

# INTRODUCTION TO DRAWING ISOPLETHS

## STUDENT EXPECTATIONS

Upon completion of this unit, students will be expected to know:

1. How to recognize changes in weather patterns based on analyzed data.
2. How to analyze weather maps by drawing isopleths.
3. How to draw isopleths using raw data.
4. How isopleth information can be used in forecasting weather changes.
5. How significant weather changes can change their lives and the lives of those around them to include crops, livestock, and wildlife.
6. Students should be given an understanding of how significant weather patterns can affect even migration habits of wildlife including insects, and even sometimes the transfer of diseases.

## STATE STANDARDS:

The following **Colorado** Model Content Standards for Science will be met or exceeded: (Unless otherwise noted, the standards for grades 5 through 8 are used.)

Standard 1, 2.1, 2.2, 3.1, 3.3, 4.1,4.2, 5, 6,

The following **Texas** Essential Knowledge and Skills for Science will be met or exceeded: (Unless otherwise noted, the TEKS for Middle School Science are used.)

TEKS 6.1A,B, 6.2A,C,D,E 6.3A,B,C,D 6.4A,B, 6.9A, 7.1A,B,  
7.2A,B,C,D,E, 7.3A,C,D, 7.4A,B, 7.12C, 7.14A,B, 8.1A,B,  
8.2A,B,C,D,E 8.3A,C,D,E, 8.4A,B, 8.5A,B,C, 8.10B, 8.12B

**Other standards from other specific subject areas and grade levels are also covered.**

**Isopleths** are simply lines that connect measurements of equal value. They may be isopleths of equal temperature (isotherms), pressure (isobars), altitude or almost any other measurement

including precipitation and snow cover. In short, they graphically represent a constant measurement or value.

A change in the measured value represents a gradient. When the isopleths are close together, a large change takes place and the gradient is said to be large. This could represent a significant change in weather over a small area, a steep slope on a topographic map, or a large difference in precipitation amounts. Isopleths spread out indicate a small change and the gradient would be small, so would represent a gradual slope, or small weather-related change.

Large pressure and temperature gradients represent dramatic, sometimes dangerous changes in the weather, so meteorologists are very concerned with how the isopleth patterns and contours shape up each day.

Drawing isopleths on a map may be somewhat confusing, challenging, and difficult at first, but with practice, one can become good at it and actually enjoy studying the changes and analysis of a map; it can be quite satisfying to solve the daily weather puzzle.

The following guidelines will help you get started:

1. No isopleth lines will ever cross each other.
2. Isopleth lines form curved lines not corners.
3. Estimates must be made between point values. (Example 66 is closer to 70 than 60, so you must adjust where you draw your line.)

# ISOPLETH ACTIVITY 1

## SNOW CONFETTI

### Activity Description

In this activity, be flexible. You can have students work individually, or in groups up to 4 students. It will give them an idea of how variable rainfall amounts are by using colored confetti. Each individual or team will draw isopleths based on how many pieces of "confetti snow" land in their cup and the cups of the other groups/individuals. It should be explained to students that precipitation patterns affect where people live, build their homes, what different animals live in different climates and environments with different precipitation amounts, and how a sudden downpour or severe snow event can affect the lives of both people and wildlife.

### MATERIALS

1. A substantial amount of different colors of paper confetti (confetti snow) which may simply be small pieces of colored construction paper.
2. Paper cup for each group/individual placed in a grid. (For instance if you have 12 students make a grid of cups of 3 cups by 4 cups, or 25 students, make it 5 by 5, etc.)
3. Grid paper marked off similar to the cup grid you have made.
4. PENCIL and eraser.
5. Colored pencils (optional).

### METHODS

1. Place the cups in the grid on the floor. (See examples below.)

```
  O O O O
  O O O O
  O O O O
  (3 X 4 GRID
  FOR 12 STUDENTS)
```

```
  O O O O O
  O O O O O
  O O O O O
  O O O O O
  O O O O O
  (5 X 5 GRID
  FOR 25 STUDENTS)
```

2. Scatter the "confetti snow" all over the grid randomly.
3. Have the students count the pieces of confetti in their cup and write that number on their grid paper where their cup was. They will also need to share with the other students/groups what their count was in order for each group to complete their grid paper. One idea would be to put a sample grid on the board or overhead and write in it for them to copy.
4. Have the students color the grid points with equal numbers a certain color. (For instance, all the 5's are red, the 4's are green, etc.)
5. Have the students connect the grid points of equal values with each other in smooth lines.
6. (Optional) have the students color in areas of equal value over the entire grid paper, much like a weather map with areas of equal precipitation.
7. For the students more gifted in art, you might want them to shade from light to dark.

## **CONCLUSIONS**

Just like the "snow confetti", precipitation patterns may seem very random over an area. We have all heard of heavy rain on one side of the road and a sprinkle on the other, or a severe hail storm on one side of town with tremendous damage, and no hail on the other side of town.

It is important that when we build a home, we make certain that it is above a flood plain, or if we purchase a farm that it is not likely to be washed away the next time we have a downpour. It is equally as important to our wildlife that they build their homes accordingly. Students should be aware of this, and what happens when unusual precipitation occurrences happen.

## **ISOPLETH ACTIVITY 2 TODAY'S ISOTHERM PATTERN**

In this activity, students will learn to draw isotherms using a current weather map with temperatures. They will begin to understand how weather patterns form according to temperature gradients, and how to analyze where a cold front or warm front may be located. It may work best if the students work in groups of two, but depending on the class, it may be better to work individually.

Temperature patterns affect the lives of almost every living organism and the economy of each area and should be discussed when doing this activity.

### **MATERIALS**

1. Colored pencils
2. Copy of today's temperature map from <http://dstreme.comet.ucar.edu/images/sfctemp.gif>  
(The answer key if you decide to use it is at [http://dstreme.comet.ucar.edu/images/sfc\\_temp.gif](http://dstreme.comet.ucar.edu/images/sfc_temp.gif) ), however, sometimes their computer makes small goofs.

### **METHODS**

1. Select different colors for temperatures that have the same first digit. (Examples: all the 50's are green 60's are blue-green, 70's blue etc.)
2. Put a colored dot at each station that matches the proper color for that station's temperature.
3. Draw isopleths at 10 degree intervals (gradients) based on the different colors. (Always use a pencil and have an eraser when first drawing isopleths. You can go over your lines with a dark pen when you have satisfactorily finished.)
4. Color in each of the gradients with the corresponding colors. (Artistic students shade from light to dark. Example: low 50's would be light green, high 50's dark green. It makes a very attractive map!)
5. Analyze the gradients. If there is a large gradient, there is a significant change in the weather over a small area. This would

- indicate a cold or warm front. (Go to [http://dstreme.comet.ucar.edu/images/sfc\\_adv.gif](http://dstreme.comet.ucar.edu/images/sfc_adv.gif) to find where the fronts are for today.
6. Never be upset if your analysis is not exactly the same as another's!

## **CONCLUSIONS**

Temperature patterns are very important for most of us. They can help us decide what to wear tomorrow, or possibly help a foreman decide if he will send his construction crew out tomorrow. These and other ideas should be discussed after the students have completed their maps successfully.

## **ISOPLETH ACTIVITY 3 DRAWING TODAY'S ISOBARS**

Isobars are lines of equal barometric pressure. They are valuable to the meteorologist in determining many factors of a weather forecast such as wind speed and wind direction. The larger the pressure gradient, the faster the wind will blow, and it will always blow from areas of high pressure to areas of low pressure. This is a bit more challenging. Have patience with yourself and students!

### **MATERIALS**

1. Today's weather map indicating pressures from <http://dstreme.comet.ucar.edu/images/sfcppres.gif> the answer key is at [http://dstreme.comet.ucar.edu/images/sfc\\_pres.gif](http://dstreme.comet.ucar.edu/images/sfc_pres.gif)
2. Colored pencils

### **METHODS**

1. Have the students start with a pressure of 1012, and highlight all pressures between 1012 and 1015 orange, pressures 1016 and above red, pressures between 1008 and 1011 yellow, pressures between 1004 and 1007 blue, and pressures below 1004 green.
2. Have the students make isobar lines of 1004, 1008, 1012, and 1016.
3. Have the students determine where the large and small pressure gradients are.

### **CONCLUSIONS**

Large pressure gradients (large change/small area) are usually indicators of unsettled and stormy weather.

Small pressure gradients (small or no change/large area) are usually indicators of fair or nice weather.

Look at today's weather map and see where the stormy and calm weather are and compare it to your maps.

You may want to discuss with your class how the behavior of animals (even students) seems to change with the change of a pressure system.



## **ISOPLETH ACTIVITY 4 ANALYZING PRECIPITATION PATTERNS**

### **DISCUSSION**

Now that your students are showing an understanding of drawing isopleths, a nice challenge is to analyze precipitation patterns using CoCoRaHS maps. These patterns can be very important to farmers, construction sites, schools, and the list would be never ending. The patterns indicate where flooding is or may be occurring downstream, where mosquito populations will increase, what schools will take a snow day, what crops will be destroyed, where mudslides will happen, and once again, the list goes on.

Depending on the time of year, geographic location etc, precipitation patterns will many times be very random and unpredictable, while at other times of the year, they may be very general. In areas just east of the Rockies, precipitation patterns present a special problem for forecasters because of their unpredictability and sudden changes that sometimes can lead to disaster. (Copy the article located at [www.cocorahs.org/pdfs/Coco4pg.pdf](http://www.cocorahs.org/pdfs/Coco4pg.pdf) and make it available to students. You may want the students to read the article aloud in class.)

Find a CoCoRaHS archived map for precipitation, hail, or snowfall and have students draw isopleths according to them and give possible conclusions of the results and consequences of such a weather event.