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FOCUS: Weather Maps & Meteorology

ESSENTIAL QUESTION: Can you explain how meteorologists use atmospheric data to predict weather? Can you interpret a weather map in order to predict upcoming weather in our area?

What do you already know?

- Weather is the state of the atmosphere at a given time in a particular place.
- Weather is affected by pressure systems, air masses, and fronts:
  - Pressure systems can be high or low.
  - Air masses are classified according to their temperature & humidity.
  - Fronts can be cold, warm, stationary, or occluded.

Describing Weather

- A complete report of weather includes a description of temperature, pressure, precipitation, wind speed, humidity, & cloud cover.
- ***Temperature:*** Measures the thermal energy within a volume of air.
  - Fahrenheit: standard scale used in the United States, especially on weather maps.
    - Water freezes: 32°F
    - Water boils: 212°F
    - Average temperature in N.C.: 41°F (January), 80°F (July)

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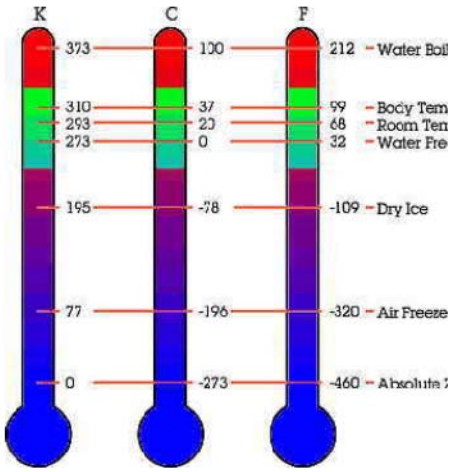
F→C

$(F-32)\frac{5}{9}=C$

$(C\times\frac{9}{5}+32=F$

- Celsius: standard scale used worldwide, especially on weather maps.
  - Water freezes: 0°C
  - Water boils: 100°C
  - Avg. temp. in N.C.: 5°C (Jan), 27°C (July)
- Kelvin: official metric unit for temperature; based on the standard of absolute zero (the theoretical temperature at which molecules stop moving).
  - Water freezes: 273 K
  - Water boils: 373K
  - Average temperature in N.C.: 278K (January), 300K (July)



- ***Pressure:*** The force that air exerts over a certain area due to its weight or motion.
  - Low pressure = cloudy, stormy, rainy weather
    - Pressure readings from 980mb to 1020mb
  - High pressure = clear, fair, dry weather
    - Pressure readings from 1020mb to 1050mb
- ***Precipitation:*** liquid or solid water falling from the sky
  - Comes in 5 forms: rain, snow, sleet, hail, or freezing rain.

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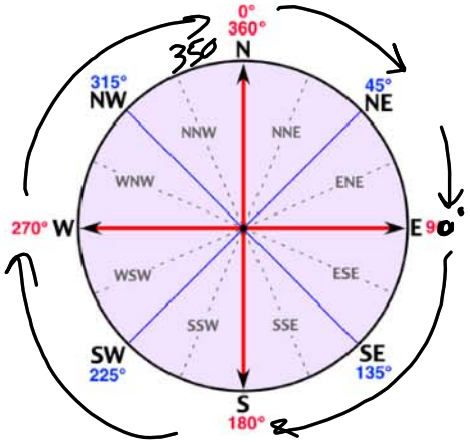
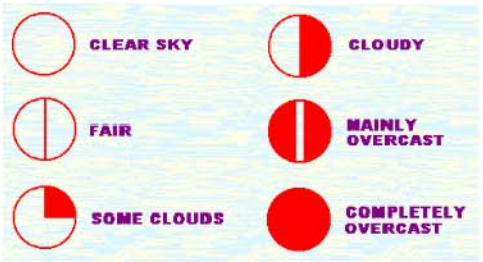
- ***Wind Speed & Direction:***
  - Speed is measured in miles per hour.
  - Direction is given as degrees of a circle, where the weather station is the center of the circle and the degrees tells you the direction from which the wind is blowing.
  - Ex: 12 mph 225^0 = Wind traveling at 12 mph *from* the SW



- ***Humidity:*** Measures the amount of water vapor in the air.
  - Expressed on a scale from 0% to 100%.
    - 100% means that the air is holding as much moisture as it possibly can at that temperature.
- ***Cloud Cover:*** Described by percentage of sky coverage.
  - clear = 0-10% cloud cover
  - scattered = 10-50% cloud cover
  - broken = 50-90% cloud cover
  - overcast = 100% cloud cover



From Weather Stations to Weather Maps

- Meteorologists at NOAA (National Oceanic & Atmospheric Administration) collect data from over 300 weather stations daily to produce weather maps across the country.

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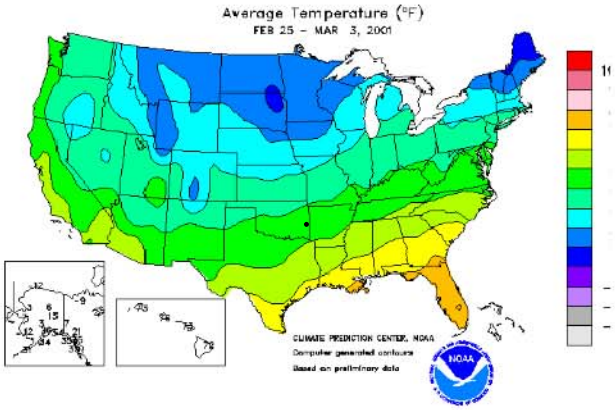
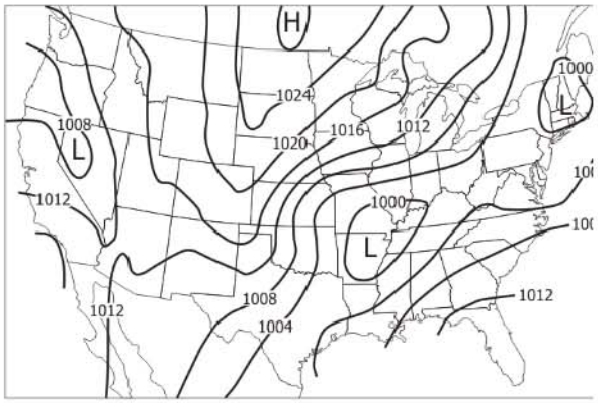
- Data from all the weather stations is compiled and connections are made.
  - Areas with similar temperature are connected by lines called isotherms.
  - "iso" = equal, "therm" = heat
    - Smooth lines that do not cross.
    - Show temperature gradients across the country.



    - Reflect the location of the jet stream and fronts.
  - Areas with similar pressure are connected by lines called isobars.
  - "iso" = equal, "bars" = pressure measurement



    - Smooth lines that do not cross.
    - Form imperfect Circles or ovals around pressure systems.

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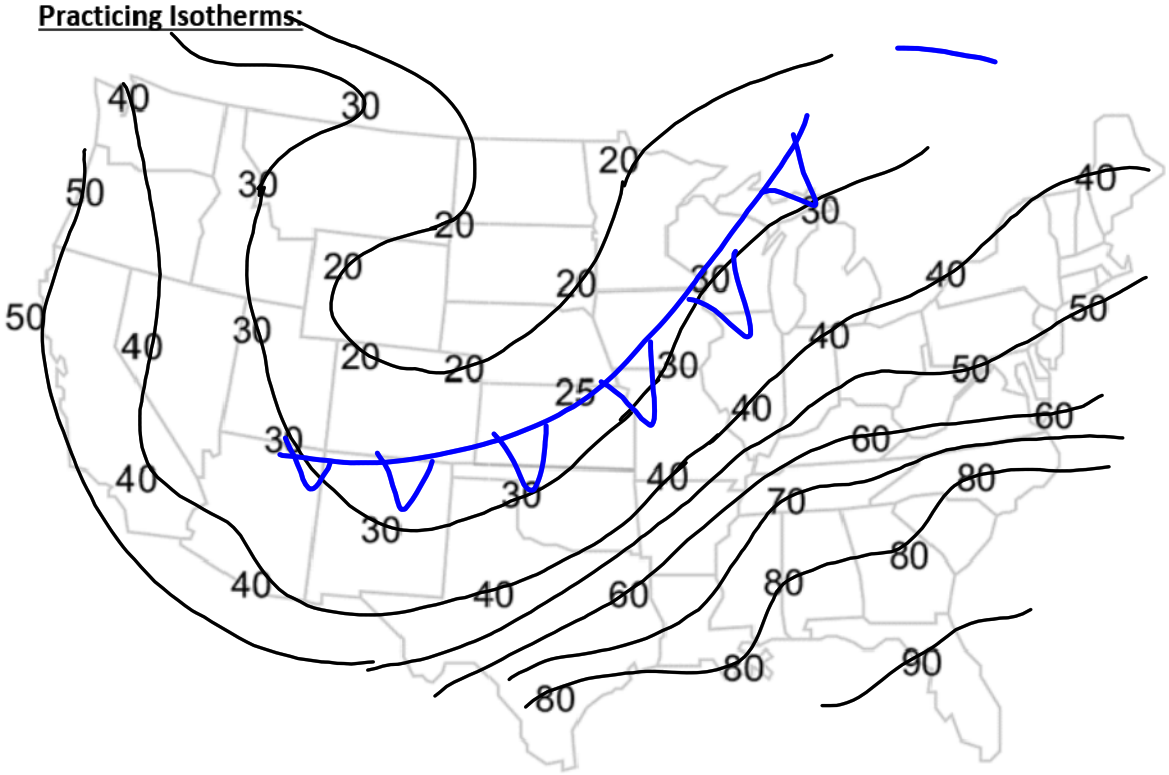
Practicing Isotherms:



This map shows the air temperature for various locations over the contiguous U.S. The values are in °F.

Objective

The student will be able to draw lines connecting equal values of temperatures, every 10°F. (Remember, these lines (called ***isotherms***) are smooth and do not cross each other).

Procedure

1. You will draw lines connecting the temperatures. However, you will also need to interpolate between values. Interpolation involves estimating values between stations which will enable you to properly analyze a map.

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2. Begin by drawing from the 40°F temperature in Seattle, Washington (top left value). Since we want to connect all the 40°F temperatures together, the nearest 40°F value is located in Reno, Nevada, (southeast of Seattle). However, in order to get there you must draw a line between a 50°F temperature along the Oregon coast and a 30°F temperature in Idaho. Since 40°F is halfway between the two locations, your line from Seattle should pass halfway between the 50°F and 30°F temperatures. Place a light dot halfway between the 50°F and 30°F temperatures. This is your interpolated 40°F location.
3. Next connect the Seattle 40°F temperature with the Reno 40°F temperature ensuring your line moves through your interpolated 40°F temperature. Continue connecting the 40°F temperatures until you get to Texas.
4. Now your line will pass between two values, 60°F and 30°F. Like the last time, you should make a mark between the 60°F and 30°F but this time a 50°F is also to be interpolated in addition to the 40°F. Between the 60°F and 30°F temperatures, place a small dot about 1/3 the distance from the 30°F and another small dot about 2/3 the distance from the 30°F. These dots become your interpolated 40°F and 50°F temperatures.
5. Finish drawing your 40°F isotherm passing through your interpolated 40°F value.
6. Repeat the above procedures with the other isotherms drawn at 10°F intervals.
7. Label your isotherms at the far western and eastern ends with their temperature values.
8. The only isotherm that should form a closed shape is the one for 20^0F.

Analysis

Isotherms are used to identify warm and cold air masses.

1. Shade, in blue, the region with the lowest temperatures.
2. Shade, in red, the region with the warmest air.

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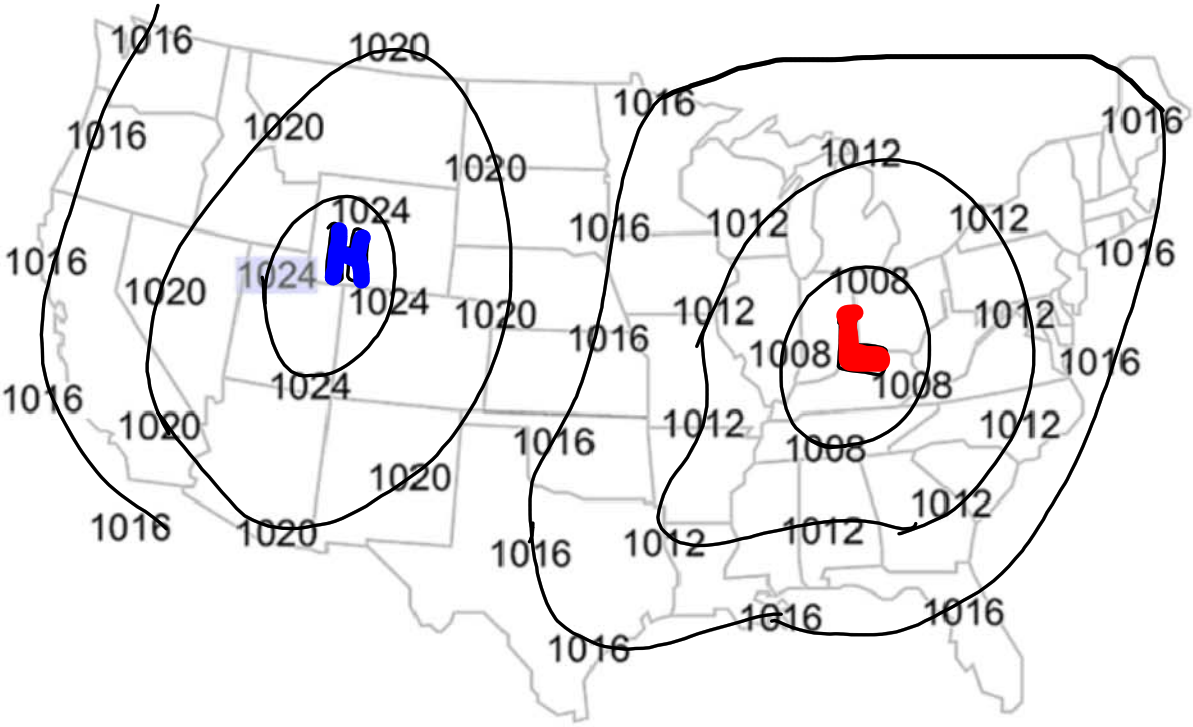
Practicing Isobars



This map shows the sea level pressures for various locations over the contiguous U.S. The values are in whole millibars.

Objective

The student will draw lines connecting identical values of air 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.

Procedure

1. Begin drawing from the 1024 millibars station pressure over Salt Lake City, Utah (highlighted). 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 that usually form a closed

shape.The result is an elongated circle, centered approximately over Eastern Utah. The line that was drawn represents the 1024 millibars 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 4 millibars. Since there are no 1028 millibars values on the map, then your next line will follow the 1020 millibars reports.
3. Continue with the remaining values until you have all the reports connected with an isobar. **Hint: The 1016 isobar on the west coast will form a line, but NOT a closed circle. The 1016 isobar in the eastern U.S. WILL form a closed shape.
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.

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

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

1. Shade, in green, the state(s) would you expect to see rain or snow.
2. 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.

1. Draw arrows around the "H" on your map to indicate the wind direction.
2. Draw arrows around the "L" on your map to indicate the wind direction.