USGS
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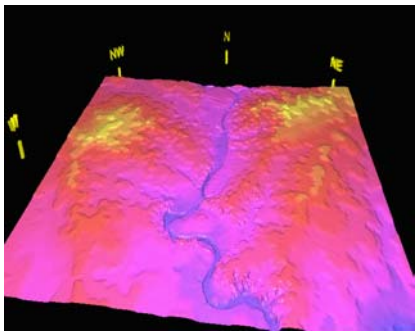
Geographic Information Systems in Education

Geographic Information Systems

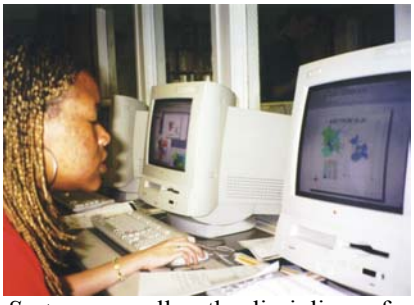
Geographic information systems (GIS) provide a technology and method to analyze *spatial data*, or information about the Earth. The earth's climate, natural hazards, population, geology, vegetation, soils, land use, and other characteristics can be analyzed in a GIS using computerized maps, aerial photographs, satellite images, databases, and graphs. By analyzing phenomena about the Earth's hydrosphere, lithosphere, atmosphere, and biosphere, a GIS helps people understand patterns, linkages, and trends about our planet.

The USGS has been producing digital map data since the 1970s. These data sets include scanned topographic maps, digital aerial photographs, land use and land cover, hydrography, transportation, 3D models of the Earth's surface, satellite imagery, and more. The USGS uses GIS to analyze urban growth, investigate the downstream effects of abandoned mine lands, to create flood models, and in other investigations.



Interest in Using GIS In Education

Since the 1960s, GIS has quietly transformed decision-making in universities, government, and industry by bringing digital spatial data sets and geographic analysis to desktop computers. *Geographic Information Sciences* include Geographic Information



Systems as well as the disciplines of geography (examining the patterns of the Earth's people and physical environment), cartography (mapmaking), geodesy (the science of measuring and surveying the Earth), and remote sensing (studying the Earth from space).

GIS is used in three major ways in courses at the elementary, secondary, and college level. First, teaching *about* GIS dominates at the college level, where courses in methods and theory of GIS are taught in geography, engineering, business, environmental studies, geology, and in other disciplines. Second, teaching *with* GIS is emphasized at the elementary and secondary level, where GIS is used to teach concepts and skills in earth science, geography, chemistry, biological science, history, and mathematics courses. Finally, GIS is used as a fundamental research tool in all institutes of higher education in geography, demography, geology, and other disciplines.

The U.S. Labor Secretary's Commission on Achieving Necessary Skills (SCANS) stated that the most effective way to teach skills is "in context" (U.S. Dept. of Labor 1991). SCANS competencies include identifying resources, working with others, using information, and understanding complex interrelationships. Implementing GIS into the curriculum may encourage students to examine data from a variety of fields.

Since the publication of the first national content standards in geography (Geography Education Standards Project 1994), social studies (National Council for the Social Studies, National Task Force for Social Studies Standards 1994), science (National Research Council 1996), and technology (International Society for Technology in Education 2000), educators nationwide have been progressing toward a model of instruction that emphasizes a hands-on, interdisciplinary, research-based learning experience. The national geography standards state, "the power of a GIS is that it allows us to ask questions of data." Students using this inquiry approach form research questions, develop a methodology, gather and analyze data, and draw conclusions.

The approach with GIS should not be, "How can we get GIS into the curriculum?" but "How can GIS help meet curricular goals?"

Examples of GIS In Education

Students using GIS in the curriculum are studying phenomena from the local to global scale. The use of GIS fosters a connection with the community through the acquisition of data and maps and through fieldwork.

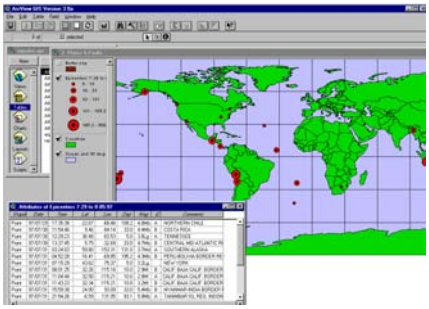
With GIS, students can examine the Earth in a new way, through three-dimensional

analysis of a watershed, or by examining the Pacific "Ring of Fire" using a map projection that shows all of the Pacific Ocean in one view.

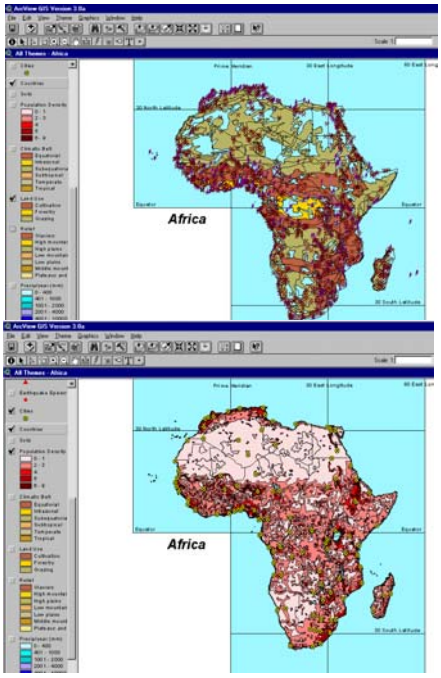
Rhode Island students study the economic impact of rivers in their communities. Other students map and analyze tree species on their school property.

In North Dakota, high school students help state parks use GIS to study and manage their resources. Middle school students map alternative sites for a local landfill.

In science courses, students use USGS earthquake information on the Internet in a lesson on plate tectonics (below).



World Geography students examine the climate, vegetation, population, natural hazards, landforms, and political geography of Africa (below).



Students in Los Angeles map and analyze the ethnic makeup of neighborhoods in their city over time.

Vermont middle school students use GIS technology, science journals, and photographs to determine the origin and ecological relationship of a local pond to the community.

Students use GIS with Global Positioning System (GPS) receivers to collect coordinates and chemical constituents of local streams (below).

For More Information

Implementing GIS in the curriculum requires GIS software, spatial data, and a network of supporting organizations.

Software

The following companies make GIS software that are often used in education:

ArcView, by Environmental Systems Research Institute (ESRI):
www.esri.com

Idrisi, by Clark Labs at Clark University:
www.clarklabs.org

GeoMedia, by Intergraph Corporation:
www.ingr.com

MapInfo, by MapInfo Corporation:
www.mapinfo.com

Maptitude, by Caliper Corporation:
www.caliper.com

Starting Points

USGS
www.usgs.gov

USGS online aerial photographs and topographic maps:
www.terraserver.microsoft.com

Educational Applications of GIS
www.esri.com/k-12

National Atlas
www.nationalatlas.gov

Bureau of Census
www.census.gov

Federal Geographic Data Committee
www.fgdc.gov

Geography Network
www.geographynetwork.com

Conferences

ESRI hosts an international conference in GIS education each summer in California: www.esri.com/educ

Listserve

TERC hosts an email listserve called EDGIS on this topic. See list.terc.edu/mailman/listinfo/edgis for subscription information.

Training

The USGS conducts training for teachers:
rockyweb.cr.usgs.gov/public/outreach/

List of Training Events:
www.kangis.org/learn

References

Geography Education Standards Project. 1994. *Geography for Life: National Geography Standards*. Washington, DC: *National Geographic Society*, 272 p.

International Society for Technology in Education. 2000. *National Education Technology Standards for Students*. Eugene, Oregon: ISTE, 373 p.

National Council for the Social Studies. 1994. *Curriculum Standards for Social Studies.* Washington, DC: NCSS, 178 p.

National Research Council. 1996. *National Science Education Standards*. Washington, DC: National Academy Press, 262 p.

U. S. Dept. of Labor. 1991. Secretary's Commission on Achieving Necessary Skills (SCANS). Washington, DC: GPO.