Resource Materials for Teachers on Benefits of GIS in the Classroom

Wednesday, January 17th, 2018

Movie (1:02) on **What is GIS** (by Esri): https://youtu.be/LHDCRjAxpI0

☑Movie (1:34) on **The Science of Where - Unlock Data's Full Potential**: https://youtu.be/XrU8GX7manc

Movie (2:48) on **ArcGIS Overview**: https://youtu.be/nAruX0NHdA8

☑Movie (9:12) on The **Top 10 Benefits of Using GIS In Education**: https://youtu.be/DbkHEqDbLz0

☑Movie (4:13/3:50) on **Why is Geo-Literacy Important?**: https://vimeo.com/41358334 or https://youtu.be/sTUG13RCz9A

Movie (3:50) on **What is Geo-Literacy?**: https://youtu.be/Pb8yenSogzE

Movie (8:23) on **How to Import, Map and Analyze GLOBE data in ArcGIS Online**: https://youtu.be/YuTVqpOYxic

☑☑**Story Maps – Everyone has a story to tell** – Engage and Inspire Your Audience: https://storymaps.arcgis.com/en/

Story Map Gallery (search): https://storymaps.arcgis.com/en/gallery/#s=0

Introduction to Story Maps:
https://story.maps.arcgis.com/apps/MapSeries/index.html?appid=4aaf9036c7324b0cb5c8ee3e609126e7

Careers in GIS (Esri):
http://k12.maps.arcgis.com/home/group.html?start=1&view=list&sortOrder=asc&sortField=title&id=9529af976fd04af28103217fbfc3ab3b#content

☑Esri Website – **GIS & Geo-enabled Career Videos**:

http://education.maps.arcgis.com/home/group.html?id=e0df1d54cad942d9885b34b202adcd2c#overview

    Movies by Career:

    Civil Engineer (3:59): https://www.virtualjobshadow.com/vs3/partners/esri/2B1C5CE4-8DEF-4E6E-A6D1-14AC9D48341C

    App Developer (3:52): https://www.virtualjobshadow.com/vs3/partners/esri/4A6B78AA-B191-4CB0-B695-7AFB3B02C93D

    Conservationist (4:09): https://www.virtualjobshadow.com/vs3/partners/esri/E7D2CBE6-9AB8-4B29-A5E5-E4082B930AD6

Movie (New GIS career video: Civil engineering: https://community.esri.com/external-link.jspa?url=http%3A%2F%2Feducation.maps.arcgis.com%2Fhome%2Fgroup.html%3Fid%3De0df1d54cad942d9885b34b202adcd2c%23overview   Website: https://community.esri.com/community/education/blog/2017/10/19/new-gis-career-video-civil-engineering

VirtualJobShadow.com provides career exploration for K-12, post-secondary institutions and workforce development programs nationwide.

Bureau of Labor Statistics – **Job Market for Geographers**: https://www.bls.gov/ooh/life-physical-and-social-science/geographers.htm

GIS Average Salary -- PayScale.com: https://www.payscale.com/research/US/Skill=Geographic_Information_Systems_(GIS)/Salary

Including Geography in your Curriculum (National Geographic Society): https://www.nationalgeographic.org/education/teaching-geography/

☑**Helping Educators (Esri – T3G):**

http://k12.maps.arcgis.com/home/group.html?id=8b369385f5374526a941697a4c5bfc10#overview

ArcGIS Online for Educators (Esri – eBook):

http://k12.maps.arcgis.com/home/item.html?id=8bb6bae8a509477da2ce596292ce88aa -- Featured eBooks: https://www.esri.com/esri-news/publications/ebooks

Teaching Math with GIS (GIS Lounge): https://www.gislounge.com/teaching-math-gis/

GIS Employment Outlook (UCLA – Dec 2016): http://gis.ucla.edu/blog/gis-employment-outlook

GIS Salary Expectations: Climb the GIS Career Ladder (GISGeography.com): http://gisgeography.com/gis-salary-expectations-gis-career/

Students Embrace GIS for Project-based Learning – Esri Blog Post by Charlie Fitzpatrick: https://www.esri.com/about/newsroom/blog/students-embrace-gis-impact-community/

☑**Movie** (1:03:02) on getting **Teachers, Start Your Mapping: Free online GIS in the classroom from Esri and ConnectEd!**: https://youtu.be/Iq5Eq6j6DLw

Using GIS in a STEM Curriculum (Geography4Geographers): http://www.geographyforgeographers.com/gis-in-a-stem-curriculum.html

☑**Esri's Educational K-12 Subject Matter Site**: https://www.esri.com/industries/education/schools#

Esri's School Mapping Software Bundle (FREE): http://www.esri.com/industries/education/software-bundle#

☑**Free course** (4 hours, 45 minutes): **Teaching with GIS: Introduction to Using GIS in the Classroom:** https://www.esri.com/training/catalog/57630436851d31e02a43f125/teaching-with-gis:-introduction-to-using-gis-in-the-classroom/ Technology is an excellent tool to engage students inside the classroom. This course presents strategies for integrating GIS to support instruction, discussion, and extended learning on any topic. Many practical ideas for GIS activities that enhance student learning and critical thinking skills are shared.

Free course (3 hours, 30 minutes): **Getting Started with GIS**: https://www.esri.com/training/catalog/57630434851d31e02a43ef28/getting-started-with-gis/   A GIS helps people visualize and create information that can be used to make decisions and solve problems. Get an introduction to the basic components of a GIS. Learn fundamental concepts that underlie the use of a GIS with hands-on experience with maps and geographic data.

Free instructional resources for Teachers (NGS): https://www.nationalgeographic.org/education/teaching-resources/

Free instructional resources for Teachers (Esri): https://www.esri.com/industries/education/instructional-resources#

Educator Support Website (Free instructional resources) -- Many resources exist to help teachers and club leaders learn about GIS and mapping. Depending on student age and ability, many of these resources are appropriate for students as well: https://www.esri.com/industries/education/educator-support#

ArcGIS Online K-12 Organizational Page: http://k12.maps.arcgis.com/home/index.html

UCF Teams up with Teachers to Educate Students on GIS & Drones: https://today.ucf.edu/ucf-teams-teachers-educate-students-gis-drones/

Document (57 pages – PDF Format) **Advancing STEM Education with GIS**: https://www.esri.com/library/ebooks/advancing-stem-education-with-gis.pdf

Article (ArcUser Online – Spring 2011) – **GIS Education Today**: https://www.esri.com/news/arcuser/0311/gis-education-today.html (PDF Version: https://www.esri.com/news/arcuser/0311/files/gisedtoday.pdf)

eBook (PDF – July 2012) – **What is GIS?**: https://www.esri.com/~/media/Files/Pdfs/library/bestpractices/what-is-gis.pdf

☑**GeoNet (Esri)** – Educational Space for Teachers: https://community.esri.com/community/education   **K-12 Page**: https://community.esri.com/community/education/content?filterID=contentstatus%5Bpublished%5D~category%5Bschools-k-12%5D

☑**Website (Esri)** – **What is GIS and How Does it Work**: https://www.esri.com/what-is-gis/howgisworks

☑☑**Website (Esri)** -- **The ArcGIS Book -- 10 Big Ideas about Applying The Science of Where**: https://learn.arcgis.com/en/arcgis-book/

☑**Interactive eBook:** http://downloads.esri.com/LearnArcGIS/pdf/The-ArcGIS-Book.pdf

BASIC CONSEPTS

How Does it Work:

A simple five-step process lets you apply GIS to any business or organizational problem that requires a geographic decision.

Ask: What is the problem you are trying to solve or analyze, and where is it located? Framing the question will help you decide what to analyze and how to present the results to
your audience.

Acquire: Next you need to find the data needed to complete your project. The type of data and the geographic scope of your project will help direct your methods of collecting data and conducting the analysis.

Examine: You will only know for certain that your data is appropriate for your study after thoroughly examining it. This includes how the data is organized, how accurate it is, and where the data came from.

Analyze: Geographic analysis is the core strength of GIS. Depending on your project, there are many different analysis methods to choose from. GIS modeling tools make it relatively easy to make these changes and create new output.

Act: The results of your analysis can be shared through reports, maps, tables, and charts and delivered in printed format or digitally over a network or on the web. You need to decide on the best means for presenting your analysis, and GIS makes it easy to tailor the results for different audiences.

To use GIS effectively, educators need to know these things:

1. What GIS is and how people are using it in their infinitely diverse jobs
2. Why thinking geographically helps people understand complex situations (patterns and relationships)
3. Why using technology facilitates exploration and discovery of situations
4. How to use technology ... different devices, operating systems, software, combinations ...
5. How to teach ... not as a delivery process but as an engagement process.
6. How to teach with technology, especially in an age of rapid evolution ... lifelong learning
7. How to teach with GIS

Why use GIS in the classroom?

GIS is an interdisciplinary technology tool

GIS technology offers the opportunity for many interdisciplinary projects. There are many different aspects of social studies, science, math, language arrs and and other curriculum that GIS can help students explore. The important part is to have a location or series of locations to explore or relate to the curriculum.

A great example of the interdisciplinary nature of GIS stems from a literature unit about Mark Twain. Barbaree Duke, a middle school teacher in Raleigh, North Carolina, created a GIS project for her students based on the travels of Mark Twain. Her students measured distances (math) using the tools found in the ESRI ArcVoyager product and queried the database to find locations around the world that Twain had visited (social studies and technology).

Other ideas include:

- **Social Studies** - explore demographic information for countries of the world; visualization of historical events; explore natural change over time
- **Science Education** - explore natural phenomena such as earthquakes and volcano locations; explore habits of animals and impact of humans, and many more
- **Business and Marketing Education** - business location analysis; create travel routes for a business that will be delivering goods in a town or city
- **Language Arts** - explore locations of a books plot; map the travel logs/journals of a specific author
- **Mathematics** - explore mathematical functions of demographic data (ie differences between the number of males and females of cities, proportions of Hispanic Americans to African Americans in major US cities)
- **Health and Physical Education**-explore locations and spread of diseases and illnesses
- Other great GIS education projects

Another exciting use of GIS in the classroom occurs when educators and their students collect and create their own data. The GIS is then used to display the data and analyze the results. GPS (Global Positioning System) units can also be used to collect location information, which can be used in a GIS. More on GIS analysis...

GIS technology promotes higher order thinking skills. GIS use in the classroom can also help students understand the spatial relationships that are found in their world. Spatial analyses, such location selection, change over time, and environmental impact, can play an intregral part in GIS use in the classroom.

Power of Data Project: Helping provide professional development for teacher educators (Arizona): http://www.pod-stem.org/

Jumpstarting GIS Use in the Classroom

By Deborah Alongi Johnson and Steven Moore
**Center for Image Processing in Education**

Editor's Note: The Center for Image Processing in Education (CIPE) has developed instructional materials that use ArcView GIS to help teachers and students in grades six through 10 learn about science, mathematics, and technology. Using CIPE's guided discovery approach, students acquire data, analyze problems, formulate solutions, and present findings using maps, posters, and other methods. CIPE also conducts professional development workshops that teach educators the theory and practice of GIS as well as techniques for developing their own lesson projects. This article discusses why GIS is a powerful teaching tool and what types of materials are needed by educators to increase the use of GIS.

Developing GIS-Based Curriculums

CIPE is a nonprofit educational organization that promotes computer-aided visualization as a tool for teaching and learning. CIPE conducts workshops and develops instructional materials that use image processing (IP) and GIS technologies as platforms for teaching about science, social studies, mathematics, and technology. Over the past two years, CIPE has developed a series of lessons that utilize ArcView GIS as a tool for teaching standards-based science and social studies content. These lessons form the basis for a two-day professional development workshop for teachers entitled Discovering GIS. The workshop is offered in association with regional educator conferences and on-site at local schools or districts. CIPE plans to continue its GIS instructional materials development with a full complement of earth systems science, life science, environmental science, geography, and marketing/business lessons that incorporate mathematics and social science content.
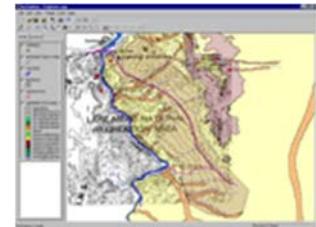
GIS is a computer-based technology for viewing and manipulating any kind of data that can be referenced geographically. It gives researchers and planners the ability to quantify and visually display interrelationships among geographically referenced biological, social, geochemical, physical, atmospheric, and other variables. "What if?" and "How come?" questions are easily asked and answered with GIS. Powerful database management and display features allow complex combinations of scientific data to be distilled into easily interpretable maps and graphics. Because of its great analytical power, GIS is currently used as a research and planning tool in a variety of industries including agriculture (e.g., for precision planting and application of pesticides and fertilizer); environmental planning and research (e.g., to conduct environmental impact assessments and groundwater contamination modeling); forestry (e.g., to model wildfires and plan harvests); and petroleum and mining exploration (e.g., to identify potential locations of oil and mineral deposits).
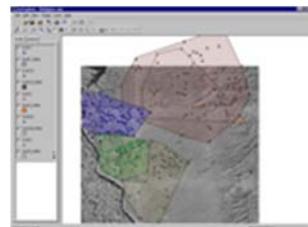
Pioneering educators have successfully used GIS to teach science and mathematics content. High school students in Detroit have used GIS to map lead contamination in household drinking water and attempted to correlate standardized test scores of elementary students to lead contamination. In another project, middle school students in Boston, Massachusetts, investigated a variety of environmental conditions in the Muddy River. They employed GIS to answer questions about the overgrowth of phragmites (marsh reeds); low levels of dissolved oxygen and eutrophication; leaking underground storage tanks; sewer overflows; illegal cross-connections between sewers and storm drains; and contamination with fecal coliform bacteria.

Transportable Materials Needed
Through its educational discount program, Esri has made GIS software easily affordable to schools. With such a favorable purchasing program, one would anticipate widespread implementation of the technology. But mainstream educators have not widely embraced GIS. According to a needs analysis survey conducted by CIPE during one of its recent workshops, the primary obstacle faced by educators wishing to use GIS is time. Most educators simply do not have time in their busy professional lives to self-learn a new technology. Although a significant percentage (approximately 40 percent) of the educators found the software difficult to learn, the majority did not. Nearly all educators in the study thought their students could easily learn GIS, particularly if instructional materials were available to lead them through the process. Most educators felt that administrators at their school supported the use of GIS and that they had adequate access to computers.

To implement a new technology in their classrooms, teachers need support. They do not have sufficient time to master the mechanics of a new piece of software, look for data that their students can use, and prepare the data for use in the classroom. Mainstream educators wishing to use GIS need training and teaching materials that are relevant to their subject areas and in a format that is easily transferable to their classrooms. Unfortunately, such materials and training are largely unavailable. A search of the Eisenhower National Clearinghouse for Mathematics and Science Education (ENC 1999) yielded no comprehensive materials designed to help educators teach science and mathematics content with GIS. The meager GIS materials and training resources encountered during the search, in general, were very specialized and largely left educators to their own devices for learning and implementing the technology.

Meeting the Need
To promote adoption of GIS technology as an instructional tool in the nation's middle and secondary schools and support mainstream teachers as they explore the new technology, CIPE plans to develop instructional materials with the following characteristics:

- o Utilize a guided-discovery approach that incrementally discloses data to students as they become comfortable dealing with the unknowns of science and inquiry. This approach to science education supports and simplifies students' tasks. Guided discovery can facilitate conceptual change, excite student interest, overcome negative attitudes toward science, and provide a meaningful, hands-on experience with the process of scientific discovery (Nissani 1996).
- o Lessons will be designed to support the National Science Education Standards (NSES) (NAS/NRC 1996), National Council of Teachers of Mathematics (NCTM) standards (NCTM 1999), National Geography Standards, and the National Educational Standards for Students (NESS) (ISTE 1999) of the International Society for Technology in Education (ISTE).
- o ArcView GIS software will be utilized as a research tool to support the primary science, math, and geography instructional objectives. ArcView GIS skills will be incorporated into the lessons as tools for discovering content but not as primary objectives. Utilization of real data and a real research tool will provide students with experience in performing an authentic task that bears a strong resemblance to tasks performed in a real work setting.

- o Two types of lessons--starter and project--will be developed. Short, focused starter lessons present case studies along with the necessary data and project files already prepared. Longer, more open-ended project lessons are templates for teachers and students to gather their own data and create their own, localized GIS projects.

[The accompanying article, Why Did the Sheep Cross the Road, describes a starter lesson developed by CIPE.]

Looking to the Future

Needs Analysis
   As noted previously, CIPE has begun to evaluate the needs of mainstream educators wishing to use GIS. A formal needs analysis survey was conducted at a GIS workshop conducted by CIPE during the winter of 1999. In general, the educators at the workshop voiced strong support for instructional materials and professional development workshops that combine packaged lessons with open-ended exploration of GIS data. They also strongly supported materials that make clear connections to the kinds of careers that employ GIS. CIPE plans to continue this needs analysis with educator focus groups, GIS specialists, and other key stakeholders.

Lesson Testing
   As development of Discovering GIS progresses, the lessons will be field tested in representative classrooms across the country. Special consideration will be given to ensure that race, ethnicity, gender, regionalism and socioeconomic status are considered in selection of field test sites. Upon completion of field testing, the lessons will be revised to incorporate teacher and student feedback.

Dissemination
   CIPE plans to disseminate its instructional materials through professional development workshops held in association with regional professional meetings and at schools throughout the United States (in-district workshops). In the future, when the complement of instructional materials reaches completion, Discovering GIS will be disseminated as a stand-alone product. For more information on these teaching materials, contact

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