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Using Cartograms to Explore the Electoral College: Comparing 1908 with 2008

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Teaching government to middle school students can be a tricky proposition. In general, our experience has been that students do not find the concepts very interesting and tend to perceive government—particularly at the federal level—as a distant, impersonal, monolithic institution that their parents occasionally complain about, but otherwise has little impact on their lives. A unit of study on government is also typically taught as an isolated topic that is not integrated into other content areas in a meaningful way.

The activity presented here involves creating and interpreting cartograms as a means of learning how the Electoral College functions and how the composition of that body has changed over time—reflecting changes in the nation's population distribution. It's a lesson on government that is integrated with the study of history, geography, and mathematics. It also engages students in critical thinking and creative problem solving.

The Electoral College

To be sure, the Electoral College is just one element of a well-conceived unit of study on the presidency or the U.S. Constitution. Nevertheless, it's essential that students understand how presidential elections are decided.

Briefly, each state is allocated one vote—an *elector*—for each senator and representative in the U.S. Congress. (Under the Twenty-third Amendment, Washington D.C. is allocated three electors.) California, for example, currently has 55 electoral votes; the state has two Senators and 53 Representatives. Seven states have just three electoral votes. The allocation of electors changes every ten years when the census is taken and seats in the House are reapportioned to reflect population changes that have occurred over the previous decade.[1]

The electors pledge to cast their electoral votes to reflect the popular vote within their state. But there is a catch: each state legislature determines exactly how its electors will be "appointed." Currently, 48 states and the District of Columbia are "winner-takes-all" states, meaning that the presidential candidate who wins the popular vote in that state is awarded *all* of that state's electoral votes.

Nebraska and Maine are the only exceptions: two electoral votes are awarded to the presidential candidate who wins the popular vote statewide and the others go to the winner of the popular vote within each congressional district. Before the 2008 presidential election, neither Maine nor Nebraska had ever split their electoral votes, but in that year, four electors in Nebraska were awarded to John McCain, while the final electoral vote (representing metropolitan Omaha) went to Barack Obama.

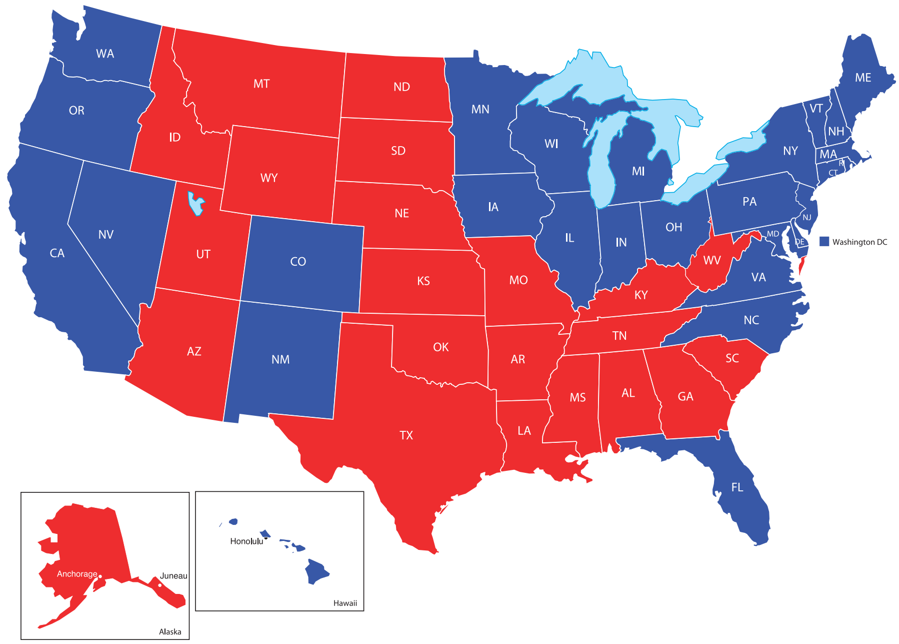
The relationship between the popular vote and electoral votes within each state is critically important to the outcome of presidential elections. For example, George W. Bush narrowly won the 2000 election, with 271 electoral votes to Al Gore's 266 (with one elector abstaining in the official tally). The election was noteworthy for problems in the swing state of Florida. In the weeks following Election Day, it was not clear how that state's electors (winner take all) would be assigned. Ultimately, a U.S. Supreme Court ruling on December 12, 2000 (to halt a recount of the vote) was favorable to Bush.

Al Gore won the national popular vote by more than 500,000, but failed to win the presidency by 6 votes in the Electoral College. Florida has 25 electors. In presidential elections, it is the electoral votes that really matter.

Inventing Cartograms

Cartograms can be a valuable tool in comparing the relative importance of each state to the outcome of the election.

Figure 1. **Who Won?**



The term *cartogram* may not be entirely familiar to some middle school social studies teachers, but they have undoubtedly seen dozens of these "data maps."[2] Newspapers, popular news magazines and social studies books frequently feature cartograms because they are so effective in visually representing data sets for social, economic, and political phenomena.

A *cartogram* is a map that illustrates a set of statistical data, often with the use of shading, color, or dots. What's fun about cartograms is that the mapmaker can choose to *distort* usual map features—like shape and size—to make a point about the statistics. For example, in a value-by-area map, geographic regions are enlarged or reduced in proportion to the data from each region. The trick is to preserve shapes and spatial relationships as much as possible so that the viewer can recognize familiar political boundaries, but also understand the distribution of a measurement, such as size of population.

Value-by-area cartograms appeared in the 1920s and 1930s. In the United States, some of the earliest cartograms were a series produced by Erwin Raisz in 1934, illustrating regional differences in population, distribution of wealth, manufacturing activity, mineral deposits, and oil production.[3]

Displaying Election Results

For an activity involving changes in the Electoral College, sixth grade teacher Kurk Aegerter began by putting a map of the United States on the document projector (**FIGURE 1**). He told his students that the map showed the results of a presidential election, but did not say which one. (This map, a standard, outline map of the United States, shows the results of the 2008 election, with John McCain's victories colored red, and states that Barack Obama carried in blue.)

After giving the students only half a minute to look at the map, Kurk asked students to guess who won the election. The class split roughly into thirds: one-third saying the blue candidate, one-third the red candidate, and one-third maintaining it was too close to say.

Some uncertainty was understandable, since the map is ambiguous. If you just look at the color, it would appear that the red candidate was the victor. The red candidate won many of the largest states *in terms of land area*, so the map gives the impression that the red candidate won. But many of these red states are also relatively small *in terms of population*.

If you carefully count the states by color, the map reveals that the red candidate won 22 states, while the blue candidate won 28 states and the District of Columbia. That count, however, does still not provide a conclusive answer.

A discussion ensued in the classroom. A few students mentioned that the size of a state in area was not as important as its size in terms of population, and a few students connected that concept to the Electoral College. The debate continued for a time with students shifting from one position to another, but it was clear that most students did not have a firm opinion on who won the election. A better visual answer, Mr. Aegerter suggested, might be found if we produce cartograms of the Electoral College results. And to make matters really interesting, the class would compare this election with one that took place exactly 100 years earlier, just to see what might be learned from the exercise.

A Creative Challenge

Each student began with a couple of pieces of graph paper with a one-centimeter grid, an outline map of the United States with each state identified (AL = Alabama, etc.), and a table showing the Electoral College as it stood on the eve of the elections in 1908 and in 2008 (**FIGURE 2,** page 5**)**. Half of Mr. Aegerter's class worked on creating cartograms for the 1908 presidential election (in which William H. Taft was victorious over William J. Bryan), and the other half produced cartograms for the 2008 election.

Using a scale of one square centimeter equals one electoral vote; students began penciling in rough shapes for the states on their cartograms. (See the **SIDEBAR** "Creating Cartograms from Scratch," page 5) In Kurk's class, almost every student began on the west coast and worked eastward. It seems that students could better deal with more irregular shapes of the eastern states once they had some practice with simpler shapes like those of California and Colorado. A handful of students began in the middle of the country and worked their way out toward the coasts.

Over three 50-minute class periods, each student produced a unique cartogram that captured the composition of the Electoral College and, with varying degrees of success, preserved the shapes of and spatial relationships between states. Students then traced their cartograms onto large sheets of white paper. Finally they color-coded the maps to illustrate the results of the 1908 or 2008 election.[4]

Although the process of hand drawing a cartogram is somewhat time consuming (involving a great deal of trial-and-error sketching, drawing and erasing of borders, and counting of grid squares), it is also a valuable exercise in spatial reasoning and problem solving. Most important, the finished cartograms provided a clear illustration of the weight of each state in the Electoral College. Comparing the 1908 cartogram with the 2008 cartogram also revealed how the composition of the Electoral College has changed over time (**FIGURE 3,** page 6).

Looking at Elections

With the use of the cartograms that they created, students could identify particular features of the map or recognize changes that occur over time. For example, when viewing the 1908 and 2008 Electoral College cartograms, one could first identify states that are represented as larger or smaller in size than they appear on a land-area map.

Second, one could see whether Republicans or Democrats won in 1908 in various states or regions of the country as compared with the results in 2008. Mr. Aegerter asked the students to analyze the 2008 cartogram to uncover some generalizations about voting patterns. Students quickly noticed that John McCain won only a handful of states worth ten or more electoral votes. At that point, Mr. Aegerter provided students with a table

that broke down each state's population into urban and rural residents.[5] He asked students to compare those data with their cartograms. In short order, students recognized that, with some exceptions, McCain clearly ran better in more rural states, while Obama was stronger in more urban states.

Third, one could look at states that gained or lost the most electoral votes between 1908 and 2008, reflecting population migration over the 20th century. Finally, one can investigate factors that may have produced the changes represented in the maps—to ask questions about cause and effect. In short, the tremendous educational value of cartograms lies in engaging students in looking beyond the data incorporated in the map and uncovering a richer and more nuanced understanding of how the phenomena depicted in the map came to be.

Looking at Demographics

The cartograms illustrating changes in the composition of the Electoral College are quite telling in terms of how the political landscape in this country has shifted over the past 100 years. They hint at the massive demographic shift from northeastern and midwestern states to southern and western states. Clearly, the largest gains in the Electoral College between the 1908 and 2008 elections have come in the South and West, while the states of the Midwest and East have lost electoral votes.

This result is not due to simple population losses in the Midwest and East. Every state added population between the 1900 and 2000 censuses. Rather, what the cartograms illustrate is *relative* growth: how rapid population growth has been in the "Sunbelt" in relation to growth in the "Rustbelt" (Also note that four western states—Arizona, New Mexico, Alaska and Hawaii—were added to the Union between 1912 and 1959, while the District of Columbia first cast its three electoral votes in the 1964 election.)

These cartograms of Electoral College data have a useful aspect for teachers. Of course, one could show maps of U.S. population in 1908 and 2008, but the numbers are large—in the tens and hundreds of millions. The number of electors for the whole nation, however, is small—currently 538—which is an easier number for students to contemplate than, say, 300,000,000, which is approximately the population of the United States today. Working with the distribution of electors across the states in 1908 and 2008 emphasized the concept of *relative* size.[6]

Inquiring about Causation

Of course, there are a number of factors involved in producing the demographic shifts of the 20th century. The decline of

continued on page 7

Creating Cartograms from Scratch

Determining Scale

Creating cartograms as a classroom activity can be engaging and challenging. It involves some data analysis, spatial reasoning, critical thinking, and creative problem solving.

To make a value-by-area cartogram, begin with a data set, a map, and graph paper. Looking at the data, one has to make decisions regarding what an appropriate scale might be in order to capture the information on the graph paper. In other words, think about how many squares on the graph paper will equal a particular value in the data set. Can the biggest number be represented by squares on the map, or will it overflow? Will the smallest datum be represented by at least one square? For example, if we are looking at population data, should a square centimeter equal 100,000, or one million, or one billion people?

Proportion and Shape

Once one has determined the scale to use, convert each datum (i.e., measurement) into a proportional number of squares. On a cartogram about a presidential election, New York, which had 31 electoral votes in 2008, would be drawn with 31 squares (Scale: one square centimeter equals one electoral vote). Constructing the cartogram then becomes a matter of systematically counting squares and penciling in the borders for each country or state on the map.

In determining how to draw state boundaries, personal judgment comes into play. The completed map should, as much as possible, honor the shapes and spatial orientation of the countries or states included, as well as depict the spatial relationships between regions: Texas should have a "Texas-like" shape, and California should share borders with Oregon, Nevada, and Arizona. But there is no perfect way to draw a value-by-area cartogram. Each student must find his or her own way.

Telling a Story

In the end, a completed cartogram should look like a map, albeit one that has numerous and often profound distortions. The quirky and pixelated shapes of the states might be funny, but they are also useful—they can tell us about the statistics represented, and they can inspire interesting questions.

Figure 2. **U.S. Electoral College in 1908 and 2008**

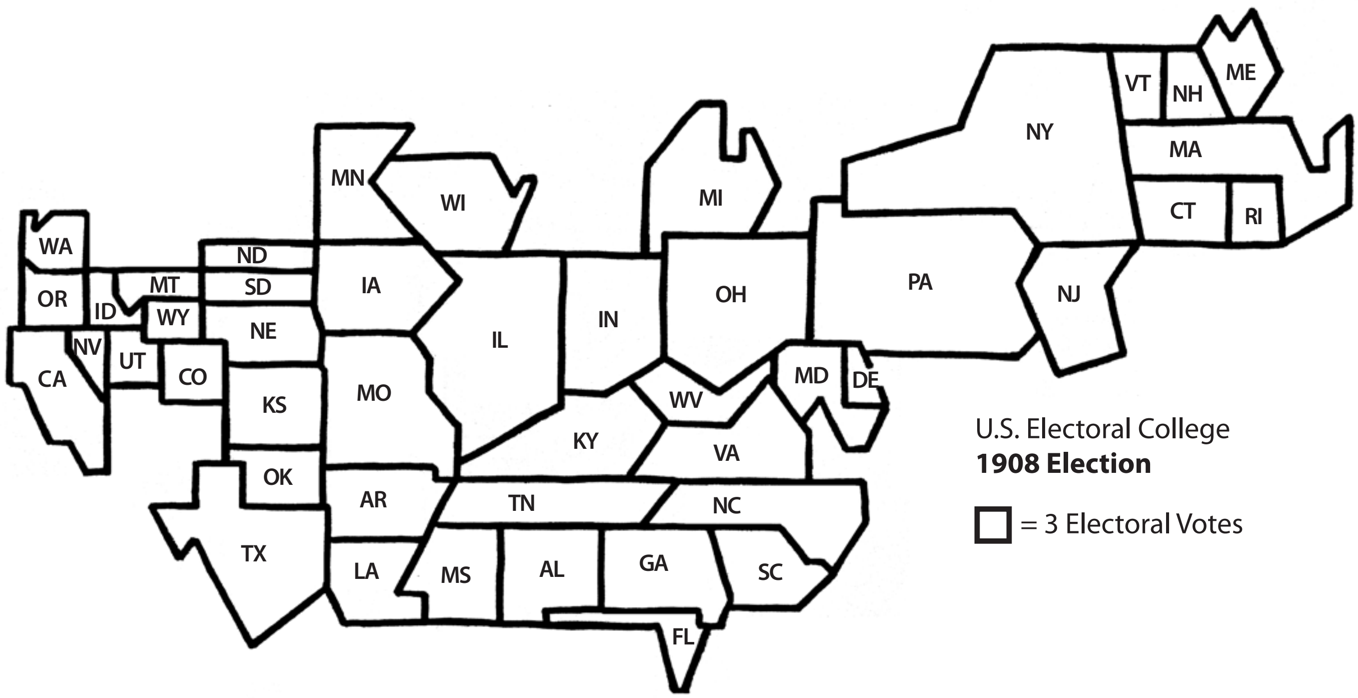
State	1908	2008	Difference
Alabama	11	9	-2
Alaska*	0	3	+3
Arizona*	0	10	+10
Arkansas	9	6	-3
California	10	55	+45
Colorado	5	9	+4
Connecticut	7	7	0
Delaware	3	3	0
Dist. of Columbia**	0	3	+3
Florida	5	27	+22
Georgia	13	15	+2
Hawaii*	0	4	+4
Idaho	3	4	+1
Illinois	27	21	-6
Indiana	15	11	-4
Iowa	13	7	-6
Kansas	10	6	-4
Kentucky	13	8	-5
Louisiana	9	9	0
Maine	6	4	-2
Maryland	8	10	+2
Massachusetts	16	12	-4
Michigan	14	17	+3
Minnesota	11	10	-1
Mississippi	10	6	-4
Missouri	18	11	-7
Montana	3	3	0
Nebraska	8	5	-3
Nevada	3	5	+2
New Hampshire	4	4	0
New Jersey	12	15	+3
New Mexico*	0	5	+5
New York	39	31	-8
North Carolina	12	15	+3
North Dakota	4	3	-1
Ohio	23	20	-3
Oklahoma	7	7	0
Oregon	4	7	+3
Pennsylvania	34	21	-13
Rhode Island	4	4	0
South Carolina	9	8	-1
South Dakota	4	3	-1
Tennessee	12	11	-1
Texas	18	34	+16
Utah	3	5	+2
Vermont	4	3	-1
Virginia	12	13	+1
Washington	5	11	+6
West Virginia	7	5	-2
Wisconsin	13	10	-3
Wyoming	3	3	0
TOTALS	483	538	+55

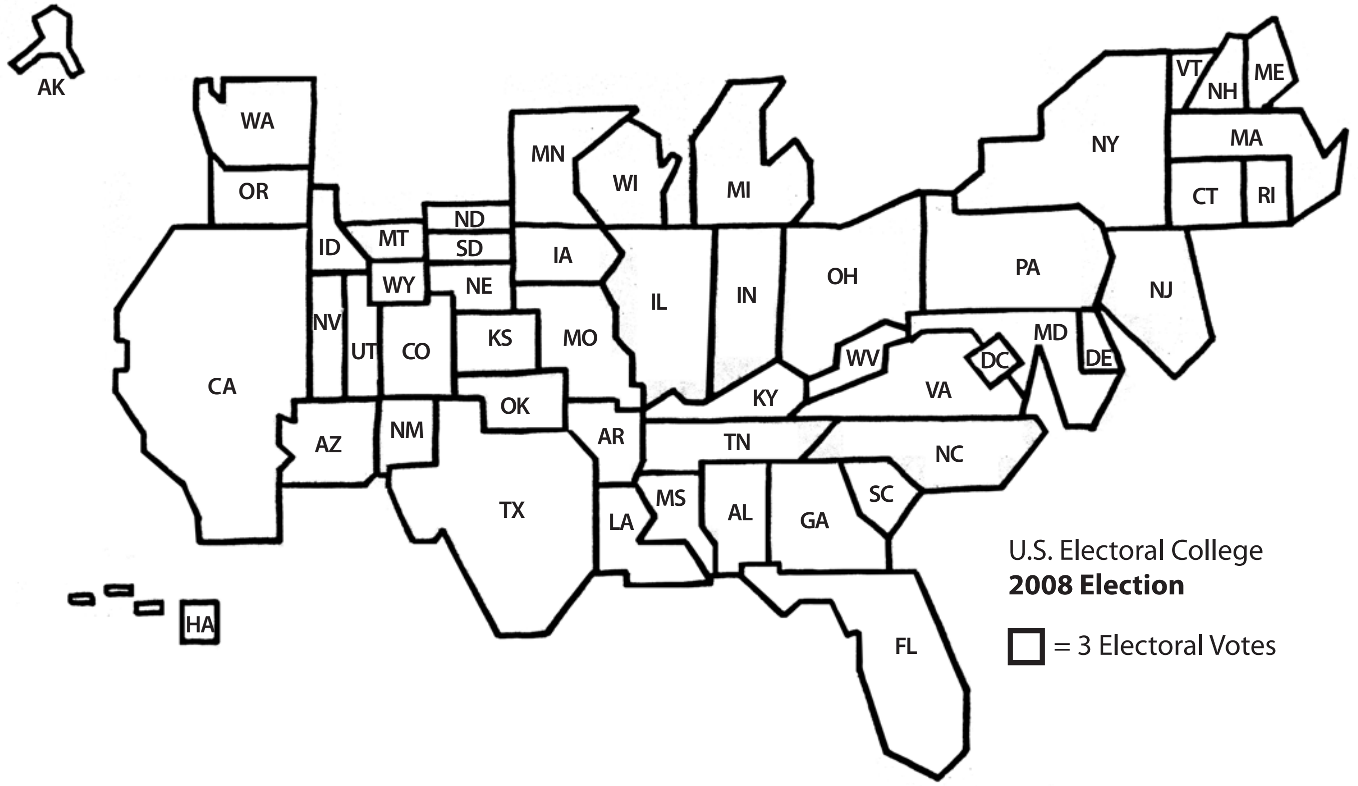
Notes for Figure 2

* Alaska, Arizona, Hawaii and New Mexico were not yet states in 1908.

** The District of Columbia was not included in the Electoral College until 1964.

Figure 3. **U.S. Electoral College Cartograms**





heavy industry and manufacturing in the Rustbelt along with the rise of large-scale farming in the Midwestern "Farmbelt" are important factors. The advent of lighter, more mobile manufacturing and technology-driven industries, as well as the growth of the service economy in the Sunbelt, also helped that region to grow.

A burgeoning population of retirees in the states of the South and West (many of whom moved from states with colder climates) is also an important factor in produce these demographic trends. Also; the Sunbelt states tend to draw huge numbers of recent immigrants: 27 percent of California's population is foreign born. In Texas, foreign born residents account for 10 percent of the population, and in Florida almost 9 percent.[7]

Students can explore additional factors that contribute to these changing population patterns. Water projects in the West (dams, irrigation systems, and man-made lakes constructed during the last century) are critical to supporting the growing cities and suburbs of the southwestern states and California, both in terms of delivering clean water and in generating electricity. Other subtle but important factors, such as the mass production of air conditioning in the 1960s, were crucial to the growth of Florida and other southern states, where summer temperatures often hover above 90 degrees Fahrengeit.

Thus, in analyzing demographic shifts, we find that historical, social, cultural, and economic factors, as well as public policy are involved. Such insights can be the culmination of a discussion that begins when students notice differences in cartograms that they have created themselves.

Applying New Knowledge

With these understandings, Mr. Aegerter's students were beginning to act like political scientists. They began speculating about what sorts of issues would be more important to a rural or an urban voter. To be sure, the class discussion did not cover

every issue that may have influenced how voters cast their ballots, but it did begin to cultivate in students a certain curiosity about voter behavior and American political culture. Moreover, the government unit had begun to explore some of the "real" issues and take on greater relevance for these future voters. Indeed, the students began thinking of themselves as participants in the democratic process who were capable of understanding the country's political landscape.

When comparing the standard map of the U.S (**FIGURE 1**) with one of the completed cartograms for the 2008 election (**FIGURE 3**, lower map), one student said, "It was hard to tell who won when looking at the regular map, but it is obvious on the cartogram." Noting that a cartogram could be useful in planning campaign strategy, another student commented, "If I were going to run for president, I'd rather have a cartogram. That would tell me which states I should worry the most about winning."

Notes

1. See teaching resources on the "U.S. Electoral College" at www.archives.gov/federal-register/electoral-college/index.html. For background, see Gary E. Bugh, *Electoral College Reform: Challenges and Possibilities* (Burlington, VT: Ashgate, in preparation); and George C. Edwards III, *Why the Electoral College is Bad for America* (New Haven, CT: Yale University Press, 2004).
2. Edward R. Tufte, *The Visual Display of Quantitative Information* (Cheshire, CT: Graphic Press, 1983): 16-27; A book full of cartograms is Dan Smith, *The Penguin State of the World Atlas, 8th ed.* (New York, Penguin, 2008).
3. Erwin Raisz, "The Rectangular Statistical Cartogram," *Geographical Review* 24, no. 2 (1934): 292-296.
4. The teacher gave handouts to students, charts of the Electoral College Results of 1908 and 2008, so that students could color each state on the map blue or red. Charts and maps (red v. blue Mercator) of historical electoral results are available at www.uselectionatlas.org.
5. The teacher gave a handout to students: U.S. Bureau of the Census, "Urban and Rural Population by State, 2000 Census," available as an Excel file at www.census.gov/compendia/statab/tables/09s0028.xls.
6. In the "Connect the Dots" lesson plan by Population Connection, students depict the U.S. population's growth and westward shift, www.populationeducation.org/docs/300millionlessons/dots.pdf.
7. U.S. Bureau of the Census, "Population by State and U.S. Citizenship Status with Percentages by State, 2003," Table 1.16a, available as an Excel file at www.census.gov/population/socdemo/foreign/TEO23/tab1-16a.xls.

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Maps, Representations of the Earth, and Biases

Peter C. Cormas

Displaying a single world map in the middle school classroom (often some version of a political map and a Mercator projection) has contributed to student misconceptions in geography and Earth science. Students may confuse common directional terms (up, down, right, and left) with cardinal directions (north, south, east, west); describe landmasses incorrectly (e.g., Greenland does not really have a greater area than South America, although it appears so on a Mercator map), and assert information gleaned from a map as if it were infallible and complete. The following interdisciplinary lesson is one that I've used while teaching geography and Earth science. The goal is to help students understand that:

a. Maps are not true representations of the Earth,
b. Different maps have different purposes, and
c. Maps are inherently biased.

This lesson, which is based on inquiry, addresses several social studies curriculum standards for the middle grades: **I CULTURE:** the learner will understand how people from different cultures develop different values and ways of interpreting experience; **III PEOPLE, PLACES, AND ENVIRONMENTS**: the learner will evaluate effects of spatial relationships on their own lives and the lives of others; and **VIII SCIENCE, TECHNOLOGY, AND SOCIETY**: the learner will understand that advancements in science and technology to solve a particular problem can have unanticipated consequences.[1]

Initial Question (10 minutes)
I begin the lesson with a question to assess prior knowledge: "How is a map different from a globe?" I ask students gather in groups of three to discuss this question and write their thoughts in their social studies notebooks (which they bring to every class). I move from group to group, monitoring the progress of these conversations.

After an appropriate amount of time (usually 5 to 10 minutes), I ask students for their educated guesses. I maintain a noncommittal attitude, not judging their responses or hinting whether a particular statement is correct. I may ask a few probing follow-up questions to determine whether students hold misconceptions or understand that maps are not true representations of the Earth. The answers to these questions will help me construct the questions I will ask later in the activity.

I set a globe on the front desk so all students can see it and inform the small groups that they will conduct an activity that deals with maps and globes. Then I pass out to each individual student a **HANDOUT** *Ways to Draw the World* (page 9). I ask the students to study the queries in the initial column of the chart ("What I notice right away about this map," etc.), to discuss possible responses to these queries in their small group, and then to write their ideas in the cells of the second column (which is blank) under the heading "Globe."

As the students work, I walk around the room, occasionally asking a probing question. For example, if a small group stalls while pondering "My guess at the uses of this map," I may ask, "Why does the globe have lines on it?"

After students respond to each query on the chart, they often look to me to tell them if they are correct. As difficult as it is, I do not indicate whether they have hit the center of the target, but stay patiently in the background of the discussion until all students have had a chance to participate in their small groups. My restraint may encourage students who are unsure of themselves to speak up.

Compare and Contrast (20 minutes)
I tell the students that I am going to pass out four maps, one at a time, and will ask them to compare the maps to the globe, and each other. As students compare each new graphic representation, questions will emerge. Since the lesson is inquiry-influenced, I do not provide answers or even present questions that easily guide students to correct answers. Rather, I listen to their explanations and ask questions that require further discussion or explanation: "How do you know you are right?" "What evidence do you have for that idea?" "Do all three of you (within a small group) agree with that conclusion?" "Why or why not?" Although I will eventually confirm the correct answers to questions that are factual, for the most part I allow the students to make predictions.

To begin the comparisons, I give each group a simple rendering of a Mercator projection world map. I ask the class to compare the map with the globe, and then to answer the appropriate queries, filling in the second blank column on their chart. If students have difficultly comparing the map with the globe, I may ask: "How are the map and globe similar, or how are they different? Do any landmasses look especially different on the map compared to the globe? Why does South America

Ways to Draw the World

Student Handout

Fill our as much of this chart as you can during class discussion. It's okay to write down your guesses and speculations. Save room in each square for facts that may be revealed toward the end of the lesson.

Name of This Map	***Globe***				
What I notice right away about this map					
What the map does well (accurately represents)					
What the map does poorly (distortions or bias)					
My guess at the uses of this map (Purpose of the map)					
Who created the map, where, and when					

look smaller than Greenland on the map, but larger on the globe? What might have been the purpose of creating a Mercator map?"

After five minutes, I pass out the Sinusoidal Equal Area map, and ask students to compare that with the Mercator projection map, and then with globe, and fill in the third black column on the chart.[2] If students have difficultly comparing the maps with globe, I may ask the same questions again ("How are these representations similar?" etc.) It might be helpful for students to compare the areas of South America with Greenland across the three formats.

After another five minutes, I pass out the Fuller map and ask students to compare the map with the previous two maps and with the globe, and to fill in the fourth blank column. The Fuller map distorts only minimally the shape of the continents. In addition to the usual questions, I would add, "What would this map look like if you were to cut it out along the edges, fold it along the dotted lines, and tape the edges together?" Then we do exactly that, winding up with a roughly spherical polyhedron.

Finally, I present the MacArthur map, and I allow the students five final minutes for comparisons, discussion, and completing the worksheet. This map "shakes up" our usual world view by placing north at the bottom of the map, among other interesting "corrections."

An Imperfect Model (20 minutes)

When the small groups have finished their discussions I ask everyone to move back to their usual seats. I project each map in turn on a screen and I ask students to summarize their groups' discussions. This begins a wider discussion between the members of the different groups, during which I listen to each group's ideas and supplement their thoughts with information from the **TEACHER'S KEY**, page 11 (for example, who first created the map projection, what their purpose was in creating it, and when it was first published.)

By the end of this discussion, most of the students understand that maps are not true representations of the Earth; that there is no single "right" map; and that the cartographer's purpose, culture, and values play an important role in the creation of a map.[3] Students might now be able to provide more specific evidence to support their arguments. For example, Australia was placed at the "top" of the MacArthur map in 1979 because its creator, Stuart MacArthur, was indeed an Australian. A generation earlier, American inventor Buckminster Fuller designed a "round" map that would, when flattened, keep the continents whole and mostly proportional in terms of size and shape. In the 1500s, Gerhardus Mercator was struggling with Columbus's confirmation of the fact that the Earth wasn't flat, it was spherical! How do you accommodate a three-dimensional shape on a flat sheet of paper?[4]

Summing Up (5 minutes)

My students usually come to a clear understanding of the main point of this lesson, but if they do not, I explain that the Earth cannot be truly represented with a flat map.[5] In fact, the Earth cannot be truly represented with a globe, either. The globe is a model that is meant to represent a real object. The Earth does not have different colored countries, does not precisely rotate on poles (but wobbles slightly), and is not perfectly spherical (but an oblate spheroid).[6]

The entire Earth is not situated "up" or "down." This is an important concept because many Americans believe that the United States is located on the "upper half" of the Earth, whereas the Earth, solar system, and universe do not have an "up" or "down." "Up" and "down" are terms used in relation to an arbitrary fixed point. That "point," in the case of the Mercator projection map, was Holland, the home of the map's creator, Gerhardus Mercator, so he placed the North Pole at the top of his map.

Online Extensions

Today, one can extend this lesson to take advantage of students' newfound knowledge of maps. In the computer lab, students can watch "Animations—Chapter 3: The Earth as a Rotating Planet," a computer animation that illustrates how the Earth is represented with various projections onto a flat surface.[7] Another computer animation shows a Fuller map, which is initially flat, as it is folded into a polygon model of Earth.[8]

Finally, the National Geographic Society has a thorough introduction to mapping the Earth.[9] This online tutorial has more meaning for students if they have first grappled with some of the challenges for themselves.

Conclusion

The most beneficial aspect of this activity is giving students the information in a well-structured way, while having them struggle a bit, and then come to correct conclusions on their own. In this case, they look at five very different maps that are supposed to represent the same physical object. The most difficult aspect of the activity for me has been to not immediately verify students' answers during the discussions. If the teacher has assessed his or her students' prior knowledge and abilities, and guides the small group discussions by asking questions, then students will come to understand the concepts through their own efforts.

Notes

1. National Council for the Social Studies, *Expectations of Excellence: Curriculum Standards for Social Studies* (Washington, DC: NCSS, 1994).
2. "Sinusoidal" means shaped like a sine wave (~).
3. Geography Education Standards Project, *Geography for Life: National Geography Standards* (Washington DC: National Geographic Society, 1994).
4. "What is a Mercator Projection?" at science.nasa.gov.
5. United States Geological Survey, *Map Projections* (1998), egsc.usgs.gov.
6. Stephen Marshak, *The Essentials of Geology* (New York: W. W. Norton, 2009).
7. *Animations-Chapter 3: The Earth as a Rotating Planet* (John Wiley, 2006), www3.interscience.wiley.com.
8. Chris Rywalt, *Dymaxion Projection Animation* (2003), See the flat map fold into a polygon at friday.westnet.com.
9. National Geographic Society, *Round Earth, Flat Maps* (2009), www.nationalgeographic.com.

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Teacher Key

Ways to Draw the World

Name of this map	***Globe***	***Mercator***	***Sinusoidal Equal Area***	***Fuller***	***MacArthur***
What I notice right away about this map	*Whatever children notice goes in this space.*	*Whatever children notice goes in this space.*	*Whatever children notice goes in this space.*	*Whatever children notice goes in this space.*	*Whatever children notice goes in this space.*
What the map does well (accurately represents) Possible uses	**a.** *DIRECTIONS:* ***True*** **b.** *DISTANCES:* ***True*** **c.** *AREAS & SHAPES:* ***True*** *Quite accurate in many ways. A line provides shortest distance between two points (a great arc).*	**a.** ***True Direction*** **b.** *Distorted* **c.** *Distorted* *Draw a line between any two points; that direction is accurate, but not likely the shortest route.*	**a.** *Distorted* **b.** *Distorted* **c.** ***True (Equal) Area*** *Geologists use it to show deposits, atlases to show distributions of resources or populations.*	**a.** *Slight distortion* **b.** *Slight distortion* **c.** *Slight distortion* *Each continent is kept whole (uncut). The shape folds into a neat 20-faceted ball that almost rivals the globe in accuracy (a-c, above).*	**a.** *Slight distortion* **b.** *Slight distortion* **c.** *Slight distortion* *To get people talking about why we lock into a fixed point of view. To shake people up. Humorous <u>and</u> useful!*
What the map does poorly (distortions or bias) Possible Problems	*Difficult to carry around in your pocket! Expensive to manufacture and ship. To show detail, it must be very big.* *Why not put the South Pole on the top?*	*Greenland looks bigger than China (which is 4X bigger). Antarctica looks like a thin alligator along the bottom of the map, if it shows at all.* *Eurocentric.*	*Shapes near the poles are distorted, but not as badly as Mercator.* *Eurocentric. "Sinusoidal" means shaped like a sine wave (~).*	*Latitude and longitude lines get chopped up.* *Compass direction "North" is a multitude of lines on the flat map, but resolves nicely when folded into a 3-D shape.*	*North is "down!"* *South is "up!"* *East is to the "left!"* *West is to the "right!"* *Australia is the center of the world! Yipes!*
The cartographer's purpose for creating this map	*Model of Earth in 3-dimensions, close to its actual shape.*	*Ocean navigation. Sailors can plot a course on the map that does not require constant correction of the ship's tack.*	*Equal Area means that areas represented on the map are proportional to the areas on Earth.*	*"We are all astronauts aboard a little space ship called Earth." Fuller was a prolific inventor: Geodesic Dome.*	*"McArthur's Universal Corrective Map" makes us think about bias and map-maker's choices.*
Who created the map, where, and when	*Nicholas Copernicus around 1500. He demonstrated that a ball-shaped planet Earth revolved around a ball-shaped, enormous sun.*	*Gerhardus Mercator in Holland, placed Europe in the center of his map in 1569.*	*Used by Jean Cossin and Jodocus Hondius, in France, beginning in 1570.*	*R. Buckminster Fuller, USA, 1946. He made up the name "Dymaxion Map" from "Dynamic + Maximum + Tension"*	*Stuart McArthur, Australia, 1979. He drew his first South-up map when he was 12 years old.*
View online and read more at	**learn.arc.nasa.gov/ svs/download.html** World Wind is a NASA virtual globe. Needs 2 GB disk space.	**science.nasa.gov/Real time/ rocket_sci/orbmech/mercator. html**	**egsc.usgs.gov/isb/pubs/ MapProjections/projections.pdf**	**bfi.org** Search on "Dymaxion." Watch the map fold into a polygon	**odtmaps.com/detail.asp_Q_ product_id_E_McA-23x35**

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How Politicans Gerrymander

Steven S. Lapham

Purpose

This is an activity to apply the concepts of redistricting and gerrymandering. What may seem odd to children—and is worth stressing—is this fact:

> **Successful gerrymandering does not require "fudging" the numbers (that is, altering the basic data). One can obtain different results simply by drawing the boundaries on the map in different ways.**

Summary

In this simulation, the imaginary state of New Gerry has been apportioned four representatives in the U.S. House of Representatives. The two imaginary political parties (the "Bear Party" and the "Lion Party") have an equal number of voters in this state. The parties could each enjoy two congressional districts in which their voters are a majority—if the four congressional district boundaries were drawn "fairly." But it is also possible that the state legislature would give the Bear Party three districts, leaving the Lions as the majority in only one.

Time Required

One 50-minute period for small groups (of three students each) to consider different arrangements of the map pieces, perform additions, fill out the chart, and discuss the results.

Prerequisite Knowledge

Before using this activity, students should know that congressional districts are determined after a census. Lesson 4, "District Decisions," on the website of the U.S. Census, **www.census.gov** is a good preparation for this activity.[1]

Use **HANDOUT 1**: *Background* as a review of these topics. Students should be able to define these terms: congressional district (and its abbreviation, "CD"), district boundaries, census, apportion, reapportionment, redistricting, state legislature, gerrymander, and cartographer.

Procedures

1. Distribute, read, and discuss **HANDOUT 1**: *Background*. Review the underlined vocabulary words. Write the class-generated definitions on the whiteboard for reference during discussion at the end of the activity.
2. Divide the class into small groups of two or three students each. Distribute, read, and discuss **HANDOUT 2**: *Instructions*.
3. Distribute **HANDOUT 3**: *Map*. Ask the small groups to consider different scenarios for creating Congressional District 1. (Students may use scissors to cut out the shapes of the counties and actually manipulate them into different arrangements—or scenarios—like pieces of a puzzle.)
4. Distribute **HANDOUT 4**: *Chart*. Model how to complete the sheet with the use of Scenario A.
5. Allow time for students to complete the calculations for Scenarios B and C and arrive at gerrymandered solution.
6. Discuss the questions listed below and others that students might raise.

Calculations

In each scenario on the chart, students add up the numbers (of Lions and of Bears) in Congressional District 1 (CD 1) to discover which party has a majority in that district under that scenario. For example, in Scenario A, the number of Bears in CD 1 is the sum of 600 Upcounty Bears + 1,300 Northblock Bears = 1,900. Compare that with the total Lions to see which party enjoys the majority of voters in CD 1 under Scenario A. (If you wish, divide the student groups into Lions and Bears at the start, and ask each group to work the numbers and recommend its preferred district lines.)

Discussion Questions

Once students have compared the three redistricting scenarios, they can consider some questions:

1. Is it fair for one political party to "shut out" another during redistricting?
2. If not, what reforms can students suggest that might prevent gerrymandering? (Compare with those described at **www.commoncause.org.** Click on "Election Reform" and then "Redistricting.")
3. In what ways has this gerrymander activity been simplified from the actual challenges of redistricting?

In real life, district lines need not follow county boundaries; actual population numbers are much greater; population equality must be maintained between districts; other variables like income and ethnicity may be mapped and considered when you draw boundaries; etc. Also, in many states, the governor must approve a plan for redistricting. State and federal courts can try cases if, for example, lines are drawn so as to favor one ethnic group over another.

Learn More

An extension to this activity is The Redistricting Game at **www.redistrictinggame.org**, which employs interactive maps that are more complex, but also a lot of fun. This website links to **www.fairvote.org**, which provides information about how redistricting is done in each of the 50 states, current controversies, and proposals for reform.

Notes

1. www.census.gov/dmd/www/pdf/912ch4.pdf. More teaching resources are at www.census.gov/schools.

Steven S. Lapham *is editor of* Middle Level Learning

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Handout 1: Background

An Introduction to the Gerrymander

What is It?

"To gerrymander" means to divide an area into political units so that one group of voters gets special advantage over another. The resulting shape of a district on the map, which can look rather strange, can be called "a gerrymander."

The word "gerrymander" comes from a famous case of redistricting in Massachusetts in 1812. The governor at the time, Elbridge Gerry, signed a map into law that included a district shaped rather like a salamander. Critics dubbed the new, oddly-shaped district the "gerrymander." (See cartoon.) By the way, Elbridge Gerry was not a politician of ill repute. Before he became a governor, he helped draft the U.S. Constitution, advocated for a strong Bill of Rights, and served in the first U.S. Congress.[1]

How Does It Work?

Today, computer technology helps mapmakers predict the future voting behavior of a neighborhood with the use of census data, the results of the last elections, and public opinion surveys. The mapmaker can draw the boundaries of congressional districts (CDs) to make it more likely that a certain party's candidate will win a majority of votes in the next election. But is that fair? The cartographer's decisions can undermine the very spirit of a fair, democratic election. Nevertheless, "gerrymandering remains a staple of partisan conflict, and both Democrats and Republicans continue to use it despite the harm it does to fair representation and voter confidence."[2]

When Does It Happen?

1. The federal government conducts a census the first year of each decade—for example, in 1980, 1990, 2000, and 2010. The population of a state will increase or decrease over time, usually because people have moved into the state, or moved away. But federal law says that the number of congress persons in the U.S. House of Representatives stays constant at 435.

2. After each census, the U.S. Congress adopts a formula that apportions each state a number of districts that reflects its share of the country's population. This is called reapportionment. States with big populations have more representatives than states with smaller populations.

3. Finally, state legislatures redistrict (draw district boundaries) after each U.S. Census. That's when gerrymandering can happen. (See the time line below.)

Will This Change?

Redistricting can be done in ways that seem fair, but in many states there are conflicts over gerrymandering, some of which wind up in court. Debate is happening in state legislatures and in the U.S. Congress about requiring mapmakers to use fixed formulas that would be more consistent and fair to all parties over the years. Maybe one or more of these formulas will become law . . . or maybe the gerrymander will squiggle on into the future! Read about how district lines get drawn in your state at **www.fairvote.org.**

Notes

1. *Greg Bradsher*, "A Founding Father in Dissent," www.archives.gov/publications/prologue/2006/spring/gerry.html.
2. The main source for this page is USC Annenberg Center for Communications, "Partisan Gerrymander," www.redistrictinggame.org.

Preparing for Elections

Census Taking	Reapportionment	Redistricting	Elections
U.S. Census Bureau	U.S. Congress	State Legislatures	State Governments
		(acting within federal guidelines)	

Handout 2: Instructions

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How Politicians *Gerrymander!*

(otherwise known as "redistricting for partisan gain")

THE SETTING

This activity simulates the act of gerrymandering. It is a simplified example, but it reflects what happens in the real world.

Look at the map of the imaginary state of New Gerry, with its five counties. There are two imaginary political parties: the Bear Party and the Lion Party. Each party has exactly 6,000 voters in this state.

Let's imagine that the state of New Gerry has been apportioned four seats in the U.S. House of Representatives according to the latest U.S. Census. Thus, the state will soon be divided into four congressional districts, abbreviated as CD 1, CD 2, CD 3, and CD 4.

A reasonable citizen might assume that two congressional seats would go to the Bears and two to the Lions. After all, the total voters in each party living in this state are equal. That outcome would seem fair, but it is not guaranteed…

THE RULES

In this activity, we will follow these simple rules: (1) the boundaries of the congressional district will follow county boundaries, and (2) the small county of Upcounty must join with one of its neighbors to form a single congressional district, yielding four districts in all.

THE CHALLENGE

In New Gerry, the state legislature—which happens to be controlled by a Bear majority this year—is responsible for redistricting (creating the boundaries of the congressional districts). How should the lines be drawn? Maybe the Bears can end up with a majority in three (not just two) of the districts!

Imagine that you are Bear Party leaders who wish to re-draw new congressional district boundaries for the state of New Gerry.

First, check the numbers. Add up the number of Bear party voters in the whole state. Then add up the number of Lion voters in the state. Make sure that both totals equal 6,000.

Then, see if you can gerrymander to give the Bear Party an advantage, even though it has no more voters in the state than does the Lion Party.

> **Can you arrange the district boundaries so that the Bears end up as the majority in THREE congressional districts, rather than just two?**

PROCEDURE

Arrange the counties (the shapes on the **map**) into different groupings. Add up the numbers (of Lions and of Bears) in the districts for each combination. Is there a combination that will "shut out" the Lions by giving them only one of the four congressional districts?

Try different scenarios. Use the **chart** to keep track of your work. Remember that Upcounty must always be paired with one of its neighboring counties to form a congressional district.

DISCUSSION

Once you have discovered how to gerrymander the map, have a discussion with your classmates. Which option should you choose? Would a gerrymander be fair to the minority party (the Lions) in this state? What might be some consequences—positive or negative—for the majority party (the Bears) of gerrymandering?

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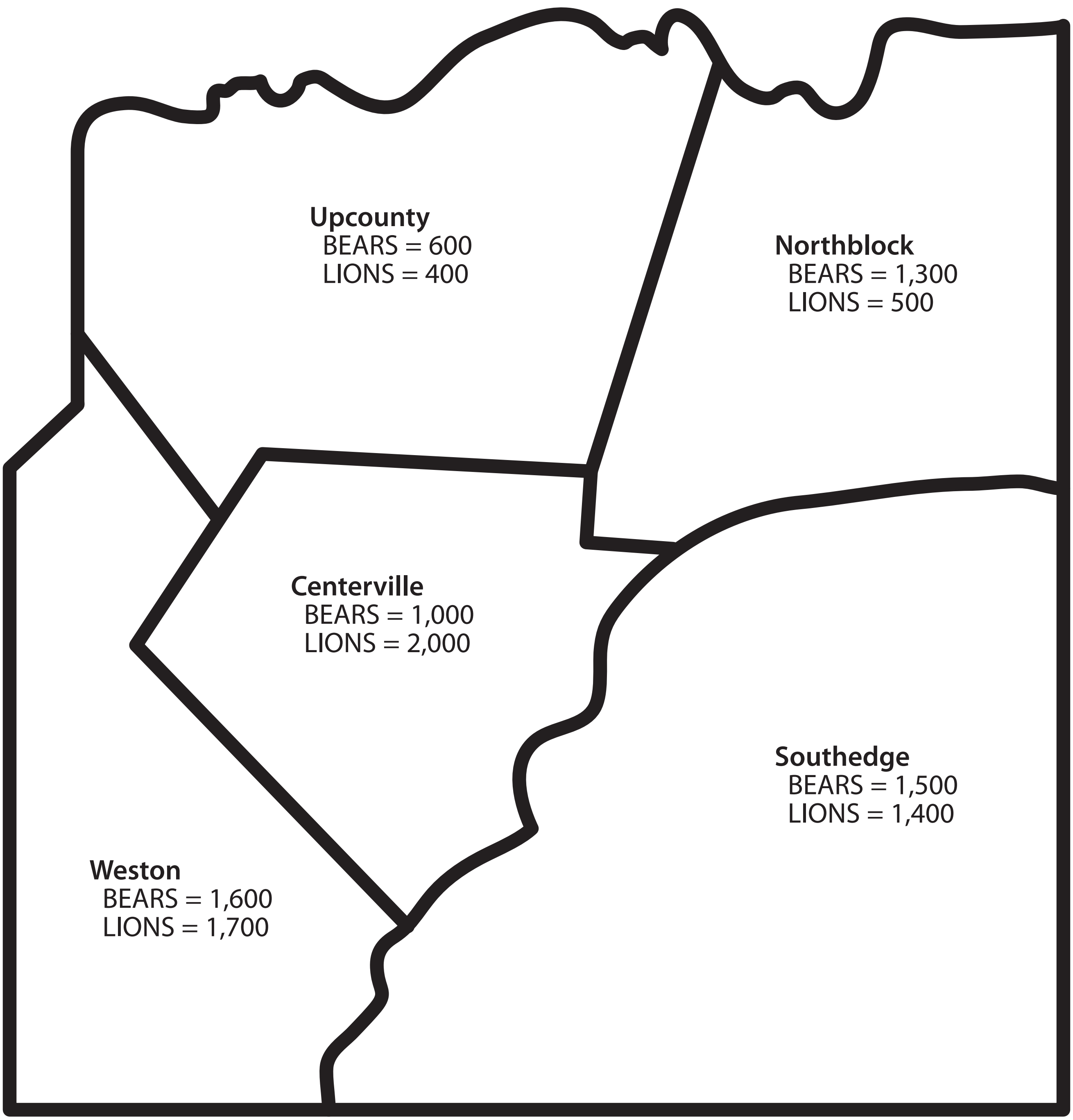
Handout 3: Map

Map of the State of New Gerry

showing the number of voters in each party
in each of the five counties



Handout 4: Chart

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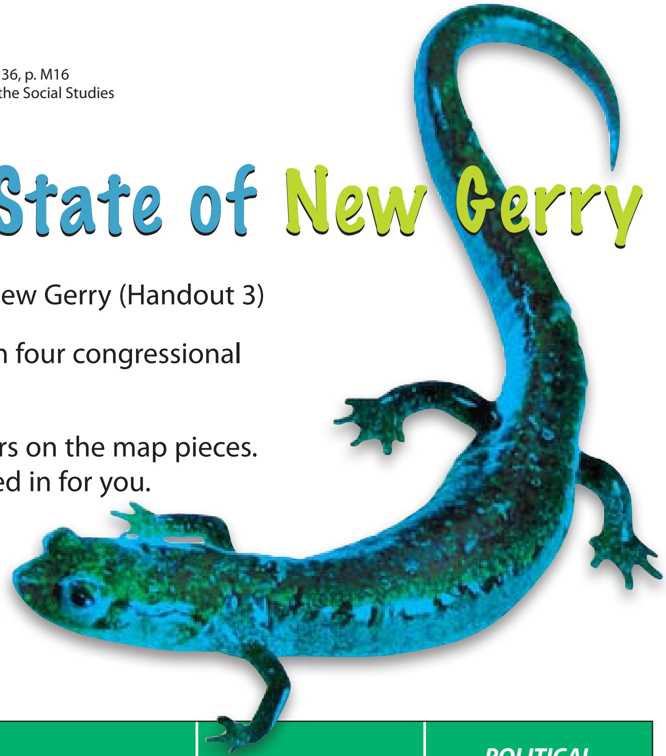
Redistricting in the State of New Gerry



- Consider the five counties as shown on the map of New Gerry (Handout 3)
- Use different groupings (Scenario A, B, and C) to form four congressional districts (abbreviated as CD 1, CD 2, CD 3, and CD 4).
- Fill in all of the blanks on this chart using the numbers on the map pieces. Some addition is required. Two blanks have been filled in for you.
- Hint: There are 1,900 BEAR Party voters living in CD 1 under scenario A. See if you can calculate the total LIONS.
- Which party now has the majority? Fill the blank!

	CD 1	CD 2	CD 3	CD 4	*POLITICAL MAJORITIES*
Redistricting **Scenario A**	Combine Upcounty and Northblock THE MAJORITY IS __________	Centerville THE MAJORITY IS ***LION***	Southedge THE MAJORITY IS __________	Weston THE MAJORITY IS __________	BEAR = **2** CDs LION = ____CDs
Redistricting **Scenario B**	Combine Upcounty and Centerville THE MAJORITY IS __________	Northblock THE MAJORITY IS __________	Southedge THE MAJORITY IS __________	Weston THE MAJORITY IS __________	BEAR = ____CDs LION = ____CDs
Redistricting **Scenario C**	Combine Upcounty and Weston THE MAJORITY IS __________	Northblock THE MAJORITY IS __________	Southedge THE MAJORITY IS __________	Centerville THE MAJORITY IS __________	BEAR = ____CDs LION = ____CDs

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