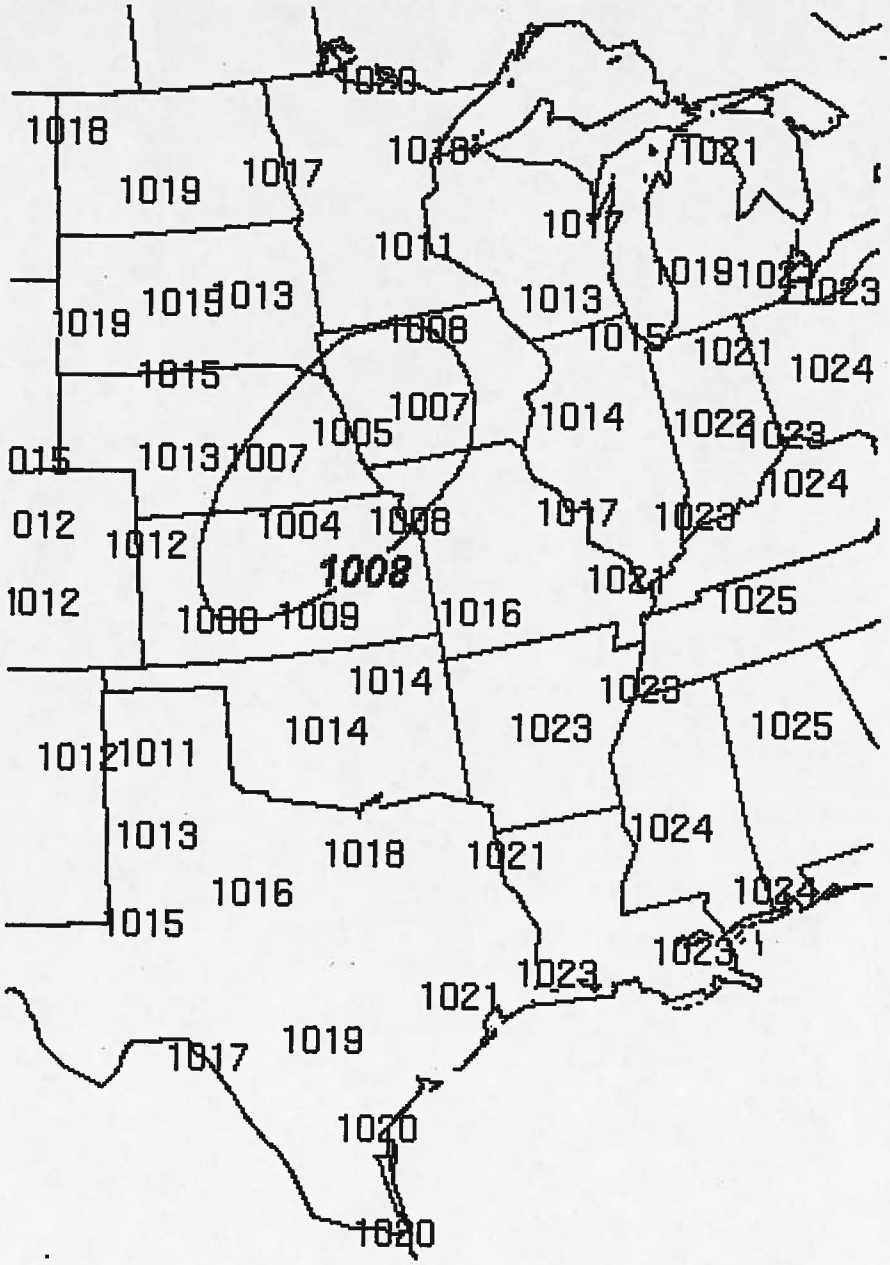


Figure 1.
Surface weather map with pressures reported in whole millibar units. The 1008-mb isobar has been drawn and labeled.

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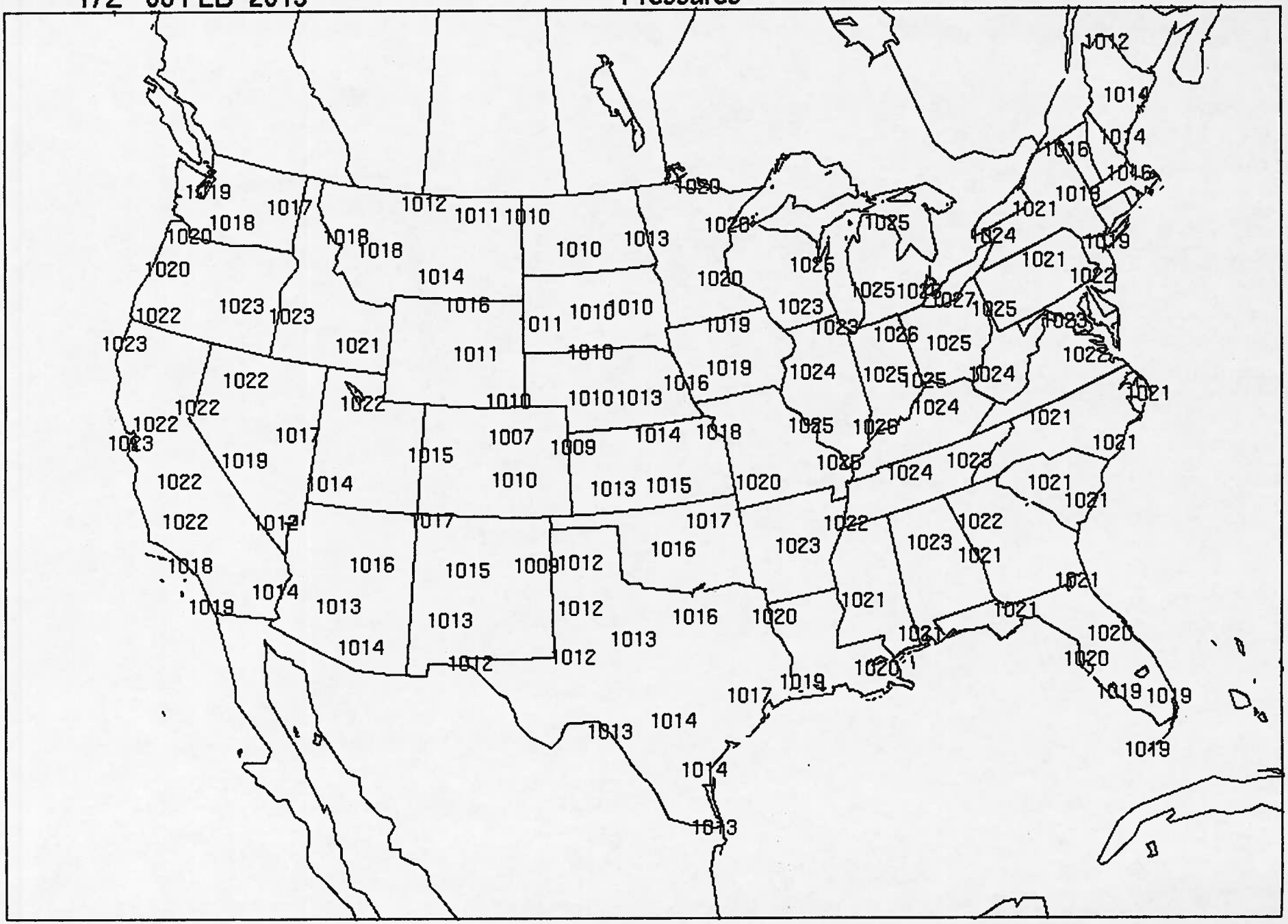
Pressures




*NCEP/NWS/NOAA*

**Investigation 1B**

# AIR PRESSURE AND WIND

## Objectives:

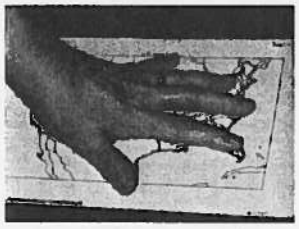
Air pressure, resulting from the weight of the overlying air, varies with location and with time. Air moves in response to horizontal differences in air pressure, setting the stage for much of the weather we experience. Wind (air in motion) tends to blow from where the air pressure is relatively high to where the air pressure is relatively low. Once air is in motion, its speed and direction may be influenced by the rotation of the Earth on its axis (the Coriolis Effect) and/or contact with Earth's surface (friction). The Coriolis Effect is important in large-scale weather systems (highs and lows of weather maps, for example) and friction affects winds blowing close to the Earth's surface below an altitude of about 1000 meters.

After completing this investigation, you should be able to:

- Describe the relationship between the patterns of relatively high and low air pressure areas (Lows or **Ls** and Highs or **Hs**) on a surface weather map and the direction of surface winds.
- Apply the "hand-twist" model of wind direction to the circulation in actual highs and lows.

## Introduction:

Turn to **Figure 1. Low**. Lightly draw a circle about 3 cm or so in diameter around the large "L" shown on the map. The "L" marks the location of lowest pressure in a low-pressure area. Using your left hand (if you are right-handed) or your right hand (if you are left-handed), cover the circle with your palm as shown to the right.

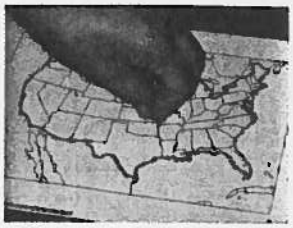


**[Note: The following analysis is more easily conducted if standing up.]** Practice rotating your hand <u>counterclockwise</u> as seen from above while gradually pulling in your thumb and fingertips as your hand turns until they touch the circle. Be sure the map does not move. Practice until you achieve a maximum twist with ease.

Place your hand back in the spread position on the map. Mark and label the positions of your thumb and fingertips 1, 2, 3, 4, and 5, respectively.

Slowly rotate your hand <u>counterclockwise</u> while gradually drawing in your thumb and fingertips. Stopping after quarter turns, mark and label (1 through 5) the positions of your thumb and fingertips. Continue the twist until your thumb and fingertips are on the circle. Connect the successive numbered positions for each finger and your thumb using a smooth curved line. Place arrowheads on the end of the lines to show the directions your fingertips and thumb moved. **The spirals represent the general flow of surface air that occurs in a typical low-pressure system.**

Now turn to **Figure 2. High**. Lightly draw a circle about 3 cm in diameter around the large "H" appearing on the map. The "H" represents the location of highest pressure in a high-pressure area.



Place the map flat on your desk. With your non-writing hand, bring the thumb and fingertips of your hand close together and place them on the circle you drew as shown to the right.

Rotate your hand slowly clockwise, as seen from above, and gradually spread out your thumb and fingertips as your hand turns. Be sure the map does not move. Practice this motion until you achieve as full a twist as you can comfortably. Place your thumb and fingertips back in the starting position on the circle. Mark and label the positions of your thumb and fingertips 1, 2, 3, 4, and 5, respectively.

Slowly rotate your hand clockwise while gradually spreading your thumb and fingertips. Go through about a quarter of your twisting motion. Stop, mark, and label (1 through 5) the positions of your thumb and fingertips on the map. Follow the same procedure in quarter steps until you complete a full twist.

Connect the successive numbered positions for each finger and your thumb using a smooth curved line. Place arrowheads on the ends of the lines to show the directions your thumb and fingertips moved. **The spirals represent the general flow of surface winds that occurs in a typical high-pressure system.**

1. Which of the following best describes the surface wind circulation around the center of a low-pressure system (as seen from above)?
   **[(*counterclockwise and outward spiral*)(*counterclockwise and inward spiral*)(*clockwise and outward spiral*)(*clockwise and inward spiral*)].**

2. Which of the following best describes the surface wind circulation around the center of a high-pressure system (as seen from above)?
   **[(*counterclockwise and outward spiral*)(*counterclockwise and inward spiral*)(*clockwise and outward spiral*)(*clockwise and inward spiral*)].**

3. On your desk, repeat the hand twists for the low- and high-pressure system models. Note the vertical motions of the palm of your hand. For the Low, the palm of your hand **[(*rises*)(*falls*)]** during the rotating motion.

4. In the case of the High, the palm of your hand **[(*rises*)(*falls*)]** during the rotating motion.

5. Imagine that the motions of your palms during these rotations represent the directions of vertical air motions in Highs and Lows. Vertical air motion in a Low is therefore **[(*upward*)(*downward*)]**.

6. In the case of the High, vertical air motion is **[(*upward*)(*downward*)]**.

7. Considering the complete air motions of the low-pressure system, air flows
[(***upward and outward in a clockwise spiral***)
(***upward and inward in a counterclockwise spiral***)
(***downward and outward in a clockwise spiral***)
(***downward and inward in a counterclockwise spiral***)].

8. In a high-pressure system, air flows
[(***upward and outward in a clockwise spiral***)
(***upward and inward in a counterclockwise spiral***)
(***downward and outward in a clockwise spiral***)
(***downward and inward in a counterclockwise spiral***)].

***As directed by your course instructor, complete this investigation by either:***

1. ***Going to the Current Weather Studies link on the course website, or***
2. ***Continuing to the Applications section for this investigation that immediately follows in this Investigations Manual.***

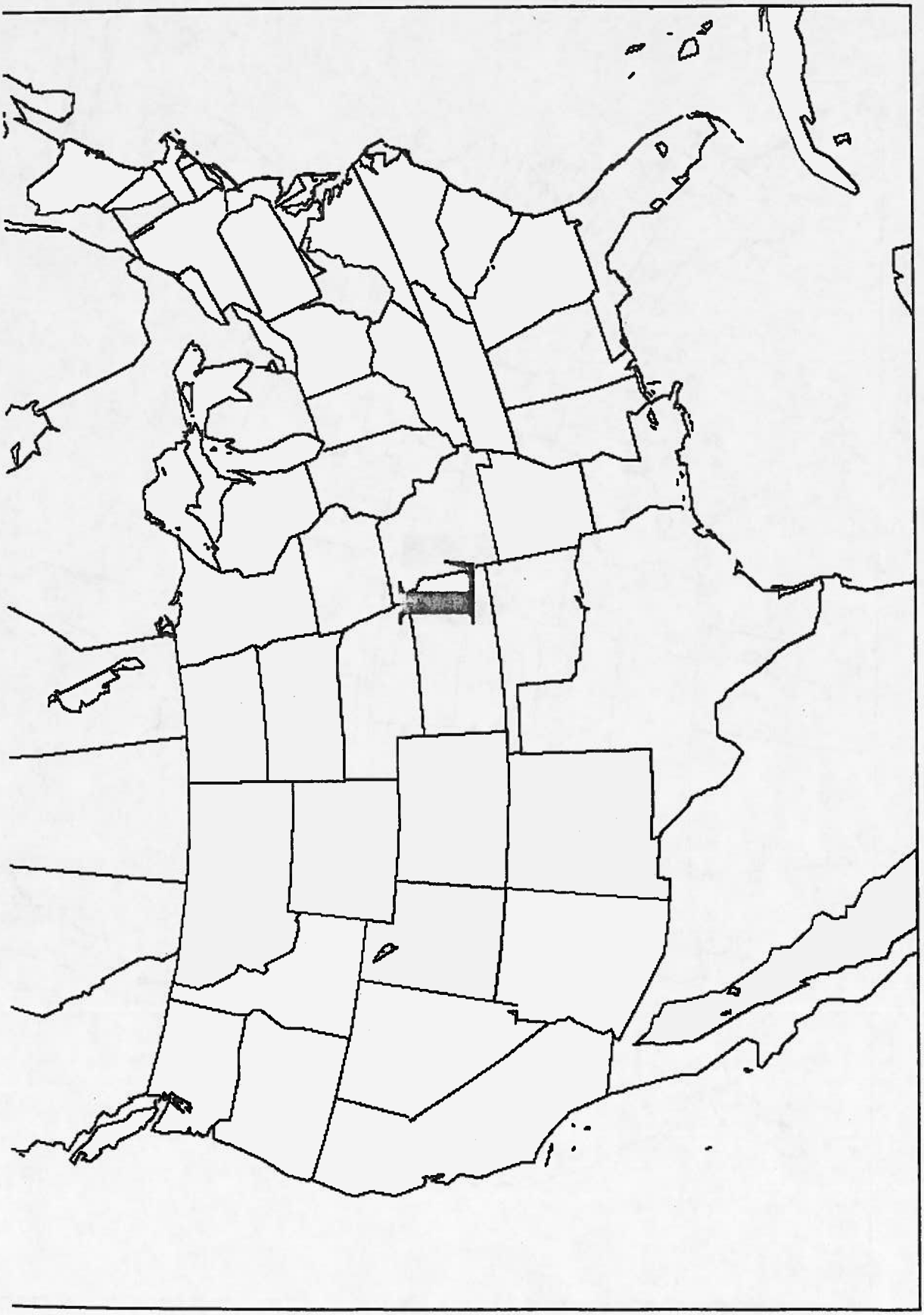


Figure 1. Low

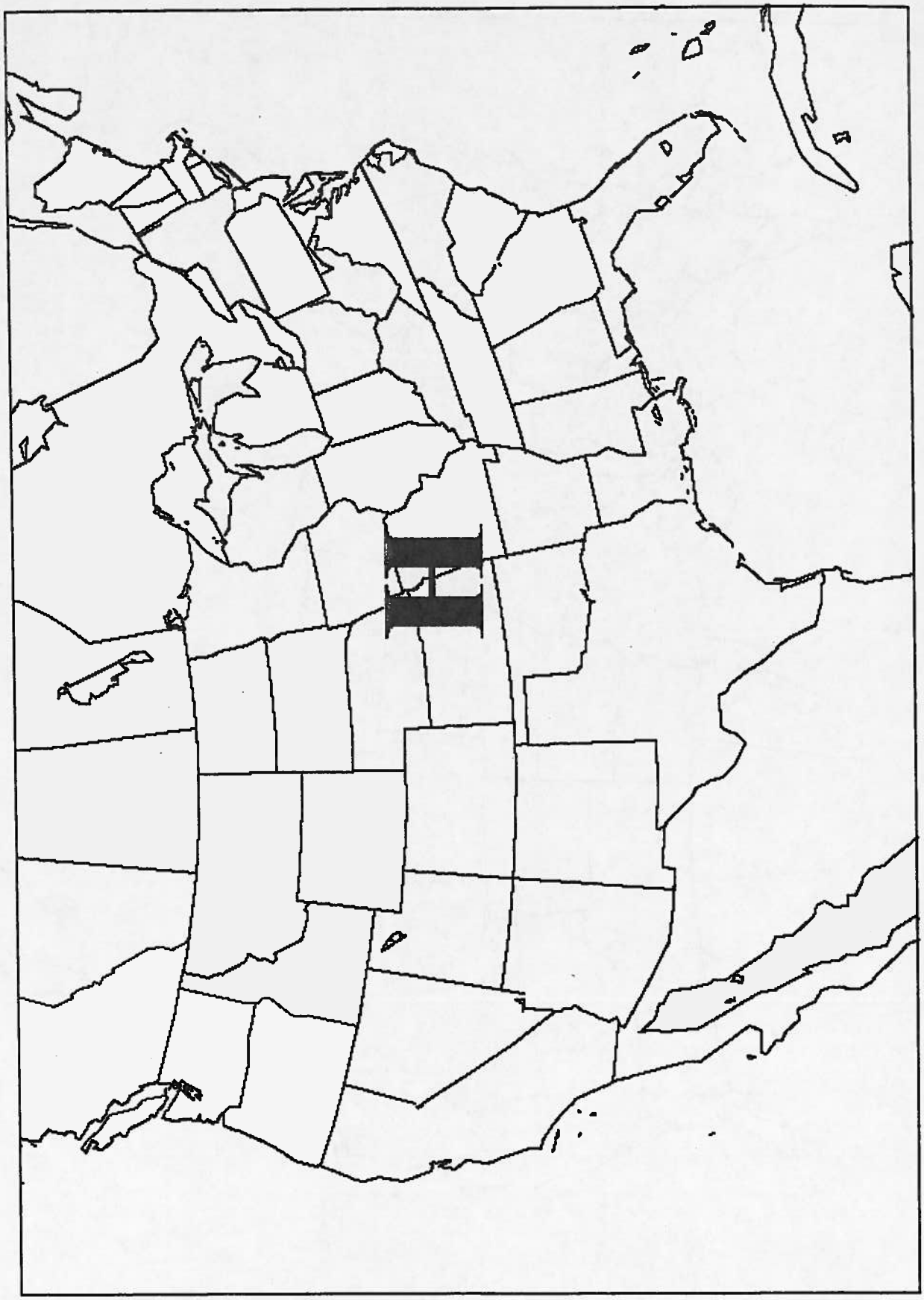


Figure 2. High

# Interpreting Weather Maps

## Background

Weather maps are made by combining meteorological data collected from stations all over the nation or the world. Weather stations are maintained at airports, at broadcasting stations, by schools, by private citizens, and in remote areas by the National Oceanic and Atmospheric Administration (NOAA). Weather maps usually have an outline of the area being surveyed, the names of the cities where the reporting stations are located, and symbols that represent the weather data. These weather symbols express a lot of information in a concise way. If you combine information from many stations on a map, the map will give you a picture of the large weather systems across the nation.

Figure 1 shows an example of the weather stations symbols, and the information given by each symbol. Following Figure 1 is an explanation of each type of information. As of this writing, weather station symbols in the United States are still expressed in the English system of measurement.

### Objective

The objective of this activity is to learn how to interpret a basic weather map.

### Materials

For each student:

- colored pencil

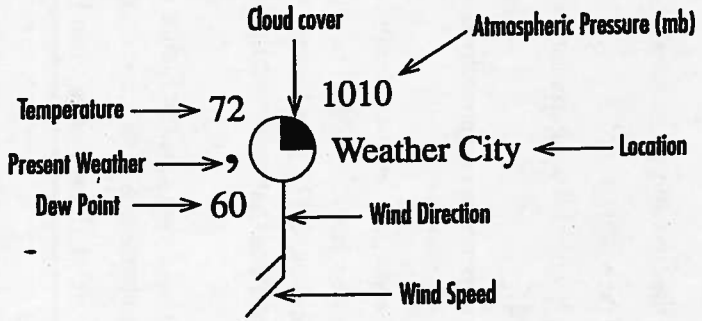



Figure 1

*Atmospheric pressure:* This is the atmospheric (or air) pressure measured in millibars (mb). Air pressure at sea level averages about 1013 mb (14.7 lb/in$^2$ or 1.04 kg/cm$^2$ or 760 mm Hg or 29.92 in. Hg). Often weather maps have curved lines



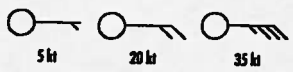



Figure 2

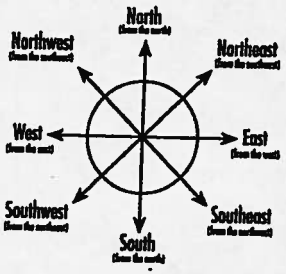



Figure 3

called isobars (literally "equal bars"). These lines are drawn by connecting lines between locations on the map with the same air pressure.

*Wind speed:* The small lines that look like barbs represent the wind speed. Each full line represents 10 knots (kt) of wind speed (1 kt=1.15 mph=1.8 kph). Shorter lines represent wind speeds of 5 knots. Add the lines to get the total wind speed. Figure 2 shows several examples.

*Wind direction:* If you think of the wind speed lines as feathers on an arrow, the circle represents the arrowhead. The arrow points the direction the wind is blowing, but wind direction is designated as the direction the wind is blowing from. Therefore, if an arrow points to the east, the wind direction is actually called "from the west." In Figure 1 above, the wind direction is from the south. See Figure 3 for the principal wind directions.

*Temperature:* This is the temperature measured in °F every hour.

*Dew Point:* This is the temperature in °F the air would have to be cooled to for the air to become saturated and for water vapor in the air to condense.

*Cloud cover:* The amount of cloud cover is represented by the amount of the circle that is blackened. Figure 4 shows some examples.


Figure 4

*Present weather:* Figure 5 shows a list of symbols used to designate some of the different types of weather.

Figure 5

| | |
|---|---|
| • Intermittent rain | 9 Intermittent drizzle |
| • • Continuous rain (light) | 9 9 Continuous drizzle |
| △ Hail | ⌜ Thunderstorms |
| ▲ Sleet | = Fog |
| * Intermittent snow | ▽ Slight rain showers |
| * * Continuous snow (light) | ▽ Moderate or heavy rain showers |


## Procedure

1. Answer the following questions referring to the weather map in Figure 6:
   a. What is the "present" weather in Dallas, Texas?
   b. What is the atmospheric pressure in Kansas City?
   c. From which direction is the wind blowing at Hatteras, North Carolina, and what is its speed?
   d. What is the temperature in Pueblo, Colorado?
   e. What is the cloud cover in Miami, Florida?
   f. What is the atmospheric pressure in Roswell, New Mexico?
   g. What is the "present" weather in Chicago, Illinois?
   h. What is the cloud cover in New York City?
   i. From which direction is the wind blowing in Helena, Montana and what is its speed?
   j. What region of the nation appears to be generally cloudy? What region appears to be generally clear?
2. In Weather City, the atmospheric pressure is 1010 mb. The temperature is 54°F, and the dew point is 40°F. The wind speed is 15 knots from the southeast. The cloud cover is 50 percent. Draw the weather symbols that represent the data recorded at Weather City.
3. Use a colored pencil to shade lightly all areas in Figure 6 that are experiencing 100 percent cloudiness or precipitation.
4. Why is it important to be informed about weather conditions?
5. Of all the weather conditions that occur in your area, which pose threats to life and property?