Activity 3.4 Plotting Temperatures on a Weather Map

Teacher Background

Of all the factors which influence our weather, temperature and the prospect of precipitation(rain, snow, sleet, etc.) rank first in impacting the way we dress and the conditions under which we work and play. But temperature is usually the only weather measurement we see displayed on bank signs and outdoor displays. It's simple and meaningful. The color and weight of the clothes we wear varies with the changing seasons in response to the varying outdoor temperatures.

On a large scale, variations in temperatures across the Earth are due to the uneven heating of the Earth's surface. (See Activity 1.1.) This variation is both horizontal, across latitudes and vertical, up through the atmosphere, the result of elevation. The curvature of the Earth causes latitudes near the equator to receive more direct radiational heating by the Sun. Latitudes nearer the poles receive the Sun's rays at a lower angle, resulting in less intense light spread over a larger area. These differences in heating, combined with the 23.5 degree tilt of the Earth's axis and the varying duration of daylight, drive our weather systems. Regions closer to the equator demonstrate a narrower range of temperature change than do those at higher latitudes. In fact, day/night temperature variations in the tropics may be greater than *seasonal* temperature changes, from summer to winter or wet to dry season.

The middle latitudes are the perpetual battleground for clashes between warm air masses flowing out from the tropics and cold air masses streaming down from the poles. These influences combined with variations in surface topography and oceans both coasts help make weather in the contiguous United States so dynamic.

Meteorologists generate weather maps displaying temperatures recorded at numerous surface weather stations. In a standard topographical map, contour lines are drawn through points of equal elevation. In a temperature map, lines are drawn through positions connecting points of equal temperature. These lines are called "isotherms." Rather than connecting all points of equal temperature on a map, an interval is used. The standard isotherm interval is 10 degrees. Colors can then be added to highlight each ten degree zone of temperature. Today, isotherm maps are among the most common and most easily understood of all weather maps. They can be seen regularly on the Weather Channel, local TV weather reports, and on the Weather Page of USA TODAY.

Objectives

Students will plot predicted high temperatures for various cities on blank U.S. maps using the standard temperature interval of 10 degrees to locate and draw isotherms.
Students will compare and contrast their isotherm maps of *predicted* temperatures with published weather maps of *actual* data.
Students will convert numerical temperature data into a graphical representation.

Note: this Activity will require portions of 2 class periods, at least 2 and no more than 3 days apart: the first to plot *predicted* temperatures and the second to compare predicted with *actual* temperatures.

Vocabulary
contour
isotherm
latitude
longitude
radiational
topographical

Materials and Preparation
one blank U.S. map for each student
listing of high temperature forecasts for U.S. cities
colored pencils (It would be best to have pencils available correspond to the colors used by the source of the weather maps you use.)
several atlases or U.S. maps

Preparation
Obtain a copy of USA TODAY for the day on which you start this activity. The Weather Page includes a listing of 2 day and 3 day temperature forecasts for numerous U.S. cities. Furnish each student with a list of these temperature forecasts and the corresponding cities. Give each student a blank U.S. map which shows only state borders. These might be obtained from a geography, history or social studies teacher or can be downloaded and printed directly from the AMS DataStreme web site. (See URL below.)

Engage
Discuss with students ways in which temperature impacts their daily activities. (An example might be deciding what clothes to wear orthe need for heating and cooling systems to make school or home comfortable.) Students in some regions may recall early dismissals or school cancellations due to outdoor temperature extremes, both uncomfortably hot and dangerously cold. Ask the students to explain the reasons for the wide range of temperatures across the nation. They may better understand differences in temperature across latitudes than changes in elevation. How does the uneven heating of the Earth's surface drive weather systems? What other factors can modify temperatures within a region? (Possible answers: cloud cover, shoreline/interior or land/water contrasts, urban heat islands, etc.)

Procedure
Choose whether you will have students plot second day or third day high temperature forecasts. Using the temperature listings from USA TODAY, they should identify the locations of the cities, and fill in the predicted high temperatures for each location. Provide access to atlases or pre-labeled U.S. maps for reference. Once all the temperatures have been noted, the students should draw in lines representing 10 degree intervals. (Round temperatures from X1-X4 degrees [where X=1(0), 2(0), 3(0), 4(0) degrees, etc.) down to X(0), and temperatures from X(5)-X(9) up to the next highest unit, X+10.] These lines are called isotherms. When drawing isotherms they should follow the tips below:

1. Draw the isotherms so temperatures above the value are always on one side of the line and temperatures below the value are on the other side of the line.
2. Assume a steady temperature change between points on the map. Neighboring isotherms generally tend to look alike, following similar curves.
3. Isotherms should continue to the edge of the map or until they form closed loops. They should never touch, cross, or fork.
4. Isotherms should always appear in sequence, never skipping a value.
5. Always draw isotherms within predicated values, between the highest temperature and lowest temperature noted on the map.
6. Label the isotherms. After drawing all of the isotherms on the map, the students should use colored pencils to shade in each 10 degree range, such as the 40's, the 50's, etc. They should also include a legend on the side of the map.

Obtain a copy of USA TODAY or visit the Weather Underground website (both linked from the LIVE FROM THE STORM home page) for the day of the predicted temperatures. Students should compare and contrast their temperature maps to the actual weather maps for that day. Discuss reasons for any variation between the maps.

Expand/Adapt/Connect

Cut out the large USA TODAY isotherm maps for several consecutive days and display them on a classroom wall or bulletin board. Use the sequence of maps to point out the movement of warm and cool air masses across the country. Compare isotherm maps collected during different seasons of the year. The GLOBE website (Resources) provides daily student-generated weather maps, including isotherms, that can be compared and contrasted with the official results.

Older students can research the seasonal impact of arctic and tropical air masses on U.S. weather. What role does the jet stream play in influencing regional temperatures?

Suggested URLs

http://www.usatoday.com/weather/basemaps/wcity1.htm
USA TODAY national map, by city, for the forecast data.

http://www.comet.ucar.edu/dstreme/images/sfc_temp.gif
The AMS Project DataStreme Isotherm and Temperature map

http://www.coe.usouthal.edu/oar/html/forecasting.html
NOAA/OAR page for students on weather forecasting

http://www.cotf.edu/ete/modules/weathernot/weathernot.html
Classroom of the Future

http://ww2010.atmos.uiuc.edu/(Gh)/guides/crclm/act/ftmp.rxml
Interactive activity challenging students to predict the effect different factors will have on temperature.