

# Mapping Data 2: Choropleth Mapping Strategies

OVERVIEW & OBJECTIVES	GRADES
<p>Students will examine three choropleth mapping strategies and compare and contrast the resulting maps. Students will understand the importance of recognizing patterns on the map as well as recognizing the strategy used by the mapmaker. The lesson assumes data on U.S. states, but data at a local, national, or global scale may be used. Students should be familiar with choropleth mapping as presented in the lesson, “Mapping Data: Constructing a Choropleth Map”.</p> <p><i>Students will be able to...</i></p> <ul style="list-style-type: none"> <li>• Acquire skills in data based mapping</li> <li>• Recognize patterns of distribution</li> <li>• Explain the concept of region</li> <li>• Analyze multiple strategies used to map data</li> </ul>	8 <sup>th</sup> and 9 <sup>th</sup>
	<b>TIME</b>
	2 classes
	<p style="text-align: center;"><b>REQUIRED MATERIALS</b></p> <ul style="list-style-type: none"> <li>✓ Blank maps of United States</li> <li>✓ Colored pencils</li> <li>✓ Atlases</li> <li>✓ List of data (from U.S. Census Bureau, CIA World Factbook, Population Reference Bureau, others)</li> <li>✓ Handout: “Choropleth Mapping Strategies”</li> <li>✓ Computer access for students (optional)</li> <li>✓ Graph paper (optional)</li> </ul>
MINNESOTA SOCIAL STUDIES STANDARDS & BENCHMARKS	
<p>8<sup>th</sup> Grade  <b>Standard 1.</b> People use geographic representations and geospatial technologies to acquire, process and report information within a spatial context.  <b>8.3.1.1.2</b> Create and use various kinds of maps, including overlaying thematic maps, of places in the world; incorporate the “TODALSS” map basics, as well as points, lines and colored areas to display spatial information</p> <p>9<sup>th</sup> Grade  <b>Standard 1.</b> People use geographic representations and geospatial technologies to acquire, process and report information within a spatial context.  <b>9.3.1.1.1</b> Create tables, graphs, charts, diagrams and various kinds of maps including symbol, dot and choropleth maps to depict the geographic implications of current world events or to solve geographic problems.</p>	

## SUGGESTED PROCEDURE

### Preparation:

The teacher will gather data and appropriate blank maps. Students will be mapping the same data. [Note: Consider the following categories found at the U.S. Census Bureau to identify specific topics: Population, Income, Births and Deaths, Labor Force, Education, Law Enforcement, Health and Nutrition, Elections, Agriculture.] States could be analyzed at the county or metropolitan level as well. Global data might include Infant Mortality Rate, Number of Physicians, and Number of Primary Schools.

### Opening:

Begin by showing students a list of data and discuss what the data seems to indicate. Next, show them the same data mapped and discuss what they notice. Ask students: Does this map seem to indicate any

patterns? Could we map the same data differently? Would the resulting map be different? What other data would you like to see mapped?

Students can understand how using different map-making strategies affect results using examples of the U.S. Presidential election and electoral votes. "Maps of the 2012 U.S. Presidential Election Results" is available at <http://www-personal.umich.edu/~mejn/election/2012/>

### **Development:**

The teacher will give students the handout, "Choropleth Mapping Strategies", and a list of data to be mapped. Note that providing a list of data in graduated order would be easier for younger students to use. Students will map the data using the directions provided on the handout. They will title their map and provide a legend and source. Students will share their maps by posting them and comparing their maps with their classmates' maps. Ask students: What regions were identified on your classmates' maps? What regions were similar? What regions were different?

The teacher will begin by reviewing the handout, "Choropleth Mapping Strategies" with students. Next, organize students into three groups so that each group will follow the directions for a different mapping strategy. You may also subdivide the three groups with directions for each subgroup to use a different number of groups (3, 4, 5 and 6). Students will work through their strategy to map the data.

### **Closing:**

Compare the resulting maps and discuss the importance of understanding the legend and the power of the cartographer to convey information. Students will discuss their findings as a class focusing on the process of choropleth mapping and why knowing how data is mapped is important. Preliminary questions may include: What patterns of the mapped data can you identify? How did making the maps help you understand the patterns? How does mapping the data help you to analyze it? Are regions or patterns of places important to recognize?

Further questions include: How did the strategy you used to construct your choropleth map affect the map's appearance and understanding of the map? How did a different strategy give a different map? Was one strategy "better" than another strategy? How did a different number of groups give a different map? Were a particular number of groups "better" than another? What problems are there when mapping data? What responsibilities does the cartographer have when mapping data? What do you need to do when reading a map?

Students may be asked to write a brief analysis of mapmaking, explaining how the choices cartographers make to map data influences the presentation and understanding of the data mapped.

### **Extensions**

1. Students construct their map using a paint or draw program on the computer. Students use colors or shading in the same manner as described in the handout. Students then examine their individual maps. They compare maps by printing their maps or posting them to a common site in order to analyze the map strategies.
2. Students generate their own data and map it. Topics might include: What state in the U.S. would you most like to visit? (Students are surveyed and responses compiled.) What states have professional sports teams? (Students include numbers of sports teams per state.)
3. Students will investigate examples of maps that show bias by the cartographer in the map strategy or groupings used. Students will find that maps of controversial topics are particularly useful for examining the influence of the cartographer.

### **Assessment**

- Map data accurately
- Class discussion

## Website Resources

“Maps of the 2012 U.S. Presidential Election Results” by Mark Newman at University of Michigan

<http://www-personal.umich.edu/~mejn/election/2012/>

This site provides maps of 2012 election mapped differently

U.S. Census Bureau

<http://www.census.gov/>

Provides data for states

CIA World Factbook

<https://www.cia.gov/library/publications/the-world-factbook/>

Provides data for countries

Population Reference Bureau

<http://www.prb.org/>

Provides data for countries

“Geography 353 Cartography and Visualization” from J. B. Krygier at Ohio Wesleyan University

[http://go.owu.edu/~jbkrygie/krygier\\_html/geog\\_353/geog\\_353\\_lo/geog\\_353\\_lo08.html](http://go.owu.edu/~jbkrygie/krygier_html/geog_353/geog_353_lo/geog_353_lo08.html)

This link provides a brief overview of Map Symbolization that would be helpful to teachers before teaching this lesson.

“Census Data and Thematic Maps” at Penn State University

<https://www.e-education.psu.edu/natureofgeoinfo/book/export/html/1553>

This link provides an overview of mapping and mapping strategies that would be helpful to teachers before teaching this lesson.

“Courtney’s Cartography” at Courtney Roden’s Webpage

<http://www.geocities.ws/croden256/energyconmap.htm>

This link clearly shows choropleth mapping strategies using U.S. Total Energy Consumption, 1999

# Choropleth Mapping Strategies

Choropleth maps reveal patterns in data by showing relationships based on the spatial distribution of data. Given data from different places, cartographers construct a choropleth map to show patterns and possible relationships. To make a choropleth map, the cartographer gathers data for an area. Next, the cartographer groups the data and classifies each group, usually by ranking the data from very high to very low in distinct categories that do not overlap. A color is attached to each group with the darkest color shade indicating dense and the lightest color shade indicating sparse. Of course, a key is needed to show what the colors mean. The cartographer then colors the map, shading each group from highest to lowest. The completed map is examined for patterns that become spatially visible. Through map analysis hypotheses about the topic can be made and tested.

Although cartographers have standardized methods of mapping, the grouping of data varies according to the strategies the cartographer chooses. The groups provide patterns that are not visible with the listing of individual data; in fact, individual data is usually lost on a choropleth map. Thus, the groups that the cartographer chooses to use are vitally important.

- The number of groups will skew the data. The cartographer may select few or many groups that would provide less or more detail.
- The borders of groups will skew the data depending on the strategy used (determined by natural breaks in data versus equal groups versus absolute number within each group)

## **Choropleth Mapping Strategies:**

Three different choropleth strategies are summarized and examples are provided. For each of the examples, the data is assumed to total fifteen. Three groups are used instead of four or five for ease in providing the examples.

### **Natural Breaks Method:**

Given a set of data, place the individual numbers on a graph. Identify the clusters of data and the "breaks" in the data where spaces are found and groups could be formed. The number of groups (3-6) is determined by the graphed data and by the cartographer.

Example: The 3 groups could be: 1-6, 8-11, 13-15 assuming "breaks" occur after 6 and 11

### **Equal Groups Method (also called Equal Intervals Method):**

Given a set of data, identify the highest and lowest number and subtract the two to determine the difference or "range". Then identify the number of desired groups (3-6). Divide the "range" by the number of groups. That number becomes the difference between each of the groups.

Example: The 3 groups could be: 3-4, 5-8, 9-14 if the range between the highest and lowest number was 12

### **Equal Quantities Method:**

Given a set of data, identify the total number of individual pieces of data. Then identify the number of desired groups (3-6). Divide the individual pieces of data by the number of groups so that each group has the same number of individual pieces of data.

Example: The 3 groups could be: 3-7, 8-10, 11-14 if each group has the same number of data

### **Procedure for Natural Breaks Method:**

1. Plot the data points on the graph sections. The graph area is divided into 100 units with major marks or divisions every 10. Just above the graph section write the numbers for the divisions: 0, 10, 20, 30, etc. or 0, 5, 10, 15, etc. or whatever works best.
2. Use Xs to mark the data points on the graph sections.

3. When you have placed all the Xs on your graph, look at it to see if any patterns are visible. If so, you may use these natural breaks to determine your categories. If there are no clear natural groupings, you will need to decide arbitrary boundaries for categories. Break the data into 4-5 categories: very high, high, medium, low, and very low. Be sure to record the limits for each category because this will become your Legend. Determine the colors or shading that you will use for each category to produce graduated colors. Remember that dark is more; light is less. Remember that the goal of this strategy is to use naturally occurring divisions or “breaks” in the data.
4. Sort the list of data to identify its color by labeling each data with its category or color.
5. Color the map using the Legend that you created as a guide. Atlases may be used.
6. Title the map and include the Legend and Source of the data.

You are now ready to analyze your map.

#### **Procedure for Equal Groups Method:**

1. Find the range of your data. Look at your list of data and identify the highest and lowest value (or highest and lowest number). Subtract these 2 numbers and you will have the range that the data numbers fall within.
2. Determine your categories for the map. Divide that number (the range) by the number of categories that you plan to use. Usually the number of categories is 4 or 5.
3. Determine the colors or shading that you will use for each category to produce graduated colors. Remember that dark is more; light is less. Complete the Legend on your map. Remember that the goal of this strategy is to group data from the lowest to highest without including numbers at the low and high ends that contain no data.
4. Sort the list of data to identify its color by labeling each data with its category or color.
5. Color the map using the Legend that you created as a guide. Atlases may be used.
6. Title the map and include the Legend and Source of the data.

You are now ready to analyze your map.

#### **Procedure for Equal Quantities Method:**

1. Identify the total number of data that you will map. Divide that number by the number of categories you will use. Usually the number of categories is 4 or 5. This final number is the one you will use to make your map.
2. Determine the colors or shading that you will use for each category to produce graduated colors. Remember that dark is more; light is less. Complete the Legend on your map. Remember that the goal of this strategy is to group data so the same number of data is found in each group.
3. Sort the list of data to identify its color by labeling each data with its category or color. Use the final number from step #1 to count the number of data for each category.
4. Color the map using the Legend that you created as a guide. Atlases may be used.
5. Title the map and include the Legend and Source of the data.

You are now ready to analyze your map.