpretation.

### Purpose

The student will compare and contrast readings for at least one 24-hour period to determine patterns that may occur during a day. Because many aspects of weather are dependent on the heating of the Earth's surface, changes will occur as the surface warms on a typical day.

As air warms, it expands and allows barometers to drop slightly during the afternoon in many locations. Relative humidity is as dependent on temperature as it is on moisture in the air. For every  $10^{\circ}$  increase in air temperature, the amount of moisture (water vapor) that air can hold (saturation) doubles. So 50% relative humidity at  $50^{\circ}$  is much less water vapor than 50% relative humidity at  $70^{\circ}$ .

Another aspect that changes as the surface warms is wind speed. As air heats and expands, it increases its motion, which can be measured as wind speed. By studying the data for at least one 24-hour period, students may be able to make more connections about how weather occurs.

### Materials

1. Data (for Suggestions 1 and 2) for at least one 24-hour period
2. Graph paper (for Suggestion 1)
3. Chart, one provided with this lesson or teacher-made (for Suggestion 1)
4. Rulers, markers (optional)

### Procedure

1. Introduce lesson after basic concepts of temperature, humidity, and barometric pressure have been taught.
2. Distribute data collected and direct students to follow procedures outlined in Suggestion 1 or 2 listed above.

## Daily Weather Changes

During a 24-hour period, changes in many elements of the weather occur. Heating of the Earth's surface during daylight hours and cooling at night will cause some of these changes. Observations for one or more days should reveal some patterns that occur most days.

### Materials

1. Weather readings for at least one 24-hour period
2. Graphing or charting materials as directed by teacher
3. Student Question and Answer sheets, which follow

### Procedure

Have the following readings available for analysis as you complete the following questions: **temperature, relative humidity, wind direction, wind speed, barometric pressure, tendency, and precipitation.** Be sure to note any changes or patterns that you observe during a 24-hour time period. Note whether these occur during daylight hours or darkness.

1. What temperature changes occurred during the 24 hours? What was the highest temperature? What was the lowest?

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2. How did the wind speed or direction change during the 24-hour period? What hour(s) recorded the highest wind speeds?

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3. Describe the barometric pressure readings throughout the period.

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4. As the temperature rose, what happened to the wind speed?

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5. As the temperature rose, what happened to the barometric pressure?

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6. Was precipitation recorded? If so, what was the amount and when did it occur?

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7. Describe any patterns that you observed during this period.

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8. How could you check your observations and conclusions to make sure that this day was not out of the ordinary?

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## Answer Key for Part I

1. Use a newspaper or other media to verify the passing of a front; cold air mass boundaries (cold front) cause temperature to drop, and usually humidity drops.
2. If a front passes through, the wind direction can swing 180° in a short period of time; from the edge of an air mass to the other side, wind direction will not change as drastically.
3. If a front passed through, it is very likely that the temperature, wind direction, and wind speed changed at the same time.
4. Air pressure is less near the edges of an air mass and greatest under the center; big increases in pressure can indicate the passage of a front.
5. Check charts to verify time and amount of any precipitation.
6. Check media to verify passage of a front; data would indicate it with some of the following: marked change in temperature, wind shift, increased wind speed, marked change in humidity, and thunderstorms.
7. Check to see whether student notes a change any of the elements listed in #6.

## Answer Key for Part II

1. Temperatures are usually highest about 5 p.m.-6 p.m. and lowest at about 6 a.m.-7 a.m.
2. Wind speed should increase to the highest occurring during the hottest part of the day; the passage of a front will cause wind shifts and marked changes in wind speed.
3. As the sun heats the ground and the ground heats the air, the air begins to expand and lift slightly during the afternoon; this lift will cause the barometer to drop; passage of a front will cause more marked changes.
4. As air heats and expands, it moves more rapidly and wind speed increases; uneven heating of the Earth's surface will cause air masses to move and wind to blow from high pressure toward lower pressure.
5. If no fronts pass through an area, the barometer will usually drop a little as temperature rises.
6. Check charts to verify time and amount of precipitation.
7. As air warms during the day, relative humidity may drop, winds may increase, the barometer may drop, and showers may occur during the hottest part of the day (if enough moisture and lifting has occurred); as air cools, the winds subside, the humidity increases, and the barometer rises.
8. Student may describe collecting data from several days and compare the new data with today's data to verify that today was just an "average" day.



