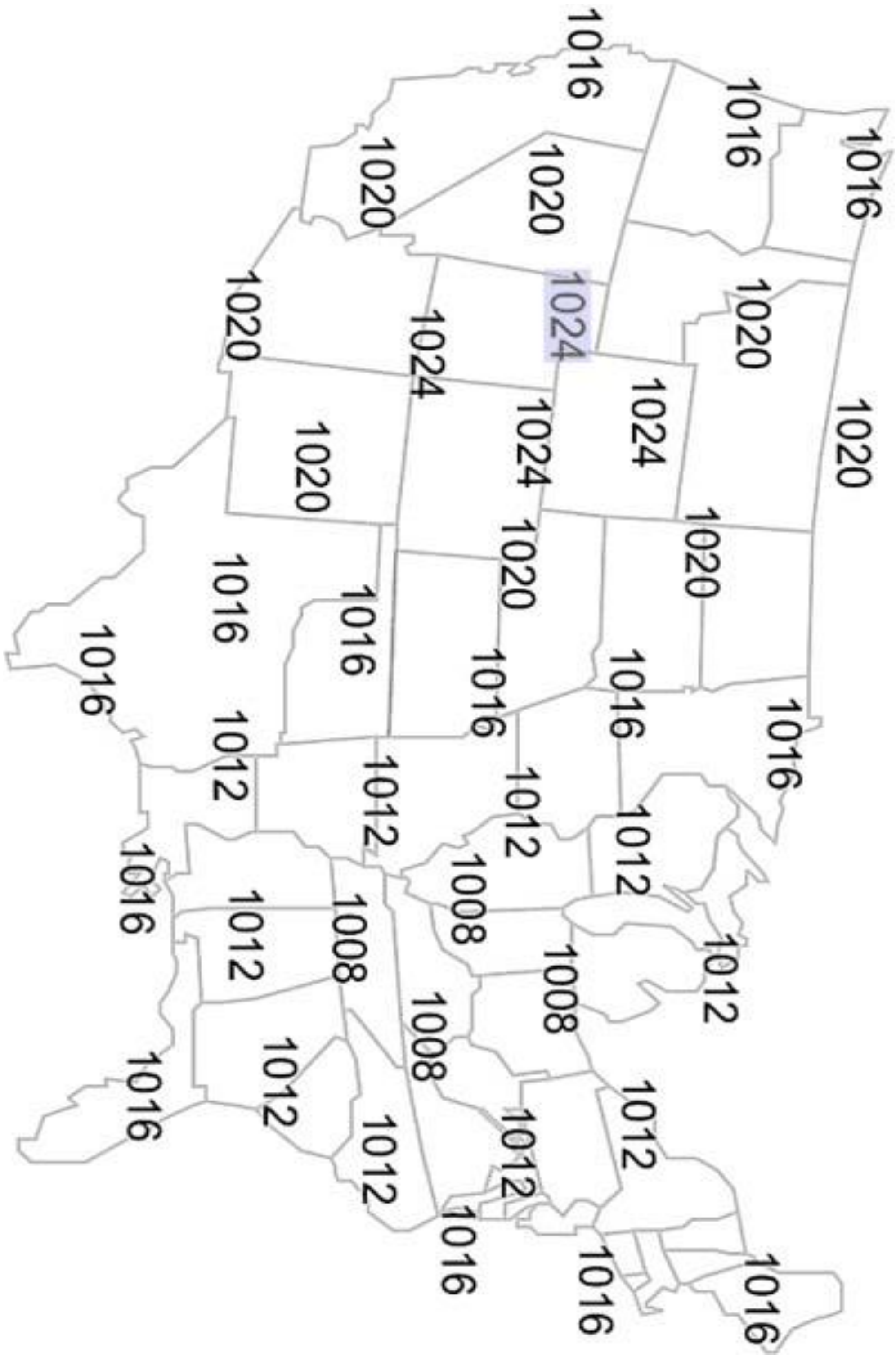
NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Learning Lesson: Drawing Conclusions - Surface Air Pressure Map

Objective

Using a black colored pencil, lightly draw lines connecting identical values of sea-level pressure. Remember, these lines, called isobars, do not cross each other. **Isobars are usually drawn for every four millibars**, using 1000 millibars as the starting point. Therefore, these lines will have values of 1000, 1004, 1008, 1012, 1016, 1020, 1024, etc., or 996, 992, 988, 984, 980, etc. The map below shows the sea-level pressures for various locations over the contiguous U.S. The values are in whole millibars.



Procedure:

1. Begin drawing from the 1024 millibars station pressure over Salt Lake City, Utah (highlighted in blue). Draw a line to the next 1024 value located to the northeast (upper right). Without lifting your pencil draw a line to the next 1024 value located to the south and then to the one located southwest, finally returning to the Salt Lake City value. Remember, isobars are smooth lines with few, if any, kinks. The result is an elongated circle, centered approximately over Eastern Utah. The line that was drawn represents the 1024 millibar line and you can expect the pressure to be 1024 millibars everywhere along that line
2. Repeat the procedure with the next isobar value. Remember, the value between isobars is four millibars. Since there are no 1028 millibar values on the map, then your next line will follow the 1020 millibar reports.
3. Then continue with the remaining values until you have all the reports connected with an isobar.
4. Label each isobar with the appropriate value. Traditionally, only the last two digits are used for labels. For example, the label on the 1024 mb isobar would be "24". A 1008 mb isobar would be labeled "08". A 992 mb isobar will be labeled "92". These labels can be placed anywhere along the isobar but are typically placed around edges of the map at the end of each line. For closed isobars (lines that connect) a gap is placed in the isobar with the value inserted in the gap.

Analysis:

Isobars can be used to identify "Highs" and "Lows". The pressure in a high is *greater* than the surrounding air. The pressure in a low is *lower* than the surrounding air.

- Label the center of the high-pressure area with a large blue "**H**".
- Label the center of the low-pressure area with a large red "**L**".

High pressure regions are usually associated with dry weather because as the air sinks it warms and the moisture evaporates. Low pressure regions usually bring precipitation because when the air rises it cools and the water vapor condenses.

- Shade, in green, the state(s) would you expect to see rain or snow.
- Shade, in yellow, the state(s) would you expect to see clear skies.

In the northern hemisphere the wind blows clockwise around centers of high pressure. The wind blows counterclockwise around lows.

- Draw arrows around the "**H**" on your map to indicate the wind direction.
- Draw arrows around the "**L**" on your map to indicate the wind direction.

Science Background: The particles that make up the various layers in the atmosphere are always moving in random directions. Despite their tiny size, when they strike a surface they exert pressure. Each particle is too small to feel and only exerts a tiny bit of pressure. However, when we add up the all the pressures from the large number of particles that strike a surface each moment, then the total pressure is considerable. This is air pressure. As the density of the air increases, then the number of strikes per unit of time and area also increases.

Since the particles move in all directions, they can even exert air pressure upwards as they smash into object from underneath. Air pressure can be exerted in all directions.

As elevation above Earth's surface increases, the number of particles decreases and the density of air therefore is less, meaning a decrease in air pressure. In fact, while the atmosphere extends more than 15 miles (24 km) up, one half of the air particles in the atmosphere are contained within the first 18,000 feet (5.6 km).

Because of this decrease in pressure with height, it makes it very hard to compare the air pressure at one location to another, especially when the elevations of each site differ. Therefore, to give meaning to the pressure values observed at each station, we need to convert the station air pressures reading to a value with a common dominator.

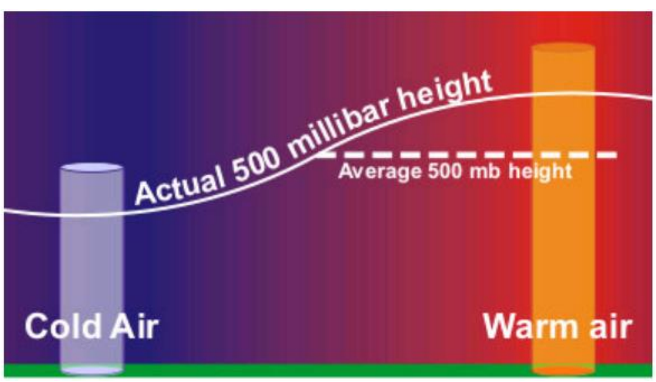
The common dominator we use is the sea level. At observation stations around the world, through a series of calculations, the air pressure reading, regardless of the station elevation, is converted a value that would be observed if that instrument were located at sea level.

In the International Space Station, the density of the air is maintained so that it is similar to the density at the earth's surface. Therefore, the air pressure is the same in the space station as the earth's surface (14.7 pounds per square inch).

The two most common units in the United States to measure the pressure are "Inches of Mercury" and "Millibars". The term "Inches of mercury" refers to the height of a column of mercury measured in hundredths of inches. This is what you will usually hear from the NOAA Weather Radio or from your favorite weather or news source. At sea level, standard air pressure in inches of mercury is 29.92.

Millibar comes from the original term for pressure "bar". Bar is from the Greek "báros" meaning weight. A millibar is 1/1000th of a bar and is approximately equal to 1000 dynes (one dyne is the amount of force it takes to accelerate an object weighing one gram, one centimeter, in one second). Millibar values, used in meteorology, range from about 100 to 1050. At sea level, standard air pressure in millibars is 1013.2. Weather maps showing the pressure at the surface are drawn using millibars.

Although the changes are usually too slow to observe directly, air pressure is almost always changing. This change in pressure is caused by changes in air density, and air density is related to temperature.



Warm air is less dense than cooler air because the particles in warm air have a greater velocity and are farther apart than in cooler air. So, while the average altitude of the 500-millibar level is around 18,000 feet (5,600 meters) the actual elevation will be higher in warm air than in cold air.

The most basic change in pressure is the twice daily rise and fall in due to the heating from the sun. Each day, around 4 a.m./p.m. the pressure is at it's lowest and near its peak around 10 a.m./p.m. The magnitude of the daily cycle are greatest near the equator decreasing toward the poles.

On top of the daily fluctuations are the larger pressure changes as a result of the migrating weather systems. Weather systems are identified by the blue H's and red L's drawn on weather maps. The H's represent the location of the area of highest pressure. The L's represent the position of the lowest pressure.