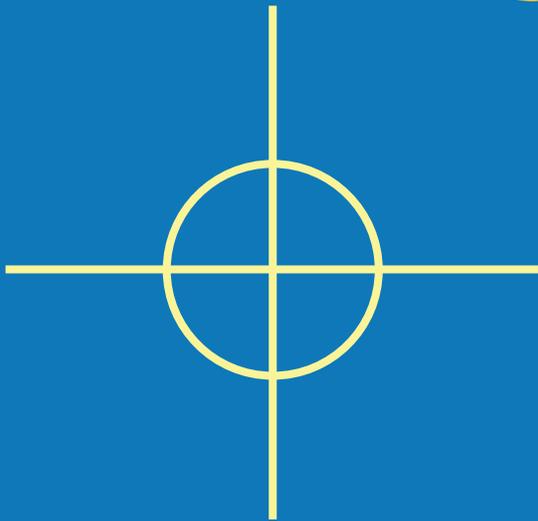


Careers in

Cartography and GIS



This booklet is published by the Cartographic and Geographic Information Society, whose mission is to support research, education, and practice to improve the understanding, creation, analysis, and use of maps and geographic information to support effective decision-making and improve the



www.cartogis.org

quality of life. CaGIS serves both students and professionals in the fields of cartography and GIS.



The US Department of Labor lists **Geospatial Technology** as one of three **emerging industries** with the **highest demand for workers and potential for growth** in the coming decade!



Careers in Cartography and GIS is published as a service to the discipline by the Cartography and Geographic Information Society (CaGIS) which is solely responsible for its content. It is an updated version (2008) of brochures by the same name published in 1998 and 2001.



Additional copies of this publication can be ordered for \$1 each, plus shipping and handling, by contacting CaGIS by e-mail (cagis@acsm.net), or by writing to: CaGIS, c/o ACSM, 6 Montgomery Village Avenue, Suite 403, Gaithersburg, MD 20879. Telephone: (240) 632-9522.

The brochure is also available for free; pdf download at www.cartogis.org.

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CaGIS is a Member Organization of the American Congress of Surveying and Mapping (www.acsm.net). CaGIS serves as the U.S. Member Organization of the International Cartographic Society (www.icaci.org).





CARTOGRAPHY? Hasn't the world already been mapped?

For the most part, yes, but professional map makers no longer just create maps of places that have never been mapped before. Think of all the different uses of maps that you've seen... tourists navigating around a new city, mountain bikers planning their next ride, businesspeople figuring out where to build a new store, scientists identifying all the different types of plants and animals in a region, weather reporters showing the paths of hurricanes... cartographers and geographic information professionals are working behind the scenes to collect **up-to-date information** and display them on **maps and computers** to help a diverse range of users do an infinite number of things.

So... it's more than just Rand McNally that hires map makers?

Rand McNally is a well-known company that has been producing maps for over a century, but people in the mapping sciences are everywhere: in **engineering**, **recreation**, **health care**, **city planning**, **environmental** and **earth sciences**, **planetary astronomy**, **real estate**, **local** and **federal government**, **universities**, **the Internet**... and since so much information in the world now is collected with geographic coordinates, **careers in the mapping sciences** are among the fastest-growing and most in-demand professions in North America.

This brochure will show you the wide variety of professions in **Cartography and **GIS**, two major careers in the mapping sciences using geospatial technology. Inside, we **introduce** you to folks who work with **maps and computers** every day, explain some **terms** and **tools** that you'll encounter all the time in this career, and tell you about the kinds of **jobs**, **salaries**, and **technologies** you'll find in **Cartography** and **GIS**.**

What is GIS? Should I learn about it if I want to be a map maker?

GIS stands for **geographic information systems**. In today's digital age, billions of pieces of data are collected every day, and much of this information includes a component that tells the geographic location of the data (this is called **georeferencing**). GISs are automated systems used to capture, edit, store, manipulate, analyze and display all this spatial data.

Almost all maps of places on the earth are created today using these computerized systems. **Becoming expert in GIS qualifies you for a huge array of jobs that use spatial information.**

GIS is about **much more than just making maps**, though. It's a tool with a mind-boggling number of uses, from modeling how far a toxic spill will reach given wind and water currents, to analyzing the best location for a new cell phone tower, to storing and maintaining data about global climate change, to finding the most energy-efficient route for your mail carrier, to helping government officials figure out how to get aid to storm victims, to

determining the vulnerability of a wetlands area to pollution.

As long as a project has a spatial component, GIS and mapping sciences can be involved. And guess what? **There aren't enough professionals who are expert in GIS to go around.** The digital revolution has created an unprecedented demand for people who understand how to make and use maps.

Job titles in Cartography and GIS

In the **private sector**, individuals are needed who are well versed in geographical and cartographic concepts but also feel comfortable working with the hardware and software that drive the applications. These positions reflect the growing importance of GIS in all sectors of society and require a unique combination of education and skills.

GIS Coordinator
 Technical Support Analyst
 Database Analyst
 Consultant/Project Manager
 Project Manager
 Software Engineer
 Internet Product Software Engineer
 Applications Programmer
 GIS Software Product Specialist
 Industry Marketing Manager
 GIS Instructor
 Data Publisher

Database and System Integrator
 Computer Mapping Technician
 GIS Database Administrator & GIS Systems Analyst
 GIS Manager/Information Services Planner
 GIS Manager/Senior Level
 GIS Specialist
 GIS Data Manager
 Senior GIS Analyst
 Senior Software Engineer
 GIS Sales Manager

Administrator & GIS Systems Analyst
 GIS Manager/Information Services Planner
 GIS Manager/Senior Level
 GIS Specialist
 GIS Data Manager
 Senior GIS Analyst
 Senior Software Engineer
 GIS Sales Manager
 Administrator & GIS Systems Analyst
 GIS Manager/Information Services Planner
 GIS Manager/Senior Level
 GIS Specialist
 GIS Data Manager
 Senior GIS Analyst
 Senior Software Engineer
 GIS Sales Manager
 GIS Analyst II

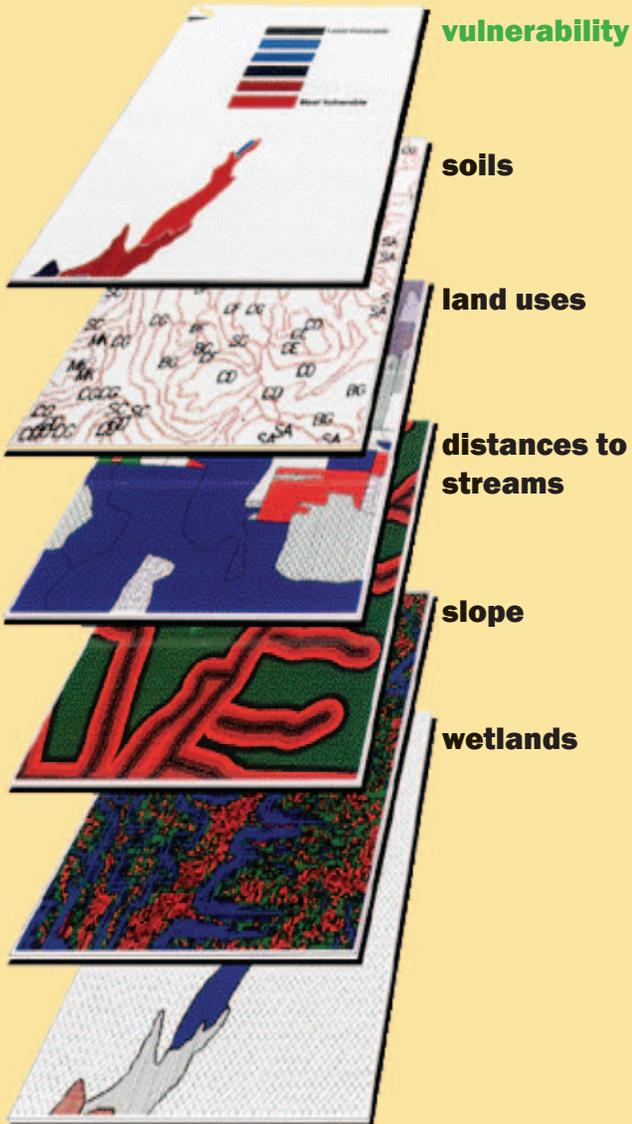


Some federal agencies with careers in cartography and GIS



National Oceanic and Atmospheric Administration
 National Geodetic Survey
 U.S. Geological Survey
 U.S. Fish & Wildlife Service
 Bureau of Land Management

National Park Service
 U.S. Forest Service
 Environmental Protection Agency
 National Geospatial Intelligence Agency



Using GIS

to determine vulnerability to pollution in a wetlands area

Data from satellites, aerial photos, digital maps, other digital data, and information in layers can be integrated in a GIS to answer questions such as how vulnerable a wetland might be to damage from nearby factories and homes.

Some mapping specialties

While most of us are most familiar with road maps and weather maps, there are several specialized maps for specific uses, and although they may use the same kinds of information, their requirements are different.

cadastral maps record and delineate legal property lines. Cadastral maps are critical to local governments, city planning, emergency response efforts, and real estate activities.

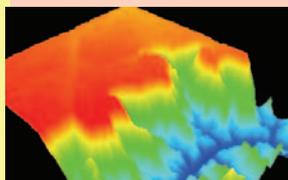
topographic maps represent the terrain - mountains and valleys - of the earth's surface. They also often include vegetation, buildings, transportation lines, boundary lines, water bodies, and place names.

nautical and aeronautical charts provide critical information about the elevation of terrain and the depth of water bodies. These maps are designed specifically for sea and air navigation.

image-based maps use aerial and satellite images like those on the base layer of Internet maps, combined with other data, such as reference grids or roads derived from conventional geometric map sources.

thematic maps portray the geographical distribution of specific geographic features such as soils, vegetation, geology, or statistics like population density, tax rates, or air quality.

geovisualization is a special category of map use that employs interactive and animated maps on a computer to display complex information about things like weather, sea temperature (El Nino), global warming, or greenhouse gases. These displays, often in three dimensions, represent an exciting new category of maps made possible through elaborate mathematical computations performed on computers.



Any advice for people thinking about a career in GIS? GIS is such a growing industry that you can make of it whatever your interests dictate. Almost all industries utilize GIS these days so you can pursue a job path that falls within your interest. Could be teaching, could be analysis, public health, oceanography, cartography, etc.... you can really work in a niche that you love.

maps.com

“

These days so many industries utilize GIS that there is a career path that can interest almost everyone.

University GIS coordinator

Describe your job and your duties.

As the GIS Coordinator, my primary responsibilities are to teach advanced GIS courses and coordinate the GISci (Geographic Information Science) Certificate Program. In addition, I assist in other university courses with GIS/GPS related course materials and act as a consultant for any GIS needs that the faculty and staff may have.

Why is your job rewarding or enjoyable?

It's enjoyable because I don't simply use GIS, but I also teach others to use the technology. To see a student go beyond what has been taught in class and use the technology for their own interests is very rewarding.

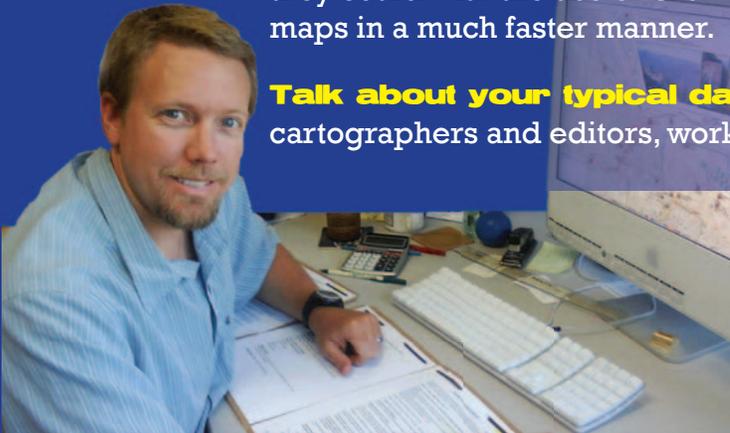


Cartographer of custom maps

Bryan Conant, Director of Mapping Services, maps.com

Describe your job and your duties. Maps.com was founded in 1991 and since its inception has become a leader in the custom mapping industry. My role at Maps.com is to oversee and manage the production of custom maps for our clients.

What types of education would you suggest to folks who are thinking about cartography or GIS as a career? My best advice for GIS students is to study design and cartography. On the other hand cartographers need to know GIS. Many 'old school' cartographers don't know GIS and as a result spend much more time creating their maps than they could with the use of GIS. GIS is a fantastic tool to get data and create maps in a much faster manner.



Talk about your typical day at work. I work with my staff of cartographers and editors, working with sales, problem solving, and dealing with our clients. I spend a lot of the day in front of the computer emailing, tracking numbers within spreadsheets, proofing maps, and occasionally producing maps. As a manager I am constantly looking at maps and researching ways to create maps faster and more accurately.

Coordinator Robbyn Abbitt, Department of Geography, Miami University of Ohio



How do you keep up with GIS? In order to stay productive with the ever-changing field of GIS, I frequently attend training workshops. It's critical to take advantage of local GIS user groups and workshops and to have knowledge of other GIS users.

Any advice for people thinking about a career in GIS?

My advice for those thinking about a career in GIS is to investigate taking courses in GIS. Many universities and colleges offer professional certificate programs in GIS. By completing these types of programs you ensure a future employer that you have the necessary training and education to be hired into a GIS position.

A study by the American Society of Photogrammetry and Remote Sensing (ASPRS) found that the biggest growth areas for geospatial professionals this decade will be environmental management and consulting, civil government, defense and security, and transportation engineering.

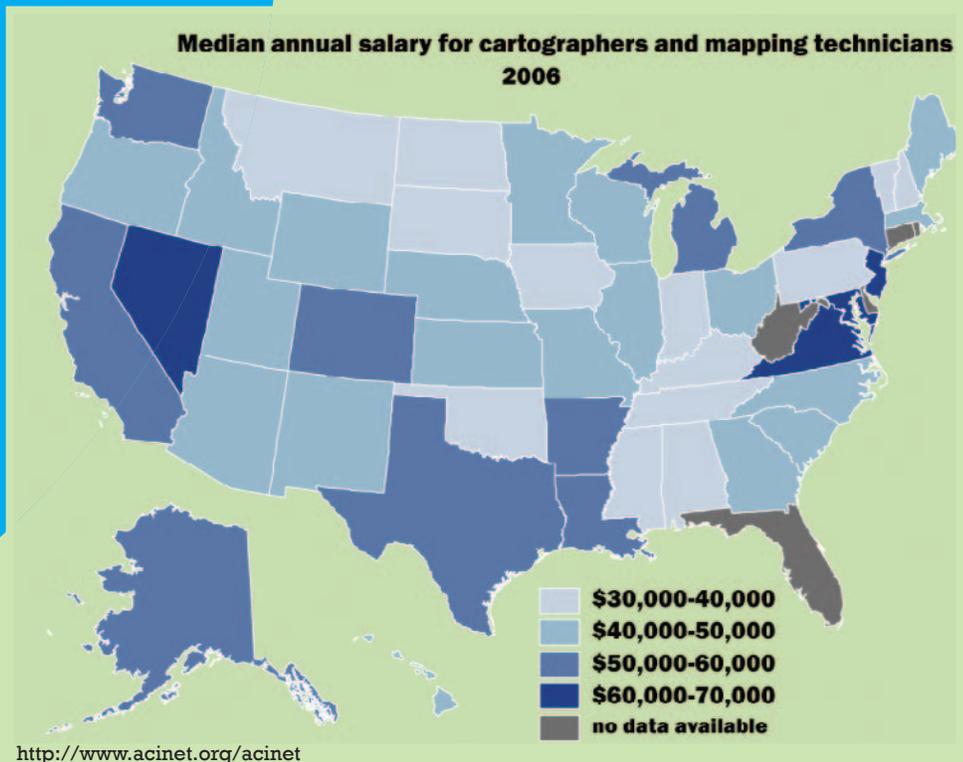
How much do cartographers and GIS professionals make?

Salaries vary considerably from one location to another. The map at right estimates salaries for cartographers and mapping technicians by state. The U.S. Bureau of Labor Statistics does not have a separate category of occupation simply called "GIS analysts" or "GIS practitioners." GIS analysts who concentrate on solving problems with geographic methods are called, simply, **geographers**.

In 2006, the median salary for geographers was about \$61,000. The highest paid GIS analysts are those who create new software or design databases; they are classified as **computer applications software engineers** or **database administrators**.

In 2006, computer applications software engineers had median annual earnings of about \$77,000.

<http://www.bls.gov/>



Web cartographer & project manager

axismaps

David Heyman, Axis Maps, Madison, WI

David is a co-founder of Axis Maps, a cartography company that focuses on "communicating information and the opportunity to turn data into knowledge." They create print, interactive, and mash-up maps.

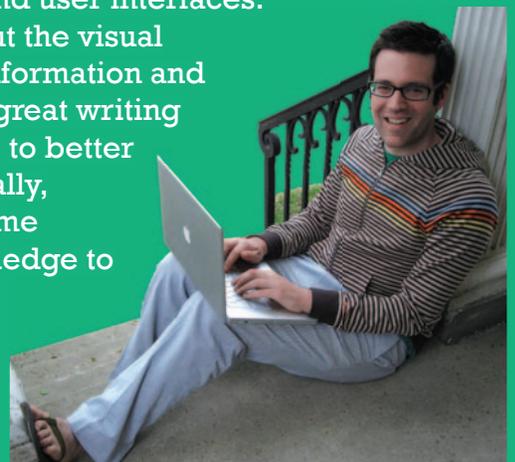
What's a hot job in cartography/GIS these days?

Interactive cartography... Web services like Yahoo!, Microsoft, and Google are letting people see geography in brand new ways and the Internet has opened up a massive portal to access and share data.

Any advice for people thinking about a career in mapping?

I think for a career in interactive cartography, someone should have three core skill sets. First, they should have a foundation in GIS and data management. Second, they should have a desire to design both maps and user interfaces.

Cartography is about the visual communication of information and great design is like great writing or speaking; it leads to better communication. Finally, they should have some programming knowledge to actually put all their great ideas to work.



How is a map made?

No matter what the purpose, making a map requires similar steps. Here is a summary of some of the major steps involved in producing a map.

Where do you get the data to put on a map?

Geospatial professionals can collect and evaluate mappable information first-hand through **field work**, or second-hand from **existing maps**, **aerial photographs**, **statistical reports**, or **computerized data files**.

Do you have to start with a blank computer screen every time?

Almost all maps now start with a base map that isn't created specifically for the map that's being made. In most cases, someone (often the local, state, or federal government) has already compiled detailed digital information, like streets and rivers and boundaries, and that information is available for map makers using GIS. Sometimes, the map maker needs to purchase data from a "vendor" if the map is really specialized. Because **no map or analysis is any good without accurate data**, it is important that databases are developed according to rigorous standards and carefully edited and maintained.

So let's say I have all this information - I'll just make a map. What's the big deal?

There are a lot of choices that a cartographer has to make when it comes to designing the map: how should the round earth be transformed to the flat page or screen (**map projection**), what size and extent should the map cover (**scale**), what colors and shapes should be on the map (**symbols**), how will it be printed or displayed? Fortunately, with computers, cartographers can now try out a bunch of map design choices - not so long ago, each change was really time-consuming and expensive.

And then the map is printed?

Lots of maps wind up on paper in some way - some using computer-driven printers and plotters, others using offset lithography. But nowadays there are many **digital ways to display the final map**. And the design of digital maps is different from those made on paper, and there are a lot of different digital formats. Imagine how different maps have to look if they're designed for **in-car GPS navigation system screens**, or tiny **cell phone displays**, or **online mapping applications**, or **video games**. A lot of modern mapping will be digital, and it's a good idea to be familiar and comfortable with computers - and even programming - as a future geospatial professional.



good stuff

to take in high school to prepare for a cartography or GIS career

Biology

Chemistry

Physics

English

Graphic Art

Foreign Languages

Social Studies

Algebra I & II

Calculus

Geometry

Trigonometry

Computer Applications

Computer Programming



▲ many maps designed for the Internet are now interactive in lots of different ways. This map interface from axis-maps (see page 8) lets users change colors and classes of the thematic map on the fly

going the distance

Many institutions now offer distance-education certification or degree programs in GIS online. Here are a few:



Birkbeck College

<http://www.bbk.ac.uk/Departments/Geography/online.htm>

California State University Bakersfield

<http://academic.csub.edu/~vkohli/giscert.html>

Charles Sturt University

<http://cilo.mit.csu.edu.au/gis>

Curtin University

<http://www.cage.curtin.edu.au/gis/distance.htm>

University of Denver

<http://www.du.edu/gis/>

Elmhurst College

<http://www.elmhurst.edu/~geo/GISCertProgram.html>

ESRI Virtual Campus

<http://campus.esri.com/>

University of Leeds

<http://www.geog.leeds.ac.uk/odl/>

University of North Dakota

<http://www.conted.und.edu/ddp/gis/>

Northwest Missouri State University

<http://www.nwmissouri.edu/gis>

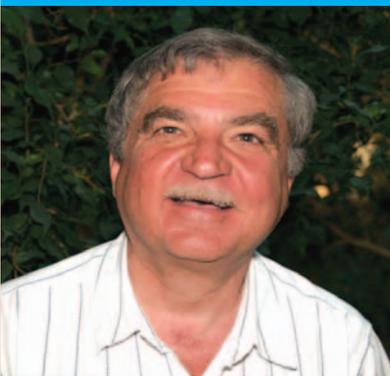
Pennsylvania State World Campus

<http://www.worldcampus.psu.edu/pub/programs/gis/Index.shtml>

University of Southern Queensland

<http://www.usq.edu.au/handbook/2002/engineer/Index.htm>

<http://www.ucgis.org/>



Academic Cartographer

Jon Kimerling, Professor and Author, Oregon State University

Many cartographers find their home in universities, teaching about maps, GIS, and geography, and conducting research in map creation, design, and understanding. Dr. Kimerling has written several books on cartography and is an editor of the *Atlas of the Pacific Northwest*.

When did you know that this is the career you wanted to pursue? I knew that I wanted to be a professor of cartography by the end of my undergraduate career when I discovered that I really liked explaining things about cartography to others, and that I liked doing research in cartography.

What kinds of education would you suggest if I'm thinking about cartography as a career? Cartography is an interesting career because it is a true blend of art, science, and technology. Making professional quality maps requires a strong education in geography with a focus on cartography and remote sensing, mathematics through basic calculus and statistics, introductory computer science including programming and database management, and basic graphic design.

What makes your job enjoyable? I am blessed with a wonderful career as an academic cartographer. Every day I enjoy coming to my department and working with students and fellow faculty members. Although I teach the same courses each year, every day is different, and I am constantly challenged by changes in cartography and questions asked by students. I have never been bored as a professor.

“

I first knew that I wanted to be a cartographer when I was 10 years old and made my first map for a class.

GIS Analyst

Zachary Andereck

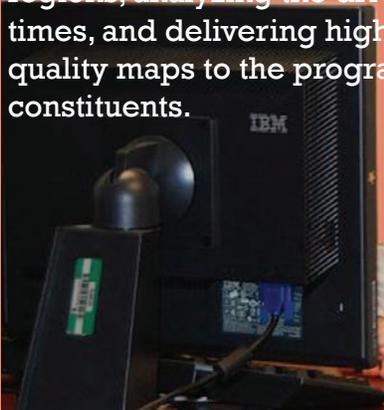
Geospatial Solutions Analyst, ICF International



What is ICF and what do you do there?

ICF International is a company that delivers consulting services and technology solutions in the energy, climate change, environment, transportation, social programs, health, defense, and emergency management markets. Right now, I'm working on the Louisiana Road Home program, designed to help residents affected by Hurricanes Katrina or Rita get back into their homes as quickly and fairly as possible.

How does GIS help with that? We use GIS to help verify and score eligible applicants by identifying those that live in special exception regions, analyzing the driving times, and delivering high-quality maps to the program's constituents.



What did you do in college to prepare you for this job?

I was an Environmental Sciences major. I think students should consider taking some of the following classes to really prepare: cartography, computer programming (especially Python these days), statistics, professional writing, and the area you'd like to specialize in—environmental science, biology, natural resource management...

Any advice for people thinking about a career in GIS?

To become truly fluent in GIS, you need to amass a large amount of time at the computer, using whatever GIS software you're going to use. Once you gain the ability to critically think through the problem at hand and you have the GIS skills at your disposal, finding the proper solution to the problem will be rewarding and make you a highly viable competitor in the GIS job

Do I need to be **certified** to have a career in GIS?

Some geospatial careers, like surveying, require a state license. Presently, you don't need a license to be a cartographer or GIS practitioner, but there is a growing interest in **GIS Certification**. The GIS Certification Institute (GISCI, www.gisci.org) provides GIS practitioners with a formal process that allows them to call themselves GIS **professionals** (GISPs). GISPs make about \$8,000 more annually than their non-certified counterparts.



County GIS Analyst

Susan Williams, Senior GIS Analyst, Stafford County, VA

Describe your job and your duties.

Stafford County is said to be the 2nd fastest growing county in the state of Virginia. It is an area rich with history that draws top government contractors who seek to house their operations within an easy commute to the DC area. I'm primarily a database manager, checking the quality of edits performed on our GIS layers. Additionally, I handle most of the Fire & Rescue Department's mapping needs.

Why is your job enjoyable?

I love seeing the surprise on people's faces when they ask me "Is it possible to get...." And I assure them it is. Then within a short time I hand them the finished product. I'm rewarded by the knowledge that I've given

“

There is a wealth of information that professionals in our field want to share.

GIS Services Coordinator, NASA

Tyler Stevens, Coordinator, Global Change Master Directory (GCMD)

Describe your job and your duties. The GCMD is a web site that enables users to locate and obtain access to Earth science data sets and services relevant to global change and Earth science research. As the coordinator,

it is my responsibility to organize all the information about the data sets and coordinate public outreach for Earth Science Data Related Services. I also develop and maintain an Internet GIS server that displays NASA satellite imagery. **What are some qualifications for a GIS job like yours?**

You should have knowledge of common GIS software packages such as ArcGIS, Mapserver, and GRASS. It's also important to have good writing, teamwork, and presentation skills so you can easily communicate your work to the science community.

Any advice for people thinking about GIS as a career?

Learn about the concepts and methodology of a GIS rather than trying to learn a specific software package. You can take the concepts you learn in the classroom and apply them to any GIS application or problem.



<http://gcmd.nasa.gov/>





them something that will help them do their job. I especially like seeing the people who are not GIS savvy take a map I've created for them and hold it like a prized possession.

Any advice for people thinking about a career in GIS? My advice

is to volunteer or apply for an internship with a company that can expose you to the GIS field. Once working within the sphere of GIS, you can see all the paths of opportunities that are available, such as internet mapping, data collection, database management, programming, and of course, designing maps.

GIS Manager, elections

Gary Bilotta, Maricopa County (AZ) Elections Department

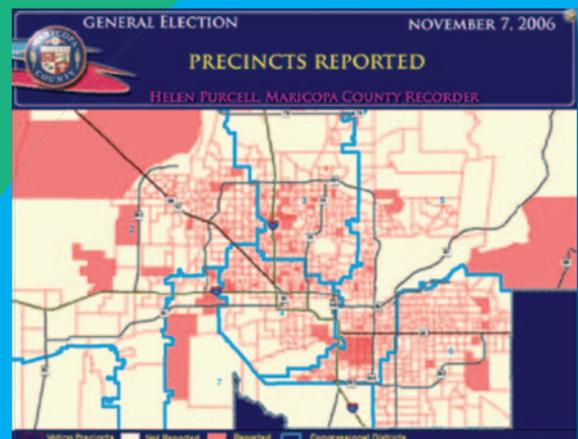
Describe your job and your duties. The Maricopa County Election Department administers primary and general countywide elections as well as municipal, school district and other various local elections. My part in the election process is to lead a team of GIS professionals who maintain the department's address, street and boundary data as well as oversee the production mapping activities in the department. I also manage the department's GIS database and develop new and maintain existing GIS desktop and Internet applications.

What types of skills do employers look for?

When looking for GIS positions, employers look for someone with programming abilities, statistics, database knowledge and map design.

How do you keep up with GIS?

In order to keep up with the growing technology of GIS, I try to go to seminars and training at least a couple times a year. Besides learning new skills at the training and seminars, it also helps to network with others there to see how they are using the technology to see if you can borrow their ideas and bring them back to your office.





GIS Operations Manager, real estate

Describe CBRE and your job there. CB

Richard Ellis is a global leader in commercial real estate services. In 2007, the cartographers and GIS professionals here at the Mapping Center produced over 56,000 maps for 1,000 professionals. We create maps including site, demographic, aerial, drive time, employee location, brochure, and large-format maps. I oversee 36 GIS professionals, and manage the GIS team in support of map products used for marketing, presentations, site tours, geographic analysis, and other needs.

ESRI is the creator of the widely-used ArcGIS family of software products designed for geospatial analysis and decision making. **Describe your job and your**

duties. I have worked for ESRI's software products department for nearly 15 years.

My job is to help our customers understand how to use ArcGIS rather than just leave them to figure out what each of the tools does. My goal is to help our customers to leverage our knowledge, at ESRI, of how to best use ArcGIS. **What are the desired**

qualifications for a GIS job like yours? At least a 4-year degree, and realistically, a masters degree in geography or related field; anything less and you'll be consigning yourself to just a job. Getting a M.A. in Geography was easily one of the top ten decisions

I've made in my life. I didn't want to just run the GIS tools that other people made or follow the instructions that other people wrote; instead I wanted to design geographically informed solutions to geographic problems. I saw GIS as a technology that would facilitate my doing that and in the process make the lives of many people better. **How**

did you get where you are today? I strongly believe that ethics must underpin the making of maps because maps are a potentially powerful information product. That

ethic has lead me through my career from trying to improve the experience of making simple mapping decisions early on with ArcView, to today where I am helping people understand how to model data in ways that make GIS data comprehensible, consumable, and therefore map-able.

How do you keep up with the growing technology of GIS? I'm lucky; it's my job. To do my job I experiment,

pushing the limits of what I can get ArcGIS to do. I'm always thinking of ways to leverage it to improve, automate, or further optimize some aspect of map making.

Cartography Researcher and GIS Developer

Charlie Frye, Environmental Systems Research Institute (ESRI), Redlands, CA



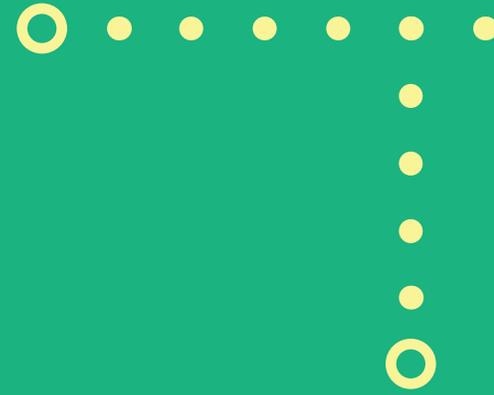
Eric Kenas, CB Richard Ellis National Mapping Center, Tempe, AZ



What is your favorite aspect of this career?

A career in GIS is not limited to just one discipline... during school, students interested in GIS can explore technology while applying their own diverse interests.

What do you see as the future of GIS? GIS is a vastly growing industry within the U.S., and has long been recognized as an international field and continues to grow globally. I have also seen GIS expanding and being implemented in web based applications, and only see GIS/web applications growing in the future, especially in business and real estate related fields.



Cartographer, NASA

Mary Gainer, NASA Langley Research Center, Hampton, VA

Describe your job and your duties.

Researchers at Langley focus on some of the biggest

challenges of our time: global climate change, access to space and revolutionizing airplanes and the air transportation system. Part of my job is to assist in the coordination with other NASA centers and government agencies. I oversee the daily maintenance of data, new data collection and maintenance of web and desktop applications. I came here from an environmental office where I used GIS for spatial analysis and to produce maps. **What's up with the bird in the photo? Is that related to your GIS work?** Yes - we were tagging juvenile osprey. This was part of a joint project with Langley Air Force Base and USDA Wildlife Services. We monitored the activity of nests in the immediate area of the aircraft runway. The maps were crucial to the Air Force to keep the runway approach clear of nesting osprey.

Any advice for people thinking about a career in GIS? I look for students primarily in geography or civil engineering. We have also had successful students with electrical, mechanical, and agricultural engineering, biology, forestry, and environmental science. The most successful cartographers also seem to have interest and ability in graphics and art. Geography still offers the best choice of majors if someone is looking for an exciting career that encompasses a wide range of applications. It is truly a major that gives you the flexibility to learn a little about everything.

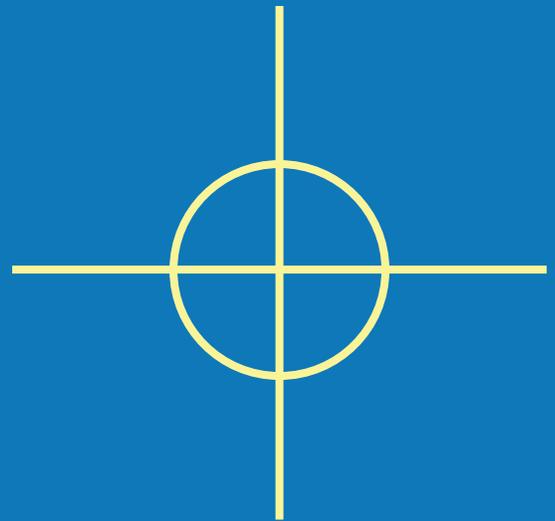


More than 800 colleges and universities offer courses in geographic information science. These are usually offered through geography departments, but GIS is applied to so many different fields that there are often GIS courses in other academic departments. The following institutions all have well-established cartography and GIS programs, and belong to the University Consortium for Geographic Information Science (www.ucgis.org):

Arizona State University
University of Arizona
Boston University
Brigham Young University
California State University System
University of California, Berkeley
University of California, Santa Barbara
Clark University
University of Colorado
University of Connecticut
University of Delaware
Florida International University
Florida State University
George Mason University

Georgia Institute of Technology
University of Georgia
Harvard University
Hunter College, City University of New York
Idaho State University
University of Idaho
University of Illinois, Chicago
University of Illinois, Urbana-Champaign
Indiana University
University of Iowa
Kansas State University
University of Kansas
University of Kentucky
Louisiana State University
University of Maine
University of Maryland, College Park
Massachusetts Institute of Technology
University of Massachusetts, Amherst
University of Memphis
Michigan State University
University of Michigan
University of Minnesota
University of Mississippi
University of Missouri
University of Nebraska
New Mexico State University
University of New Mexico
North Carolina Central University
University of North Carolina, Chapel Hill
North Carolina State University

University of North Carolina, Charlotte
Ohio State University
University of Oklahoma
Oregon State University
University of Oregon
Pennsylvania State University
University of Pennsylvania
University of Pittsburgh
University of Redlands
Rutgers University
San Diego State University
University of South Carolina
University of Southern California
State University of New York - Buffalo
Syracuse University
Temple University
University of Tennessee, Knoxville
Texas A & M University, Corpus Christi
University of Texas At Dallas
Texas State University - San Marcos
University of Utah
Virginia Commonwealth University
Virginia Tech
University of Washington
West Virginia University
University of Wisconsin, Madison
University of Wisconsin, Milwaukee
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