

# GIS *educator*

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GIS Use across the Campus

## GIS Contributes to Groundbreaking Carbon Emissions Inventory

### Library supports project and GIS use across campus

By C. C. Miller, Purdue University, West Lafayette, Indiana

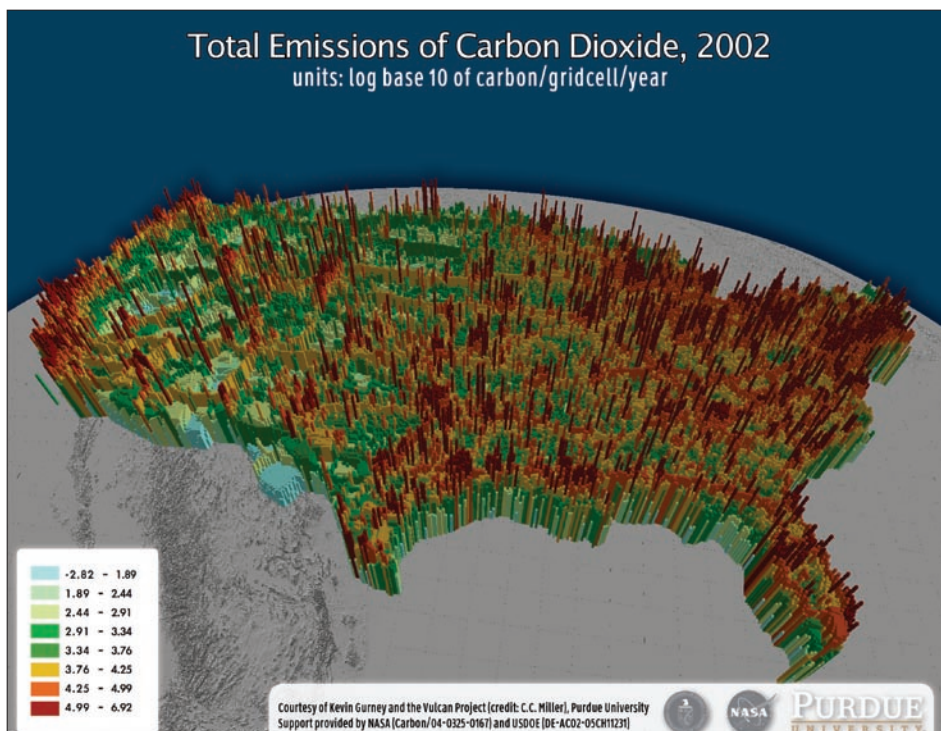
Researchers from Purdue University's Project Vulcan developed processes for aggregating carbon emissions data from multiple sources and formats. Valuable GIS support for this project came from an unlikely source: the university's library.

Vulcan is a two-year-old project funded by the National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy (DOE) and led by Kevin Gurney, assistant professor of earth and atmospheric sciences at Purdue University in West Lafayette, Indiana. Its mission is to quantify North American fossil fuel carbon dioxide (CO<sub>2</sub>) emissions at higher spatial and temporal scales than ever before.

The project's spatial component called for sig-

nificant amounts of geoprocessing. The majority of these operations, accomplished with ArcGIS, resolve input geographies (points, roads, counties) with 10-kilometer square grid cells. GIS was also used to place surrogate emissions into grid cells using population, land-use, or some other meaningful proxy when necessary. *[Emissions surrogates are used as indicators of emissions activity. The spatial distributions are assumed to be representative of the geographic distribution of emissions sources.]* Software, custom-built by team members, could then process all input data at a common unit of geography and an hourly temporal scale for an entire year.

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The purpose of the Vulcan project is to quantify North American fossil fuel carbon dioxide (CO<sub>2</sub>) emissions at higher spatial and temporal scales than ever before.

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## Becoming Citizen Scientists

### Students monitor light pollution

Grade school students in Arizona have taken an active role in protecting their community.

Astronomy contributes more than 100 million dollars annually to Arizona's economy. The dark skies that the astronomy industry has relied on are threatened as the state's population grows. Pima County understands that dark skies are a precious natural resource and has enacted an ordinance to protect this resource.

Seventh grade students at Wilson K-8 school in Tucson also appreciate the importance of dark skies in Pima County. Their science curriculum has expanded beyond the weekly star journal observations and the occasional star party. They are now participating in a worldwide project that documents light pollution in the community.

The GLOBE at Night project is a program for students, parents, and teachers. Each spring, participants from countries throughout the world observe the magnitude of stars as a measure of light pollution. These citizen scientists observe Orion, note the number of stars visible in the constellation, and record this information in an online

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# UCGIS Honors Former ESRI Education Manager

Dr. Michael Phoenix's lifelong commitment to educating people about geospatial science and technology was recognized by the University Consortium for Geographic Information Science (UCGIS). He received the 2008 UCGIS Educator Award at a ceremony during the 2008 UCGIS Summer Assembly held June 23–24 in Minneapolis, Minnesota.

A nonprofit organization, UCGIS promotes multidisciplinary research and education in geographic information science (GIScience). Phoenix was honored for his support in the development of many academic programs around the world. "Mike's professional and personal contributions to geographic information science and technology education are highly regarded in academia and industry alike. His work has been crucial in advancing GIScience and technology education," said Steve Prager, UCGIS Education Committee chairman.

Phoenix worked on ESRI's education industry solutions team for 15 years. While working for ESRI, he traveled the world promoting GIScience education. He worked with more than 3,000 institutions of higher learning, providing needed resources, support, and advice to schools building GIScience and GIS programs.

Phoenix said he was deeply honored to receive the award. "I believe the award is as much for ESRI as it is for me," said Phoenix, who retired earlier this year but continues to work on special projects for the company on an occasional basis.

"Mike pioneered an unprecedented partnership between private industry and many communities of researchers and educators," ESRI president Jack Dangermond said. "That partnership proved to be the wellspring for GIS being used to benefit people in need, care for our planet, and create knowledge that will be passed down for generations to come."

Past winners of the UCGIS Educator Award include Dr. Duane F. Marble, professor emeritus of geography at Ohio State University; Dr. Michael F. Goodchild, professor of geography at the University of California, Santa Barbara; and Dr. Karen K. Kemp, founding director of the International Masters Program in GIS at the University of Redlands in California and editor of the new *Encyclopedia of Geographic Information Science*.

For more information about UCGIS,  
visit <http://www.ucgis.org>.

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## GIS Contributes to Groundbreaking Carbon Emissions Inventory

Although much of the Vulcan workflow was ripe for GIS input, GIS was late to the party. Purdue University Libraries hired its first GIS librarian in late 2006 to help push new efforts to apply library science expertise to data and information problems facing researchers in labs and centers across campus. Faculty librarians at Purdue were encouraged to assist any department—Communications, Agronomy, Hospitality, and Tourism Management—with data and information problems. The nature of GIS meant these librarians were likely to find work in all these areas.

Response from collaborating faculty and teams has been swift. Purdue librarians have been welcomed onto teams and into collaborations not traditionally inclined to allocate a portion of grant funds for librarians' salaries. In particular, information and data—geodata especially—is so unruly and fluid that apparently researchers appreciate the benefits of having a librarian around who knows GIS, is familiar with the geodata, and can handle classic and developing technologies in GIS and geoinformatics.

Consequently, in late 2006, Vulcan project team members who needed to visualize some county data approached the libraries. Just as traditional library reference transactions tend to do, these requests evolved. Requestors asked increasingly complex questions: What could GIS do with data from multiple sources and programs? How could it represent CO<sub>2</sub> emitters in different formats? As more questions were answered using GIS, the librarian became part of the Vulcan workflow, supplying GIS support to the team and nagging about the importance of metadata and data archiving.

The rest would have been history, but the response to the initial release of Vulcan data, as well as an emerging sister program at Purdue

University, the Hestia project, indicates there is plenty of additional work for all parties. [*Hestia combines diverse data about the flow and metabolism of the energy-emissions-climate nexus in an intuitive, interactive, photorealistic, three-dimensional visualization of the Earth.*]

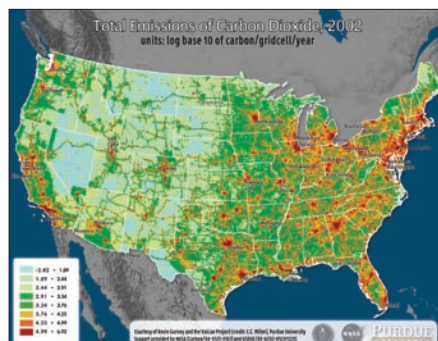
Contributing GIS and geospatial technologies to an atmospheric sciences project was not accomplished without some disruption. The lexicons that atmospheric scientists and librarians use to communicate do not always equate, nor do the dictionaries of GIS and atmospheric modeling. In addition, the small Vulcan team is required to move large datasets from place to place.

There has not been time to fully develop all the infrastructure needed to automate and streamline the project's work. However, as part of the academic trend toward more interdisciplinary scholarship and research, Vulcan is already producing valuable data and tools. Atmospheric science has been the primary beneficiary; computer graphics, geoinformatics, and data librarianship will also benefit from the labor dedicated to and lessons learned from Project Vulcan.

While all Vulcan's components are scheduled for improvement, the data used to surrogate emission sources and the automated spot-check mapping infrastructure used to quickly examine model output will be among the first enhanced. Future additions to the project will include intelligent, automated data archiving and online interaction with data. These additions will ensure that—while the computer scientists, computer graphics specialists, and atmospheric scientists will have their hands full with software, visualizations, and important new analysis—there will still be plenty of work for the resident librarian.

Some geoinformatic aspects of Vulcan were used in an inaugural geoinformatics course taught by Purdue faculty members (including the author of this article) in spring 2008. Project members expect that successful models for working with and disseminating Vulcan data will filter into other initiatives for improving accessibility to geodata across the Purdue campus.

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The project is funded by the National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy (DOE) and led by Kevin Gurney, assistant professor of earth and atmospheric sciences at Purdue University in West Lafayette, Indiana.



# Inside the Metaverse

## A Second Life for GIS education

With online delivery of education becoming more prevalent, emerging technologies will have a profound and lasting impact on how GIS courses are taught in the near future. One such technology, the metaverse (or digital universe), provides exciting possibilities for building learning communities, enhancing social presence, and creating more shared intellectual landscapes than ever before.

One such world, Second Life, is already providing opportunities for in-world discussions, project collaboration, GIS consulting, and even re-creation of real worlds inside the metaverse. Second Life is one of the better-known metaverses and has long been involved both in the development of a social network and the application of its digital environments to education.

Both free and paid accounts are available. To join, go to the Second Life Web site ([www.secondlife.com](http://www.secondlife.com)), start up an account, choose a name for your avatar (your digital alter ego), download the client software, and enter the brave new digital world. You will be asked to decide what your avatar will look like—you can be male, female, or even a furry creature. Finally you will be taken to Orientation Island to learn how to get around, do commerce, and communicate in this metaverse. You can even purchase land if you have a paid account.

New Mexico State University (NMSU) is one of a growing number of universities that have purchased virtual land inside Second Life to use for teaching. At NMSU last semester, some students in the *Fundamentals of Geographic Information Systems* course joined Second Life and formed study groups on a portion of virtual land called Aggie Island. Every week, they provided a selection of Microsoft PowerPoint slides from the previous week's lectures, converted to JPEG files so they can be uploaded to a functional display board on Second Life.

These students got together to study every Sunday evening for an hour to an hour and a half. Because the students were required to respond to the instructor's questions by typing, they not only learned the material but practiced the responses they would eventually use in essay exams. This radically improved the students' test scores.

This semester, the GIS students will be using Second Life to collaborate on project-based learning laboratories, visit their instructor during virtual office hours, and, optionally, build three-dimensional models and animations that demonstrate their understanding of GIS concepts and software implementations. The instructor and students belong to a group that provides group



Dr. Michael DeMers and some of his GIS students at New Mexico State University get together to study for lecture exams on Aggie Island in Second Life.

chat environments, member lists and profiles, and defines their roles (e.g., if they have permission to add new members). Former students in the *Fundamentals of Geographic Information Systems* have been assigned alumni status and will be paid in virtual money to act as tutors and consultants to the current cohort of students. This allows former students to become part of a larger and ever-expanding learning community.

Other institutions are also demonstrating some really clever ways that Second Life can benefit the GIS learner.

The University of Texas at Arlington has created a kiosk for its GIS users to get help with the software and individual teaching or research applications.

The University of Illinois has a site that shows displays of GIS-derived maps of the state for people to examine.

There's also a GIS coordinator and part-time instructor from the City of Berkeley, California, who is transforming real lidar data to three-dimensional Second Life objects, called sculpts. These models allow people to view real-world topographic features up close in Second Life.

These objects can be made large enough to re-create real environments so students working on GIS projects, through the use of their avatars, can actually experience the environments they are modeling with GIS. Imagine, for example, being able to use virtual worlds to experiment with real-world modeling scenarios, do ground truthing, and collect data on locations of individual avatars using the in-world maps that are available in Second Life.

The possibilities for using Second Life for GIS and spatial analysis education are nearly limitless. Much like GIS itself, these applications are lim-

ited only by the creativity of the user (apologies to Jack Dangermond for paraphrasing). Metaverses are the future of education as well as commerce. Corporations that have presence in Second Life include Coca Cola, IBM, and Sony. Other organizations—publishers including John Wiley and Sons, Inc.; federal agencies such as National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA); and government bodies such as the United States Congress—exist in Second Life and often conduct real business.

There are groups of educators who are getting together to explore how Second Life can be used for learning. The Educator's Coop from the University of Texas (<http://educatorscoop.org/>) and the Technology Enhanced Learning and Research (<http://telr.osu.edu/>) at The Ohio State are two examples of these groups.

Even Linden Laboratories, creators of Second Life, have developed forums for sharing ideas about the myriad possibilities for using Second Life for learning (<http://www.sl-educationblog.org/>). The possibilities of using this content-rich environment for GIS education are exploding.

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# Nearly Two Centuries of Data

## Historical boundary and statistical datasets available from NHGIS

Seven years ago, the Minnesota Population Center embarked on an extraordinarily ambitious social science infrastructure project. The National Historical Geographic Information System (NHGIS) was designed to create and freely disseminate GIS-compatible boundary files and statistical information that includes virtually all aggregate census information for the United States since 1790. For the first time, a researcher can explore most of the census data available from 1790 to 2000 using GIS.

The project, funded by the National Science Foundation, has four main objectives:

- Create a comprehensive, high-precision spatial database of census tract boundaries for every decade since 1910 and county boundaries in every census year since 1790. These boundaries, which are fully compatible with Census Bureau TIGER/Line files, required the construction of more than 200,000 polygons.
- Collect and enrich a massive database of historical and contemporary U.S. summary data on population, housing, agriculture, manufacturing, business patterns, voting, and other georeferenced statistics that comprise a total of 750 gigabytes of data drawn from more than one million separate source files. This involved manual data entry of key datasets from printed or manuscript sources,

correction and editing of existing datasets produced by other researchers, and reformatting census-produced data to maximize efficient storage and access.

- Develop machine-readable metadata for the entire collection, representing a total of more than five million lines of tagged and structured codebooks.
- Design and implement a data retrieval system based on 100 gigabytes of indexes with a Web-based interface that allows simple and free access to digital GIS boundary files, statistical data, and metadata.

Meeting these objectives required the dedication of 20 research and professional staff members and thousands of hours of labor. The first phase of NHGIS was completed in March 2007. The system now has more than 3,000 registered data users. Since its initial release, the NHGIS has secured additional support from both the National Science Foundation and the National Institutes of Health to implement a number of enhancements.

In April 2008, NHGIS released additional GIS boundary files that correspond to additional geographic levels. The additional geographic levels for 1990 and 2000 include American Indian Areas, Congressional Districts, County Subdivisions, Places, Urban Areas, Voting Districts, ZIP Code Tabulation Areas, Census Block Groups, and Census Blocks. For 1980, Minor Civil Divisions,

Places, and the Block Numbering Areas were also released. With the additional GIS boundary files, the match between the statistical and the GIS boundary file data available in NHGIS is approximately 90 percent.

Developments in geographic standards, statistical infrastructure, and information technology require that the NHGIS be regularly updated to capitalize fully on this investment in social science infrastructure. The following improvements are planned to be phased in over the next four years. Enhancements that include realigning boundary files, adding the most recent data, and integrating geography and data over time will maximize the usability of NHGIS for the research community.

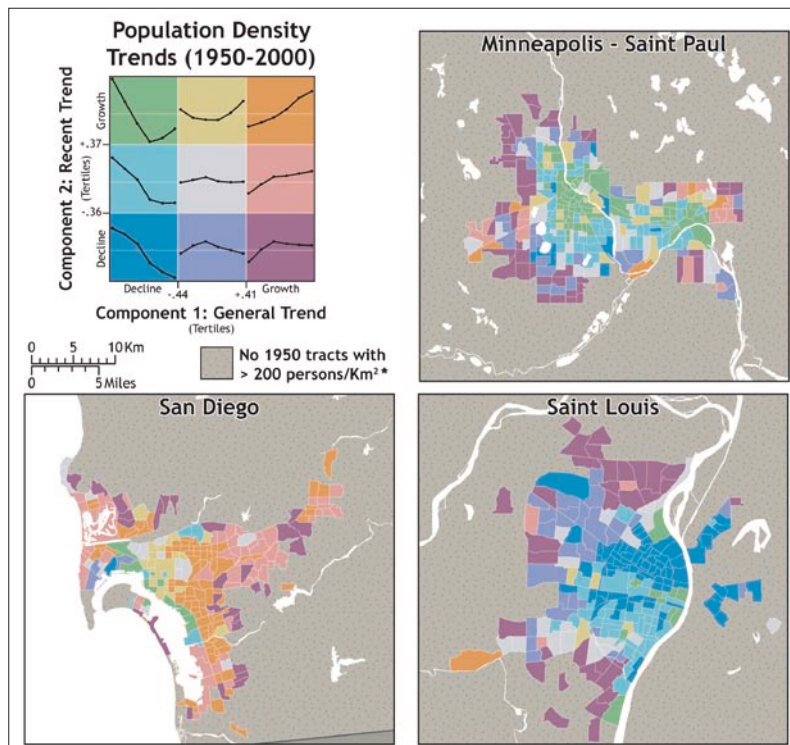
Realignment of NHGIS boundary files will ensure compatibility with new standards. In preparation for the 2010 Decennial Census of Population and Housing, the U.S. Census Bureau is carrying out the Master Address File/Topologically Integrated Geographic Encoding and Referencing Accuracy Improvement Project (MAF/TIGER AIP). Improving the accuracy of TIGER features has serious implications for the NHGIS database. NHGIS leveraged features in the 2000 TIGER/Line files to construct historic census tract and county boundaries. The historical NHGIS files will be realigned to correspond to the newly updated and released Census 2010 boundary files.

The most recent data from the American Community Survey (ACS) will be added. For the past five decades, the principal source of georeferenced summary statistics for small areas has been the long-form samples of the decennial censuses. The Census Bureau is now replacing the long form with the ACS. This new survey method offers many advantages over the census long form, but also poses new challenges. For example, data is collected continuously rather than on a specified census day, and the reference period for aggregate statistics varies according to the population size of the geographic unit.

Continued efforts will concentrate on providing data to researchers, educators, businesspeople, and policy makers. To visualize the data without having to download and use a statistical package or GIS software, NHGIS has partnered with [www.socialexplorer.com](http://www.socialexplorer.com) to provide users with ready access to simple visual representation of the NHGIS data.

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The National Historical Geographic Information System creates and freely disseminates GIS-compatible boundary files and statistical information for the United States since 1790.



# Making the Connection with Content

## Covering multiple subjects and teaching critical thinking with GIS

By Barbaree Ash Duke, Educational Consultant and Veteran Teacher

### What does GIS have to do with English and language arts?

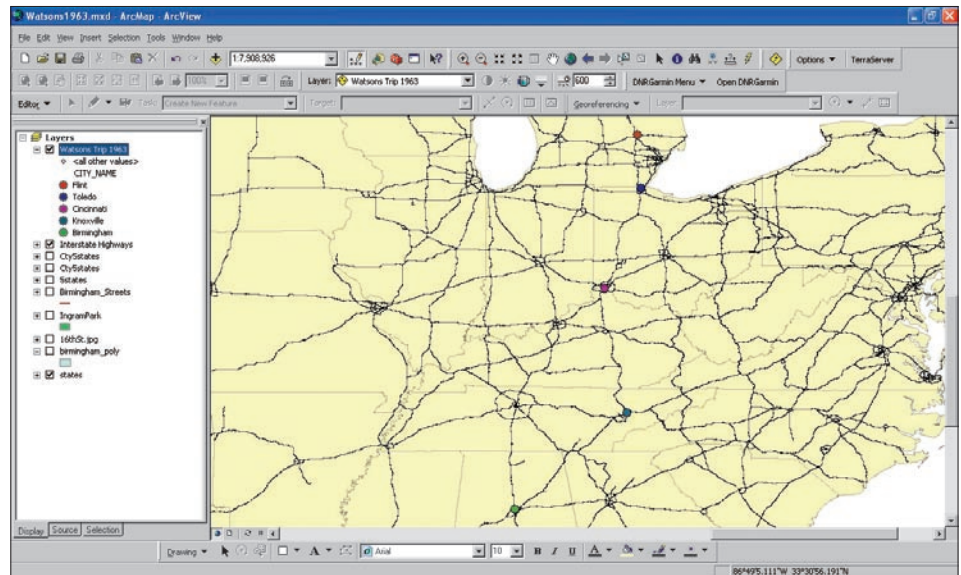
As one of my seventh graders told me several years ago, “Everything’s mappable, Mrs. Duke!” A tenth grader reminded me that often it’s difficult for them to relate to characters and situations in “dusty, old books written by a bunch of dead people.” Many students are familiar with virtual globes and Internet mapping. GIS is an excellent tool to give students that valuable connection to course content and teach them through analytical learning experiences.

English and language arts are steeped in tradition. For students who are glued to reality TV, texting, and instant messaging, the subject seems archaic. Diving into a great piece of literature and doing serious analysis of characters and symbolism seems “old school” to the current generation of students.

GIS gives opportunities to easily connect students to history, journeys, authors, settings, documentary reading, geography, poetry, creative writing, and research in a way that appeals to their graphic-driven culture. In addition, these connections are excellent building blocks that show purposeful learning across the curricular boundaries.

*The Watsons Go to Birmingham—1963* by Christopher Paul Curtis offers a great opportunity to connect several core subject areas into one unit of study. This award-winning novel takes students on the Watson family’s journey from Flint, Michigan, to Birmingham, Alabama, in the summer of 1963. The family arrives in Birmingham at one of the darkest moments in United States history—the bombing of the 16th Street Baptist Church, which killed four little girls and injured many other people.

It makes sense to look at a journey like this one on a map. The related GIS activity, 1963—A Journey North to South, begins by having students experience the journey itself. The story details the adventures the family experiences along the way. Students analyze what this trip would cost in 1963 versus today. If students are also studying environmental issues in science or social studies class, they can write an assignment that assesses what a trip like this one costs environmentally. To complete it, they use math to measure mileage, calculate miles per gallon, and determine cost. This information helps students decide who had the best plan: Mom or Dad Watson? (Because Dad



*The Watsons Go to Birmingham—1963* by Christopher Paul Curtis takes students on a journey with the Watson family from Flint, Michigan, to Birmingham, Alabama, in the summer of 1963. The first exercise is to map their route.

was driving the car, the family adopted his plan until they arrived.)

Set against the racial tensions of the civil rights era, this story about a middle-class black family recounts how they felt nervous about stopping in the Tennessee mountains, especially at night. GIS allows students to quickly examine the black population in 1960 and 1999 and decide if the Watsons should have been concerned.

Bringing an educational spin to a familiar subject helps keep students engaged. After their GIS journey, students can explore travel trivia about their state or take a virtual field trip to the Birmingham Civil Rights Institute. These explorations give students the necessary content to create written conclusions with supporting evidence from their maps. As a result, students understand the purpose of their learning as they connect to the story.

Learning about an author is another way for students to connect to content. They can “live” part of the author’s life. Most literature textbooks have biographical information about the author before each reading selection. In another GIS activity, Twain’s Travels, students learn about traveling on the Mississippi River and being a riverboat pilot. This gives students better insight into Twain’s characters.

To learn how other educators are connecting literacy and geography, check out *The Journal of Geography* published by the National Council for Geographic Education ([www.ncge.org](http://www.ncge.org)). Two re-

cent articles connect geography with English and language arts. The first article, “Mapping Skills and Activities with Children’s Literature,” is by Dr. S. Kay Gandy and appears in the November/December 2006 issue. The second, “The Stealth Approach: Geography and Poetry,” by Dr. Diane Carver Sekeres and Dr. Madeleine Gregg, appears in the January/February 2008 issue. Both articles offer excellent examples, resources, and research to support connecting literacy and geography. In addition, this organization has an outstanding reputation for providing support to teachers and students on any subject.

In these days of stressful testing requirements for students, teachers need the best tools to help students succeed. GIS is a cool tool that gives educators the time to cover multiple subjects and teach students how to think critically while maintaining high student interest. In just a short time—a class period or two—students can cover four subject areas and connect personally to what otherwise would have been just another reading assignment.



# Helping an At-Risk Population

## Developing an education model for alternative high schools

By Helenmary Hotz and Jun Zhu, Environmental, Earth, and Ocean Sciences (EEOS), University of Massachusetts, Boston

A growing population of students, living in major cities and metropolitan areas across the United States, are at risk in the public school system.

The ability of these students to succeed in a conventional public high school setting is limited by their history of disciplinary problems and/or substance abuse. Their problems leave them outside the school system with no one to urge them to obtain a diploma or GED. They are without structure or positive input to access available jobs. There is a real fear that these students may never acquire the proper skills to gain employment.

Action for Boston Community Development (ABCD), Boston's antipoverty agency, has developed a program that addresses this issue. ABCD's University High School (UHS) is an alternative high school serving students who are overage, struggling academically, or otherwise at risk in the traditional school system. UHS allows students to complete courses at ABCD and earn a Boston Public School (BPS) diploma from their original high school. UHS provides an intensive learning experience, small classes of 15 students

or less, case management, and computer and media labs.

The City of Boston negotiated with ESRI to integrate all city departments on a citywide enterprise GIS platform. This integration presents new job opportunities for Boston residents who are familiar with or skilled in GIS applications and analysis.

To help this underserved student population meet the criteria for Boston's GIS workforce, the authors applied for and successfully received a Healey Public Service grant, a University of Massachusetts, Boston, intercampus funding opportunity. This grant provided the authors with the chance to develop an innovative teaching model that integrates geography and GIS. The objective is to deliver instruction in both natural and social sciences on a GIS platform. The teaching model allows students to gain the spatial technology skills needed to build a bridge to careers in the geographic information technology industry.

The ESRI Press textbook *Mapping Our World: GIS Lessons for Educators* was ideal for this course. It covers both physical and human geog-

raphy but allowed the authors to pick and choose which chapters would be used in class demonstrations during the twice-weekly visits to UHS over a 10-week period. The course began by covering basic geographic concepts such as the size and shape of the earth and map projections. In addition to using the text, the basics of other spatial technologies, such as remote sensing and GPS, were covered. These are technologies that students are already familiar with through their use of cell phones and weather reports. At the end of the course, students wanted to work on a group project that would map crimes with guns in their neighborhoods in Boston. Using Boston neighborhood crime data and data from the Massachusetts Geographic Information System (MassGIS), students developed GIS and spatial skills that will serve as stepping stones to real jobs in Boston's new GIS industry.

Over the 10-week course period, the authors were able to attract and hold most students' interest. Three students expressed an interest in taking

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# Inspiring the Next Generation of Conservation Stewards

## SCA offers GIS-GPS internships and services

It began more than 50 years ago.

From the white-hot deserts of the Southwest to the glacial summer meadows of Alaskan national parks, a force has quietly been spreading.

The culprits are young people. These students and young professionals aren't aiming to litter or destroy; they're part of the Student Conservation Association (SCA), a nationwide youth movement bent on inspiring the next generation of conservation stewards through hands-on service to the land.

Most people familiar with the history of the SCA think of trail work as the organization's key focus. While the organization may have initially worked on trails, today the SCA provides hundreds of internships in areas as diverse as archaeology, visitor interpretation, water monitoring, and zoology. SCA members are young adults of high school and college age from all academic and personal backgrounds who are committed to conservation and interested in gaining real, hands-on experience. They build trails, map habitats, guide interpretive hikes, study plants and animals, and participate in many other conservation-related projects in America's urban and rural parks and public lands. Members work in both the backcountry and front country, indoors and out.

Through their internships, members learn invaluable skills such as wilderness first aid; data collection; public speaking; scientific monitoring; botany; and Leave No Trace, a set of principles to minimize impacts on the natural environment. In recent years, SCA has added new skill sets to that list: GIS and GPS.

SCA members who participate in the Firemon program ([www.thesca.org/Firemon](http://www.thesca.org/Firemon)) learn how to use GPS to navigate to remote backcountry sites where they gather data on local plants and fuel conditions. This data is blended with a national database that aids land resource managers and helps agencies make informed, environmentally conscious decisions about wildfire management. SCA members also learn how to create their own maps using GIS software. They acquire an impressive array of field-tested technical abilities from SCA that often makes students much more marketable to employers.

Ben Butler, program manager for the Firemon program, says that SCA has become a leader in the field of wildfire data collection. "Today SCA not only provides internship opportunities for young people but, additionally, we provide training and technical support to our agency partners," he said.

But Firemon isn't the only technical internship



SCA members are committed to conservation and gain real, hands-on experience through working on projects.

SCA offers. Currently the organization has more than 100 technical internships in its database. The opportunities range from managing Web pages and online fire information at the National Interagency Fire Center in Boise, Idaho, to building databases that catalog artifacts in Yosemite National Park and using GIS to delineate black bear home ranges in Sequoia and Kings Canyon national parks.

Don Hunger, SCA's senior director for partnership development, said that the organization is currently increasing the number of technical internships. "SCA recognizes the importance of using both GIS and GPS technologies in the natural resources field," said Hunger. "Our emphasis on GIS-based programming allows us to provide diverse opportunities for young people to learn these technologies."

More and more applicants are noticing SCA's technical side. Hannah Burgard, a GIS specialist intern in the organization's Boise, Idaho, office, feels that her six-month internship provided her with opportunities in the GIS world that she never might have experienced otherwise. "Working with the SCA has given me the opportunity to learn about the industry-leading GIS technologies including ESRI's ArcGIS Server," she said. "The internship has allowed me to build my resumé while providing a service to further conservation work throughout the country."

Each year, SCA inducts thousands of new conservation volunteers into its programs across the nation. In 2007, the 50,000th volunteer joined SCA. The nonprofit celebrated its 50th anniversary by holding a sold-out, four-day conservation summit. Earth Vision was held in April 2008 in Washington, D.C.

The organization is well known among federal agencies and school campuses. The National Park Service (NPS) was SCA's first partner. In 1957, the agency helped SCA set up two crews at Olympic and Grand Teton national parks, where they completed needed trail work and other duties. NPS continues to work with SCA every year to provide new work projects for young people. SCA volunteers now have the opportunity to work in nearly 500 national parks, monuments, forests, and other public lands across the United States. About 12 percent of current NPS staff got their start as interns with SCA. According to Grace Gordon, a ranger in the NPS, "My SCA experience, the people I worked for, and the people I met in the park last fall during my internship are the reasons I am now a park ranger."

SCA was founded because a college senior at Vassar became concerned with the state of the nation's national parks. In 1954, Elizabeth Titus Putnam (then Cushman) wrote her thesis outlining a plan for a volunteer student workforce. Her professor encouraged her to put the idea into practice. More than 50 years and a lot of labor later, SCA has become the nation's largest provider of conservation service opportunities.

For more information on how to become an SCA intern, visit [www.thesca.org](http://www.thesca.org). Additionally, if you would like more information on how to partner with SCA to accomplish your GIS/GPS-based projects, contact Don Hunger ([dhunger@thesca.org](mailto:dhunger@thesca.org)) or Ben Butler ([bbutler@thesca.org](mailto:bbutler@thesca.org)) for more information.

## Becoming Citizen Scientists

database. In the last two years, Dr. Connie Walker of the National Optical Astronomy Organization (NOAO) has implemented sky quality meters (SQMs) for this program that are used in conjunction with naked eye observations. The SQMs, manufactured by Unihedron of Ontario, Canada, provide a direct measurement that can be repeated.

NOAO loaned two SQMs to Betsy Wilkening's seventh grade class at Wilson K-8 School. Armed with an SQM and a GPS receiver, students set out to measure light pollution. They acquired latitude/longitude coordinates using the handheld GPS unit. With the SQM, they collected a digital reading of the integrated sky brightness for that location.

Darker skies register higher values on the SQM. This information was gathered at various locations during a moonless two-week period. Parents drove students to various locations to measure sky darkness. Caroline, one of the students, commented, "I had a lot of fun with my mom when she drove me to do that. It was amazing because now I can apply this science lesson to real life."

Students inputted their observation data into the international GLOBE at Night database. The students contributed approximately 5 percent of the 660 worldwide digital measurements in the program. They also contributed many of the 6,838 naked eye observations. Their measurements are now on the worldwide map created by ESRI and GLOBE at <http://www.globe.gov/globeatnight/analyze.html#>.

As an extension to this project, a local map was created using ArcGIS. Darkness patterns became apparent to the students when their SQM readings were plotted across the city of Tucson. This also raised concerns about suburban areas with lots of light pollution. Students will be able to add data on population and other factors to help them understand these readings.

Science projects often generate more questions than answers. This project was no different. It awakened an interest in obtaining and analyzing data that would make a positive impact on the community. Plans are being made to measure light pollution in other areas of the community throughout the year. A partnership has been created between teachers, students, and scientists at NOAO to continue this project in conjunction with the International Year of Astronomy in 2009. The students are excited and want to expand their citizen scientist role to become advocates who will protect Pima County's precious natural resource—dark skies.

For more information, contact Betsy Wilkening at [ewilkening@amphi.com](mailto:ewilkening@amphi.com). Light pollution information, recommendations, and an impact report on Pima County can be found at [www.darksky.org/mc/page.do](http://www.darksky.org/mc/page.do). Additional information on the GLOBE at Night project is available at [www.noao.edu/](http://www.noao.edu/).

## National Collegiate Conference Competition

### Business Analyst Online used to solve a complex business problem

For the second year, ESRI provided GIS software and staff resources to assist in the design, staging, and judging of the Business Intelligence (BI) Competition at the Association of Information Technology Professionals (AITP) annual National Collegiate Conference held March 27–28, 2008, in Memphis, Tennessee.

The BI Competition was hosted by Central Michigan University (CMU) and the Central Michigan University Research Corporation (CMU-RC). The objective of the competition was to introduce the use of GIS and BI software tools to a large audience of future technology leaders.

"We chose ESRI's Business Analyst Online software because it is a true BI tool that combines GIS technology with extensive business, consumer, and demographic data to deliver relevant reports and maps," said Roger Hayden, CMU-RC. "The software was also easy for us to integrate into the competition because it is a Web-based solution and doesn't require that any additional software be installed on the participants' computers."

Sixteen undergraduate and four graduate teams were given four hours to solve a business problem that involved prioritizing potential retail store locations from a list of six available sites to obtain the highest revenue-to-asset ratio. A budget of \$85 million and a set of key factors were part of each analysis. Participants used Business Analyst Online trade area analysis tools, such as drive-time

and buffer analyses, and its reporting functionality to generate demographic, consumer spending, market potential, and retail marketplace profit reports to derive revenue-to-asset ratios based on primary, secondary, and tertiary service areas for each potential site. Contestants used the Excel data retrieval feature in Business Analyst Online to make the query results readily available for their continued economic analysis in a spreadsheet.

Most participants had no experience using GIS software prior to preparing for this competition. However, they found Business Analyst Online to be an intuitive software tool to use. "Business Analyst Online comes with comprehensive documentation and well-organized tutorials that made it easy for most of the students who had never used the software to get up to speed quickly," says Tim Pletcher of CMU.

Findings were presented to a panel of judges in a three-page executive summary that included maps (as appropriate). The top three graduate and undergraduate placing entries received awards. Select other entries were recognized with honorable mentions.

"ESRI is proud to partner with AITP and the National Collegiate Conference," said Simon Thompson, ESRI commercial business industry solutions manager. "We are committed to providing the best education for future business leaders and are pleased to offer hands-on experience to show how the geographic advantage benefits companies."

Category	Place	Winner	Institution
Under-graduate	First	Zach Waugh Nick Tuttle	Oklahoma Panhandle State University
	Second	Nathan Bower	University of Alaska, Anchorage
	Third	Steven Bauer Matthew Brickner	Central Michigan University
Graduate	First	Adeyinka Owotuyi Iris (Yuyin) Qiu	Central Michigan University
	Second	Robb Winkie	Missouri Western State University
	Third	Shirish Modi Nilesh Hardikar	University of Central Missouri



# New Mexico Sweeps Geospatial Competition

## Students take top awards at SkillsUSA

Students from the Geographic Information Technology (GIT) program at Central New Mexico Community College (CNM) in Albuquerque, New Mexico, walked away with the gold, silver, and bronze medals at the SkillsUSA Geospatial Competition.

The SkillsUSA Geospatial Competition, co-sponsored and supported by Digital Quest, Inc., and ESRI, lets educators enhance students' learning opportunities while promoting GIS. SkillsUSA is a national organization that sponsors competitions for high school and postsecondary students in a wide variety of fields. In 2005, it added the postsecondary geospatial competition. The competition currently consists of a GIS-based project, which the students complete over a five-week period, and a written and software-based exam. Students complete an online application. If they are selected, they travel to the SkillsUSA National Finals event where they present their projects to a panel of judges and take exams.

After visiting the national competition last year, Amy Ballard, chair of geographic information technologies programs at CNM, decided to participate. "There is a lot of support for SkillsUSA at my college, and we send students to compete in a variety of contests. After seeing the competitions in person, I just knew I had to get my GIT students involved."

The process started by selecting the GIT students who would participate through an in-house competition at CNM. Students in the intermediate GIS class completed a software-based exam. An advisor from the program's industry advisory committee judged the entries, which required the students to use real data from Bernalillo County to analyze the decline in building permit requests from 2006 to 2007. The top four selected continued to the SkillsUSA competition.

These students received the information on the project for national-level competition in early May. They were tasked with developing an emergency management plan for the school. To prevent duplicate efforts, each student selected one of the five CNM campuses or facilities in Albuquerque. Students gathered or created data relating to fire hazards and emergency management. This process demonstrated the potential benefit to the school designated for the project.

The school currently maintains much of its security information in hard-copy format. This project was a great opportunity to put that data in digital format. In cooperation with the CNM Security and Facilities departments, students obtained information about floor plans, fire extinguisher lo-

cations, emergency assembly points, and other materials. Additional information was gathered during student visits to the campuses to identify exit routes, alarms, and other features.

In addition to compiling and digitizing hazard-related data, students analyzed the data to identify safe areas, fire hazard zones, and the quickest routes to hospitals and fire stations. Reports detailing these activities and products were created for the projects.

The students presented their work in Kansas City, Missouri, and took a required exam on geospatial concepts and methods during the week of June 23–27, 2008. Three CNM students took home the top honors: David Jacobs received the gold medal, Tom Elliot received the silver medal, and Darryl del Frate received the bronze medal. Jeff Simpson, also from CNM, participated. Each student will receive an ArcInfo license as well as a monetary prize, both donated by ESRI.

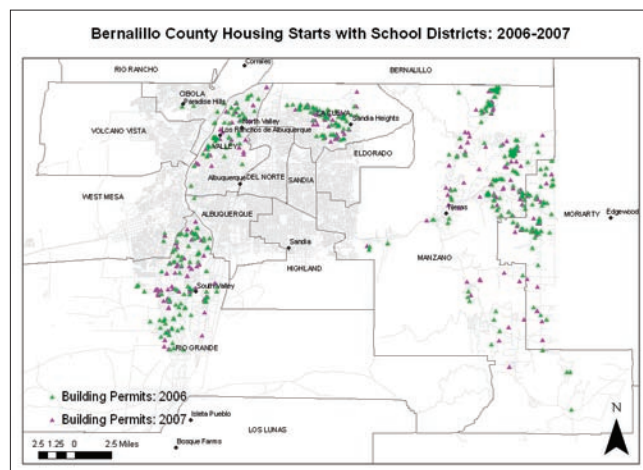
The competition was a great opportunity for the students and the school. In the near future, the students will present their projects to the CNM Security Department in the hopes that the GIS data will be integrated into the school's operations.

College and high school educators can learn about the SkillsUSA Geospatial Competition to be held in Kansas City, June 22–23, 2009, by contacting Eddie Hanebuth at [eddieh@digitalquest.com](mailto:eddieh@digitalquest.com) or visiting [www.digitalquest.com](http://www.digitalquest.com). Registration deadline is March 2009. For more information, contact

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### Acknowledgment

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Map from in-house competition

*Continued from page 6*

### Helping an At-Risk Population

additional GIS-related courses. One student, who is interested in a career in real estate, saw the value in applying GIS and geographic analysis to real estate applications. Overall, the program disseminated information about the concepts and application of GIS and geographic principles to answer scientific questions, solve real-life problems, and facilitate employment opportunities.

This model was developed and implemented at University High School as a pilot study funded by a University of Massachusetts system internal grant. In the future, external funding will be sought to improve and extend the model to include other high schools and two-year colleges. Expansion of the model to accommodate different disciplines and workforce needs in industries such as marketing, health care, law enforcement, and emergency response is envisioned.

To learn more about ABCD, visit [www.bostonabcd.org](http://www.bostonabcd.org).

### Acknowledgments

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# Making Your Point with Marker Symbols

## How to create custom symbols from photographs

By Joseph J. Kerski, Ph.D.,  
Education Manager, ESRI

ArcMap in ArcGIS Desktop comes with hundreds of point, line, and area symbols for use when symbolizing features on maps. Point marker symbols, both two- and three-dimensional, have been designed for use on maps dealing with geology, environment, business, transportation, public safety, weather, and many other themes.

Did you know that, in addition to these premade symbols, you can create your own symbols? A picture marker is one of the most helpful types of custom point markers, especially for teachers.

The spring issue of *ArcUser* included “Using GIS to Study Sports—Putting the where in baseball,” a tutorial I wrote for teachers and students that showed how to compare the coverage of radio stations broadcasting Kansas City Royals baseball games versus those broadcasting games of the St. Louis Cardinals. The lesson asks students to consider the size and shape of the two catchment areas in relationship to each team, to each other, and to other teams. In so doing, students learn about the geographic concept of diffusion and the business concept of market competition in a spatial context.

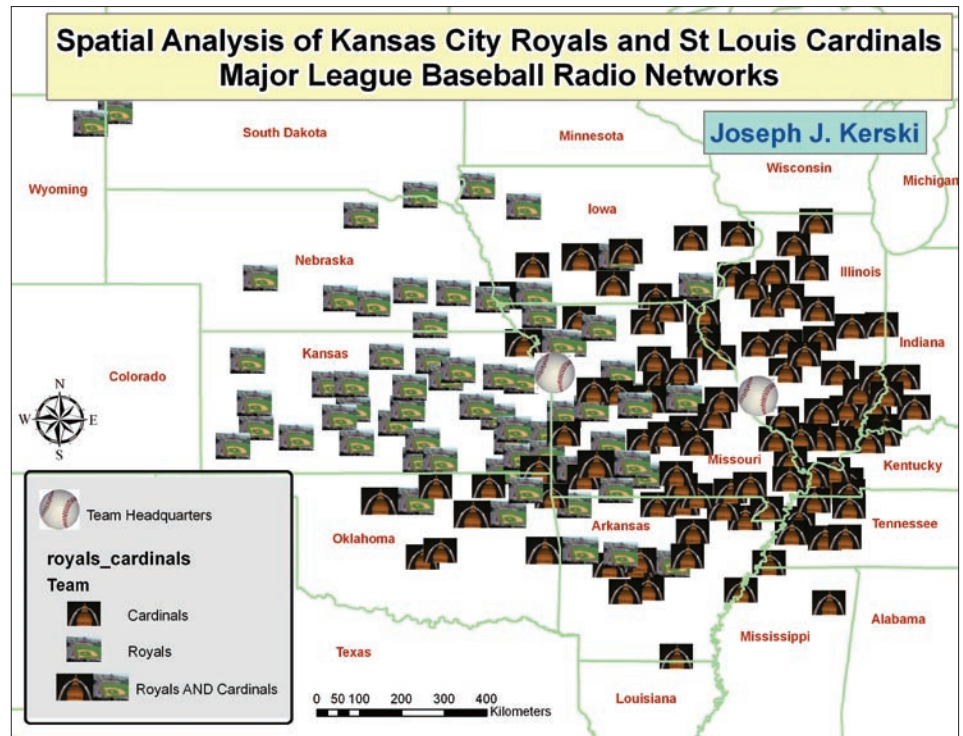
After finding lists of radio stations that broadcast the games for each team online, I added Team field in the attribute table for USA cities to indicate the team each station broadcast. I populated this field with the appropriate team name. I also noted cities that broadcast games for both teams.

To symbolize these cities based on this newly created field, I could use circles, stars, squares, or another standard point symbol. To let students more easily see the locations of the stations broadcasting each team, I created marker symbols from photographs I had taken. Photographs of Kauffman Stadium, home of Kansas City Royals, and the St. Louis arch were used to represent the two teams.

### Creating a Picture Marker

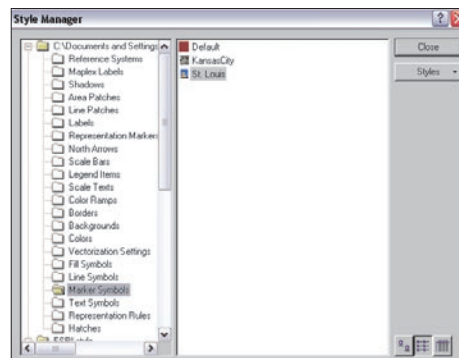
In addition to ArcGIS Desktop at any license level (ArcView, ArcEditor, or ArcInfo), a simple graphic program is required when creating picture markers from photographic images. The Paint program that comes with the Windows operating system or any program that can open a JPG format file and save it as a bitmap (BMP) file format will work.

1. To create a picture marker symbol, open the photograph in a graphics program and save it as a BMP file. Repeat this process for each photograph. For the cities that broadcast both teams, I created a panoramic image of both photographs and saved it as a separate file.



A picture marker is one of the most helpful types of custom point markers, especially for teachers.

2. Start ArcMap and choose Tools > Styles > Style Manager. In Style Manager, select the marker symbol style folder in the style tree where the new picture symbol will be saved. The style folders under Documents and Settings are associated with your logon and might be a good place to store custom markers.
3. Right-click on any part of the open space in the right pane of Style Manager and choose New > Marker Symbol.
4. In Symbol Property Editor, click the Type drop-down arrow and choose Picture Marker Symbol. Navigate to the location of the desired BMP file and select it.



After converting the photography to a BMP file, choose Tools > Styles > Style Manager.

5. If the picture is too large for the map at the scale in which it will be displayed, use Symbol Property Editor to resize it. You can also rotate the symbol, apply colors to it, change its angle, change its x or y offset, or make it transparent. When finished, click OK.
6. Back in Style Manager, assign it a name and click Close.
7. Repeat the process for each picture symbol.

### Using the Picture Marker

Once picture markers are created, they can be used on any map.

1. Open the desired map in ArcMap. Double-click on the layer to be symbolized in the table of contents.
2. In the Properties dialog box, click the Symbology tab. In this case, I selected Team as the value field to symbolize and chose Unique values under Categories.
3. Next to the symbol for each value, double-click the default point symbol to open Symbol Selector.
4. Make sure All is selected from the Category drop-down and scroll and select the desired picture marker. You can further refine size or other characteristics for display in your map. Click OK.

# Saving Some Green

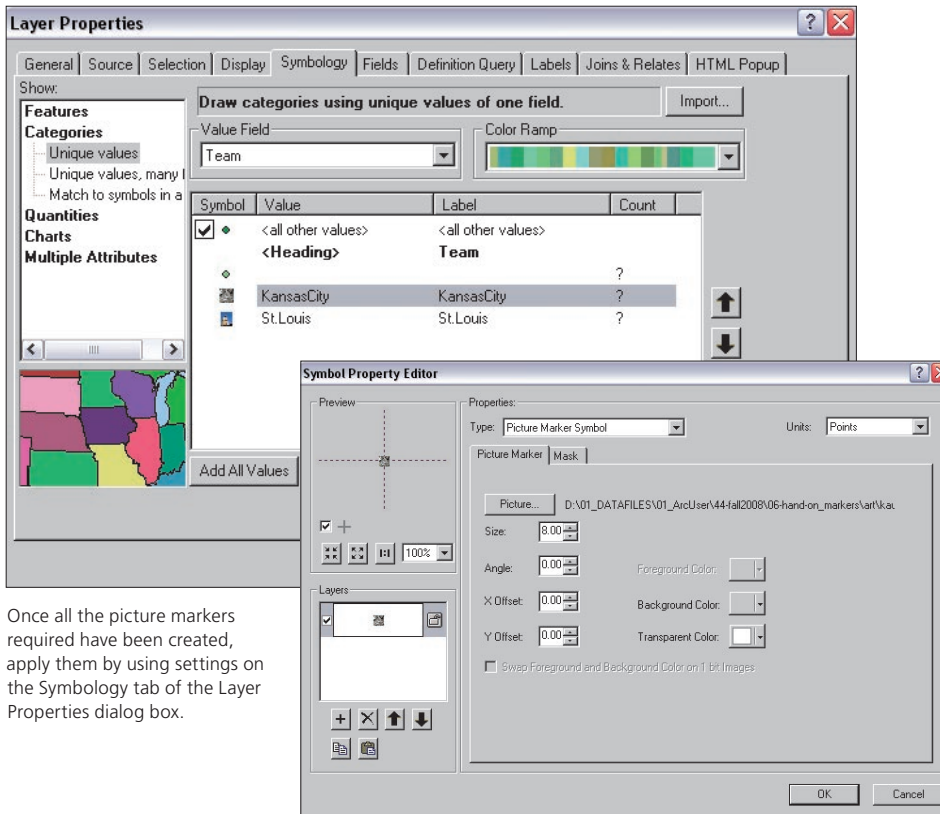
## ArcLogistics in the educational setting

Educational institutions, like many businesses, need to manage vehicle fleets efficiently. Whether these are maintenance vehicles, buses, or delivery trucks, the dramatic increase in the cost of fuel has made optimizing operations an even greater priority for schools.

With ArcLogistics, fleet managers can create optimized routes that solve scheduling problems, cut fuel costs, and improve customer service. From a small fleet operation to a large multiuser environment, ArcLogistics provides a quick and significant return on investment, not only in terms of dollars but also in environmental benefits. This “green technology” has helped cut fleet fuel consumption by as much as 30 percent in some cases.

Logistics is also a subject area for business and marketing programs or transportation planning and engineering curriculum, so ArcLogistics can be used in the classroom.

ArcLogistics 9.3, released in early October 2008, is part of the Site License Program. To learn more about ArcLogistics, visit [www.esri.com/arclogistics](http://www.esri.com/arclogistics).



Once all the picture markers required have been created, apply them by using settings on the Symbology tab of the Layer Properties dialog box.

After choosing to create a marker, use Symbol Property Editor to create and refine the picture marker symbol.

5. Repeat the process of changing the default point markers to picture markers. Click OK on the Layer Properties dialog box when finished.

### Storing and Sharing Picture Markers

Although custom symbols would typically be stored in Style Library under Documents and Settings > user name > Application data > ESRI > ArcMap, you can copy and store style libraries wherever you wish. Use Style Manager, located under Tools > Styles, to create, modify, and manage custom symbols.

If you need to share your customized symbols for others to edit, you can send the style file along with the map document and datasets. When others access ArcMap, they can load the style by accessing the Symbol Selector window.

However, using these symbols once they have been applied to a map doesn't require a style file. The symbol set gets saved with your map document (MXD file) so all that is needed is to share the map document.

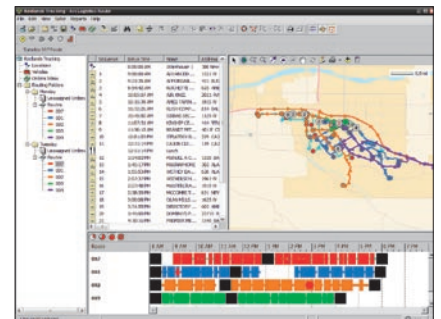
### The Bigger Picture

The ability to create and share picture markers opens up a whole new world of map symbology

and is an aid in understanding spatial patterns.

- A map of world cities could be symbolized with city images, using different types based on the size of the cities.
- An energy resources map could contain an image of a steam vent for geothermal and a turbine for wind energy.
- A community history project could include points symbolized as photographs of each house or with a graphic from the community Web site.

Be creative with picture markers and share them with others.



## Essays on Geography and GIS

*Essays on Geography and GIS*, the latest offering from the Best Practices series published by ESRI, is available online at no charge. This e-book is a collection of essays written by many of the top academics in geography and GIS technology. Previously published in *ArcNews* magazine, these articles provide insight into the power of spatial thinking and were written by Michael F. Goodchild, University of California, Santa Barbara; Jerome E. Dobson, president of the American Geographical Society; Dawn J. Wright of Oregon State University; and others. ESRI's Best Practices series contains more than 30 e-books that cover a wide range of topics in GIS. Visit the GIS Best Practices Web site at [www.esri.com/bestpractices](http://www.esri.com/bestpractices) to explore the list of offerings and download a copy free of charge.





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