Advancing STEM Education with GIS

By Tom Baker, PhD, Esri Education Manager

Science, technology, engineering, and math (STEM) education provides a multidisciplinary approach to improving education, the work force, and national competitiveness. President Barack Obama noted that "Strengthening STEM education is vital to preparing our students to compete in the twenty-first century economy, and we need to recruit and train math and science teachers to support our nation's students" (White House press release, September 27, 2010).

GIS technology can engage several critical elements in STEM curriculum and instruction. GIS tools and techniques lead to understanding cross-disciplinary phenomena and solving problems rooted in academic and real-world concepts. People use GIS to make maps, analyze data, and decide on best solutions. From a curricular perspective, GIS allows us to study climate change, design cities, inventory geologic samples, plan ecological growth models, catalog archaeological sites, and participate in countless other activities. GIS and the related geospatial technologies of Global Positioning Systems and remote sensing can be used to simultaneously engage students in STEM-related courses.

Instructionally, GIS is also well suited to driving problem-based learning (PBL), an approach to classroom inquiry commonly used in the STEM classroom. PBL is guided by a question, with students collecting data and making analytical conclusions. The National Science Education Standards indicates that PBL is an instructional framework best suited to support deep, meaningful learning.

GIS allows students to collect and visualize authoritative data about the question of interest, adding their own data to the map before performing a wide range of analyses on the data in question. GIS problems are steeped in both critical thinking and spatial thinking elements, motivating learners as they learn work force ready skills.

To support the ever growing interest in GIS and STEM from teachers, researchers, and administrators, Esri has released a new (free) e-book, *Advancing STEM Education with GIS*, that addresses the multifaceted support GIS offers STEM classrooms. The e-book is filled with rich case studies of STEM in formal and informal environments. The power of STEM collaborations and partnerships and ties to career and work force development is also a central theme of the volume. The e-book outlines three beneficial tracks for student learning in STEM by integrating GIS technology:

- Improved declarative knowledge
- Improved procedural knowledge (e.g., critical thinking, problem solving, spatial reasoning)
- Twenty-first century career skills development

I hope that you take the opportunity to examine this new book and learn how teachers throughout the world are using GIS to enhance their science and technology courses.

Tom Baker
tbaker@esri.com

STEM education aids this problem by teaching students skill sets that can be used for a variety of different careers across the spectrum. STEM-based learning is becoming more important as it builds and encourages the mindset of being innovative and creative, which is a better long-term strategy than training and educating individuals on occupation-specific skills.Â As an organization, we are constantly working and building on these types of programs to help shape a better future and open doors to students for lifelong learning. Conclusion. While STEM awareness and education is critical to the development of key skills for our youth, it is important to not overlook building soft skills from an early age. In short, GIS allows STEM students to do exactly whatSTEM professionals do in thousands of career fields daily.Advancing STEM Education with GIS Introduction 4. 5. Advancing STEM in FormalEducation with GISAdvancing STEM Education with GIS Advancing STEM in Formal Education with GIS 5.Â Only with GIS can they quickly perform multipleAdvancing STEM Education with GIS Combining Math, GIS, and Community Service 6. 7. His official GIS training was a two-week institute at a local His next step is helping students figure out a problem-solvinguniversity. Most of his GIS training has been informal. Yet, scaling up affordable access to STEM education requires a concerted effort across multiple universities and instructors at the national level. We propose a model relying on national online education platforms that were recently established in many countries, including China (XuetangX, WEMOOC, and CNMOOC), India (Swayam), and Russia [National Platform of Open Education (OpenEdu)] to address challenges associated with the shortage of qualified instructors and growing demand for higher education. National online education platforms allow resource-constrained institutions that struggle with a