

What is GIS? A very brief description for the newly curious

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Geographic information systems (GIS) combine maps with tables of information. The information—words, numbers, or images—can be linked to locations on the map. For example, a history professor discussing Sir Francis Drake’s perilous voyage around the world (1577–1580) might begin with the map in figure 1, showing the segments of his three-year journey (SAGUARO Project 2006).

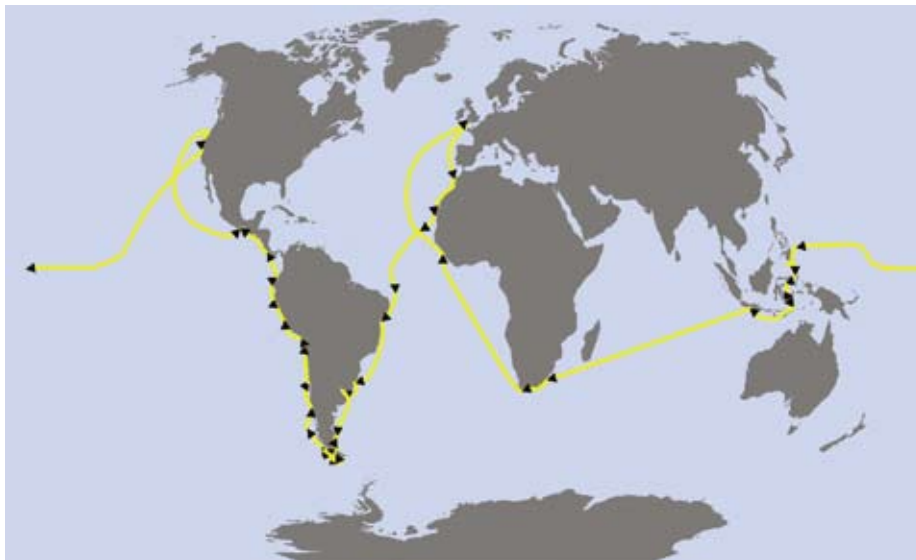


Figure 1.
Sir Francis Drake's
circumnavigation
of the world
(1577–1580).

Data courtesy of Scott
Walker, SAGUARO Project,
and ESRI Data & Maps 2004.

In figure 2 we have zoomed in to see the tip of South America. The looping path hints at navigational difficulty, and we want to know more. Information about each segment of the journey is held in one row of the table. Because the table is linked to the map, clicking a row in the table highlights that segment of the trip. Conversely, clicking a segment of the route on the map highlights the corresponding row in the table.

To make the description easier to read, we asked the software to display just that single row in a separate window. We see the summary, “Emerging from the Strait, Drake’s fleet is driven southward

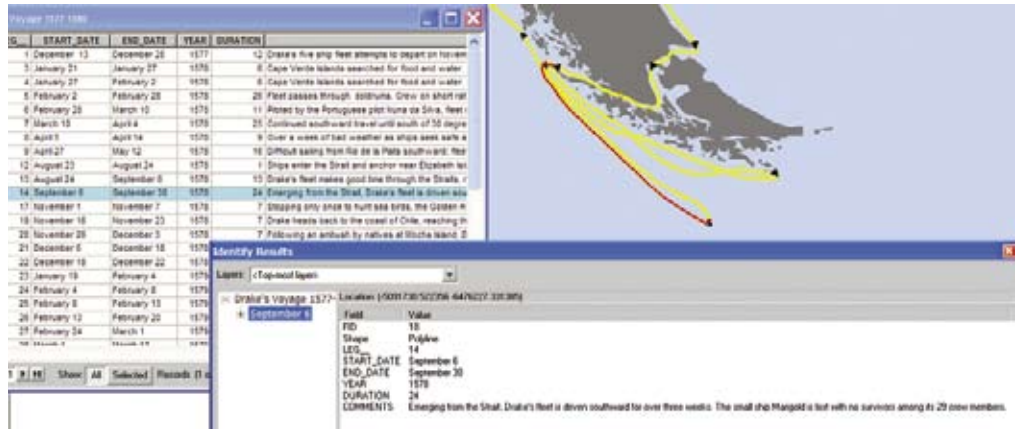


Figure 2. Drake's path near Cape Horn. Drake was sailing westward around the globe. The summary of information from each segment of the journey was extracted from the captain's logs and other historical records.

Data courtesy of Scott Walker, SAGUARO Project, and ESRI Data & Maps 2004.

for over three weeks. The small ship Marigold is lost with no survivors among its twenty-nine crew members." Students reading about the tragedy of this trip are learning about Drake and are also finding drama in data.

In addition to teaching students that maps and tables hold stories waiting to be revealed, GIS can also add context to the narrative by adding information from diverse sources. In figure 3, Drake's voyage has been layered onto a map of wind speeds. We have no wind measurements from the sixteenth century, but this contemporary data shows the conditions that Drake's fleet might have been experiencing.

We gain important insights by looking at data displayed as maps. We can also search and sort that data using GIS to enhance our "vision" via computation. For example, we could search for all trip segments with the words "perished," "lost," or "dead" in the descriptions to focus on the danger of the trip. Students might speculate on lack of food and water, and search for both loss of life and number of days between landings. They could question whether

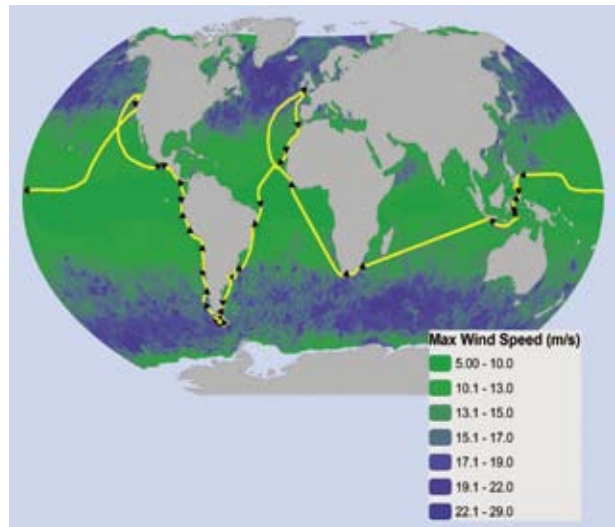


Figure 3. Drake's voyage depicted over maximum wind speeds from 2000 and 2001. Speeds are measured in meters per second.

Data courtesy of Scott Walker, SAGUARO Project, and ESRI Data & Maps 2004

crew members died in hostile encounters with the natives living near the coast. The ability to ask questions makes the data more accessible. The visual output makes it still more accessible. Students' attention is keenly focused on the experiences of the fleet, which animates their efforts to decipher historical records.

The path from a spreadsheet to a mapped representation of data may initially seem mysterious to newcomers, but conceptually it is straightforward. A mapmaker might begin with a blank image of the contiguous United States as a basemap, with each state a separate entity (figure 4). The mapmaker also starts with a table of information, such as the population of each of these states. The GIS software links the “Alabama” population to the “Alabama” shape on the map, the “Arkansas” population to the “Arkansas” shape, and so on for each state. A mapmaker can then find a state’s population either by reading the original table or by clicking on the state in the map. This works for any kind of location-based data. A mapmaker can join dots on a map to information about cities, or link lines on a map to information about rivers. Any shape, point, or line can be linked to any kind of information, as long as the feature on the map and the row in the table share a common label, such as the name of the state.

If you want to make a map of your own data, the simplest way is to begin with an existing, GIS-ready basemap. Many sources for such files exist. GIS software companies often supply basemaps with the shapes of countries, cities, oceans, and so on. Thousands of GIS maps are available on the Internet from governments, libraries, commercial distributors, and community-minded researchers and citizens. Alternatively, you can map your own environment by collecting data with global positioning system (GPS) units and then downloading the information into a computer. Scholars can map historic areas by scanning and digitizing antique maps, though copyright laws must be respected.

Once you have a basemap of your area of interest, you can enhance it with data from any number of sources. You can use a table of information from your own research or data gathered from a book or the Internet. For example, you can make a map for something as relatively obscure as the number of deaths caused by falling by downloading data from the U.S. Centers for Disease Control and Prevention (figure 5). (CDC 2005).



Figure 4. Contiguous United States as a blank basemap.
Courtesy of ESRI Data and Maps 2004.

Location Code	State Name	Death Count	Population	Crude Death Rate
01000	Alabama	159	4,478,403	3.6
02000	Alaska	20	641,616	3.1
04000	Arizona	465	5,441,713	8.5
05000	Arkansas	169	2,706,174	6.2
06000	California	1,470	35,010,990	4.2
08000	Colorado	310	4,502,435	6.9
09000	Connecticut	176	3,459,004	5.1
10000	Delaware	40	806,246	5.0
11000	District of Columbia	40	568,998	7.0
12000	Florida	1,197	16,687,068	7.2
13000	Georgia	441	8,542,720	5.2
15000	Hawaii	70	1,239,971	5.6
16000	Idaho	113	1,343,805	8.4
17000	Illinois	561	12,585,684	4.5
18000	Indiana	324	6,157,363	4.1

Figure 5. Subset of spreadsheet showing number of deaths from falls, by state, in 2002. The Crude Death Rate represents a rate per 100,000 people.

Data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

After linking the table to the map, you can choose how to display the information. Creating a simple display, such as a map that shows different sizes of symbols based on the total number of falls, is straightforward (figure 6). The message delivered by this map is clear: the greatest numbers of falls happened in California, New York, Texas, and Florida, though this figure does not convey that these states have very large populations overall. Not surprisingly, the largest numbers of falls occur in the states with the largest numbers of people.

By taking into account each state's population, you can create a rate of death from falls, such as the number of falls per 100,000 people in each state (figure 7). In this telling of the tale, California, New York, Texas, and Florida each have small dots, representing low rates of fall-related deaths.

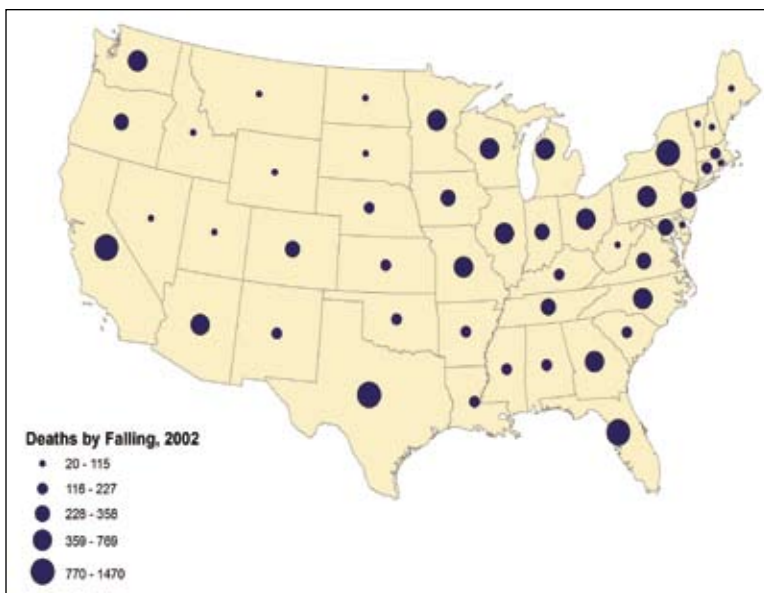


Figure 6. Total number of deaths from falls in each state, 2002.

Data courtesy of ESRI Data & Maps 2004. Additional data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

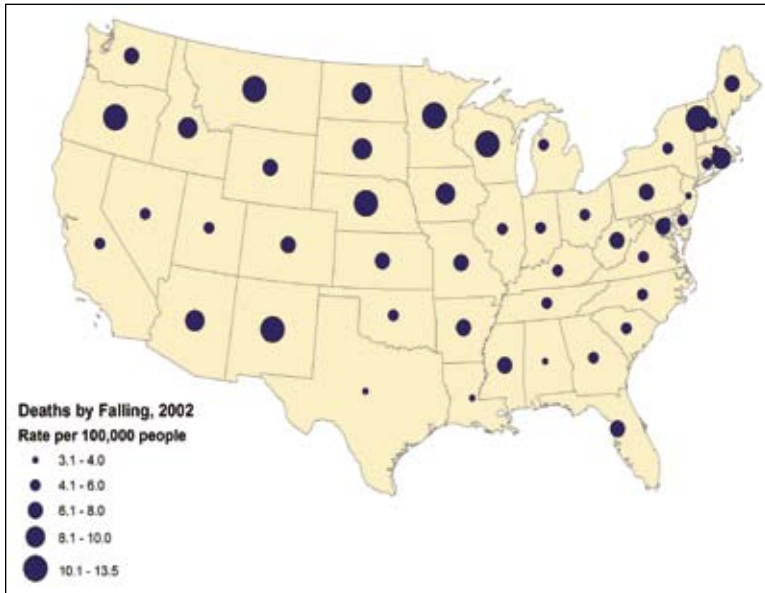


Figure 7. Number of deaths caused by falling, by state, as a proportion of total population in 2002.

Data courtesy of ESRI Data & Maps 2004. Additional data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Some less-populated rural states show a contrary pattern. Montana, Nebraska, and New Mexico, with relatively few people, have a much higher rate of death from falling. Observations like these provide opportunities for students to investigate the stories behind the images. They might seek data about the natural world such as icy weather, demographics such as populations of elderly residents, or the built environment such as safety regulations and building codes.

Comparing these maps, we see that mapmaking and map reading are not mechanical activities; they entail discernment, understanding, and communication skill. GIS provides an extensive range of display options, allowing us an extensive range of expression. Our maps can emphasize different aspects of the data to deliver very different messages.

GIS gives users control over what, how, when, and where its information is displayed. It is this control, within an interactive visualization environment, that makes GIS such a valuable teaching and learning environment (Medyckyj-Scott 1994). John Dewey, the father of modern education, put forth the enduring principle that education should be “of, by, and for experience” (Dewey 1938, p. 29). The case studies in this book describe how faculty members bring experiences to their students—letting them participate fully in the adventure of finding meaning and expanding their understanding—using a GIS mapping environment.

References

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