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Isn't That Spatial? # 6: Teaching About Scale

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One of the major contributions that geography makes to the understanding of events, patterns, and phenomena is the concept of scale. Scale is the relationship between distance on the map and distance on the ground. A map scale usually is given as a fraction or a ratio—1/10,000 or 1:10,000, and is often accompanied by a visual scale in a bar or rake form. One unit of measurement on the map—1 inch or 1 centimeter—represents 10,000 of the same units on the ground.

All phenomena occur at a specific scale and often over a range of scales. How can students understand spatial relationships unless they know the scale at which those relationships take place? During the late 1990s, a chunk of Antarctic ice broke off into the ocean that was the size of Rhode Island. That fact, and its significance to global climate change, will be lost on students unless they first understand just how large Rhode Island is. The Missouri earthquakes of 1812-1814 were felt hundreds of miles away. Just how far is “hundreds of miles” or “hundreds of kilometers?” What size and how widespread are the ozone hole, coastal erosion, urban sprawl in a city, or the decrease in the size of Lake Chad?

To be sure, how students learn the concepts of spatial relationships and scale is complex, and a number of geography educators have made important contributions to this field. I do not mean to imply by the following resource list that teaching about scale can be done easily or quickly. Yet, I have used the following resources in the K-12 and university classroom and I hope the reader will find them as useful as I have.

Ask students who has flown on an airplane. Discuss the differences between the amount of land one can see versus the amount of detail one can see on the land. Discuss how this changes as the airplane climbs higher in altitude. When it first takes off, one can see a small area but in great detail; this is analogous to a large-scale map. At higher altitudes, one can see more area, but less detail, as in a small-scale map. Discuss the extremes: A globe is the ultimate small-scale map. At the opposite extreme, a map at 1:1 scale of the classroom would be as large as the classroom itself, and rather unwieldy—hence, the need for a representative fraction—a scale.

Figure 4a
Scale 1:24000
1 inch = 2000feet
Area Shown: 1 square mile

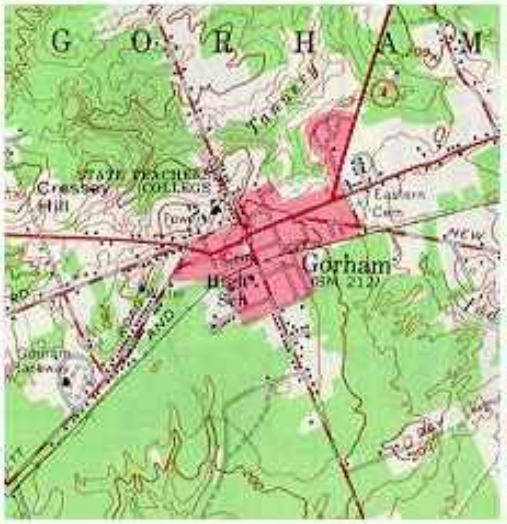

Figure 4b
Scale 1:62500
1 inch = nearly 1 mile
Area Shown: 6 3/4 square miles

Figure 4c
Scale 1:250,000
1 inch = nearly 4 miles
Area Shown: 107 square miles

Maps of Gorham, Maine, at 1:24,000, 1:62,500, and 1:250,000, from Professor Ritter's excellent map scale page on: http://www.uwsp.edu/geo/faculty/ritter/geog101/modules/tools/tools_scale.html

Use fractions to illustrate large versus small scale. I begin with simple fractions, and ask: "Which is larger, ½ or 1/10? Then ask, what is larger, 1/24,000 or 1/1,000,000? Just as 1/24,000 is a larger number than 1/1,000,000, so a 1:24,000-scale USGS map is at a larger scale than a 1:1,000,000-scale map. I often use the terms fine-scale and coarse-scale for large and small-scale, respectively. I do this because the terms large and small scale can be easily confused with referring to the scale of analysis—for example, we speak of analyzing the Earth at large scale (a large area, such as the Amazon Basin), or small scale (such as a local wetland). These terms are the opposite of the way we use large and small in referring to map scale.

Ask students to measure distances using maps of several different scales. Teach the differences between distance, area, and volume, which provides excellent connections between geography and mathematics. Consider using a Geographic Information System (GIS), as all GIS software allows users to measure distance, perimeters, and areas. Using a Global Positioning System (GPS) receiver, or measuring tape and a compass, are excellent ways to introduce measurement and scale to your classroom. Use online mapping sites, such as the National Atlas (www.nationalatlas.gov), Topozone (www.topozone.com), and Terraserver (www.terraserver-usa.com) as references for the problems you pose using scale.

My favorite online site to teach about scale is the "Powers of 10" site from Florida State University's National High Magnetic Field Laboratory, at: http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/. This reminds me of the Smithsonian Powers of Ten movie that many of us saw many years ago in our science classes, and I also more recently viewed at the Smithsonian Air and Space Museum. This wonderful set of scrollable images allows one to view protons all the way up to galaxy superclusters, and everything in between.

The USGS Map Adventures unit, suitable for lower elementary students, at: http://erg.usgs.gov/isb/pubs/teachers-packets/mapadventures/index.html, includes a segment where a girl travels in a hot air balloon over a park. This introduces the concept of maps as aerial views, and how the scale changes as the balloon rises.

Chapter 5 of mapreading.com's site: http://www.map-reading.com/chap5.php is a comprehensive set of instructional tools on map scale.

Additional information about map scale can be found on the USGS Fact Sheet on: http://mac.usgs.gov/mac/isb/pubs/factsheets/fs01502.html, Matt Rosenberg's Geography site: http://geography.about.com/cs/maps/a/mapscale.htm, a handy scale calculator at the University of Texas, on: http://www.beg.utexas.edu/GIS/tools/scale2.htm, and the San Francisco Estuary Institute's comprehensive page: http://www.sfei.org/ecoatlas/GIS/MapInterpretation/MapsandScales.html.

I hope you find this topic and references useful, and I look forward to hearing about how YOU use scale in the classroom, via our online geography education listserv. To subscribe to the listserv, send an email to LISTSERV@LSV.UKY.EDU and in the body of the email (not the subject line), enter SUBSCRIBE GEOGED. To then send an email to the list, send to geoged@lsv.uky.edu.

U.S. Department of the Interior
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URL: http://rockyweb.cr.usgs.gov/outreach/isntthatspatial_scale.html
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