

Supporting Digital Learning and STEM Education

Esri is helping more students use ArcGIS Online to learn about STEM (*science, technology, engineering, and mathematics*) subjects and become geospatially aware through free school subscriptions and support for curriculum development.

GIS activities almost always involve thinking scientifically, analyzing mathematically, breaking problems down into manageable steps, and determining a solution using technology. Introducing ArcGIS Online into STEM-related courses reinforces the scientific method and provides students with an effective way to present their findings.

Problem solving, critical thinking, data analysis, communication, and collaboration are hallmarks of GIS professionals. These are also proficiencies sought by employers everywhere. Introducing ArcGIS Online can help students build these skills and get a head start preparing for careers. Map-based classroom activities and service learning projects also foster collaboration between students.

Schools like Clark Magnet High School in La Crescenta, California, have discovered that ArcGIS Online enhances STEM subject education. The achievements of Clark Magnet High School were highlighted during the Plenary Session of the 2014 Esri Education GIS Conference. Dominique Evans-Bye, a science teacher at Clark Magnet High School, and her student Yeprem Chavdarian described how he and fellow

students have used ArcGIS Online and ArcGIS for Desktop for projects. In one project, students analyzed organic and inorganic contamination in California's spiny lobster and mapped their results. They won the grand prize in the Lexus Eco Challenge and received more than \$70,000 in student scholarships and grants to their school.

During this year's White House Science Fair, which celebrates student winners of STEM competitions, Esri president Jack Dangermond announced Esri's offer of a free ArcGIS Online account to every one of the roughly 115,000 elementary, middle, and high schools in the United States. This offer, valued at \$1 billion, was made to support President Barack Obama's ConnectED initiative to provide K–12 students with more digital learning opportunities,

"We are honored to be part of President Obama's ConnectED initiative to provide a better learning environment and future for students throughout the United States," said Dangermond. "By leveraging the power of geospatial technology, students can truly understand how the world is interconnected and help create solutions for the challenges that lay ahead."

To increase the impact of this gift, Esri has created resources that help educators take advantage of ArcGIS Online organizational accounts. Because ArcGIS Online is cloud based, students can use it

Make It Stick

The science of successful learning and GIS

By Joseph Kerski, Esri Education Team

In their wonderful book about the science of successful learning, *Make It Stick*, Peter Brown, Henry Roediger, and Mark McDaniel spell out some truths that I believe are instructive as to how we should approach teaching with GIS.

The authors claim that "learning is deeper and more durable when it's *effortful*. Learning that's easy is like writing in sand, here today and gone tomorrow." Despite the fact that teaching and learning with GIS are far easier than it was a decade ago, I think we as educators do a disservice to our colleagues in education or to students when we say, "it's easy."

Teaching and learning are difficult tasks and not for the faint-hearted. Think of everything that goes into teaching with GIS. Content knowledge, skills, and the geographic perspective must all

be balanced. Yes, it may be easier technically to bring a CSV file into ArcGIS Online than it was to bring a spreadsheet into ArcInfo back in the 1990s, but even this relies on some key foundations. You must still know

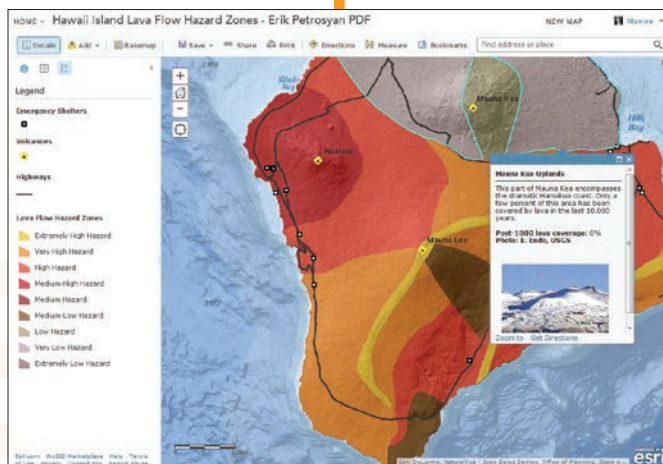
- What a database is and how to create one.
- How locations are mapped.
- How to work with latitude and longitude pairs or street addresses.
- What the pros and cons are of choosing a certain map projection over another.

Recall a time when working in GIS when you tenaciously stuck to a problem you were grappling with and finally figured it out. That shouldn't take long—you are not likely to forget those times nor the skills that you gained by the experience.



During the Plenary Session at the 2014 Esri User Conference, Dominique Evans-Bye, a science teacher at Clark Magnet High School, and her student Yeprem Chavdarian described how students are using ArcGIS.

This web map showing lava flow hazard zones on Hawaii Island was created by Clark Magnet High School student Erik Petrosyan.



on computers at school, tablets at home, and smartphones on the go—anywhere they can connect to the Internet.

This donation is part of an ongoing commitment to K–12 education that has spanned more than 20 years during which Esri has offered special educational licenses to schools, districts, and states; held the Esri Education GIS Conference; conducted numerous classroom and conference presentations; and held educator institutes.

In July 2014, Esri’s assistance to students was expanded through the signing of a memorandum of understanding (MOU) with European Schoolnet, an organization that works with multiple ministries of education to bring innovation to teaching and learning throughout Europe. During the three years the MOU is in effect, Esri will advise the European Schoolnet team members on the use of ArcGIS Online and help them develop a series of related lesson plans. ArcGIS Online will be implemented in European Schoolnet’s Future Classroom Lab, a state-of-the-art project that supports changing styles and learning.

“The cloud-based capabilities of ArcGIS Online align very well with the other technologies we are using in the Future Classroom Lab,” said Benjamin Hertz, project coordinator for European Schoolnet. “Lessons with ArcGIS Online bring STEM education to a higher level.”

If everything was easy, according to these authors, and confirmed by our own experiences in using GIS, we certainly wouldn’t remember it as well. By implication, we wouldn’t be building a foundation for new knowledge.

The authors claim that “all new learning requires a *foundation of prior knowledge*.” How often do we—either as educators or students—want to skip right to an advanced task without understanding the knowledge and skills that must be in place first?

For example, when teaching a recent workshop on mapping field data, many of the workshop participants wanted to skip to the last item on the agenda—citizen science mapping with live web mapping services—before understanding how data can be mapped and what a mapping service is in the first place.

According to these authors, “Putting new knowledge into a larger context helps learning.” The purpose of the Esri Education blog, webinars, the Teachers Teaching Teachers GIS (T3G) institute, ConnectEd, and other initiatives is to ground the use of GIS in the larger context of educational best practices within the content of a specific discipline and the context of other geospatial skills. For example, even the tried-and-true lesson of using GIS to teach about plate tectonics should take place in a larger context of the physical processes of the earth and the relationship between earthquakes, volcanoes, and plate boundaries.

There are other instructive gems for teaching and learning with GIS, such as “learning is an acquired skill, and the most effective strategies are often counterintuitive,” but I will leave it to you to read *Make It Stick*.