TEXAS STATE
LBJ INSTITUTE FOR
STEM EDUCATION AND RESEARCH

**STEM Research**
**White Paper Series**

**January, 2019**
**Volume: 3**
**Number: 1**

# Earth Science and Geospatial Literacy: Preparing Students for a Technology-based World

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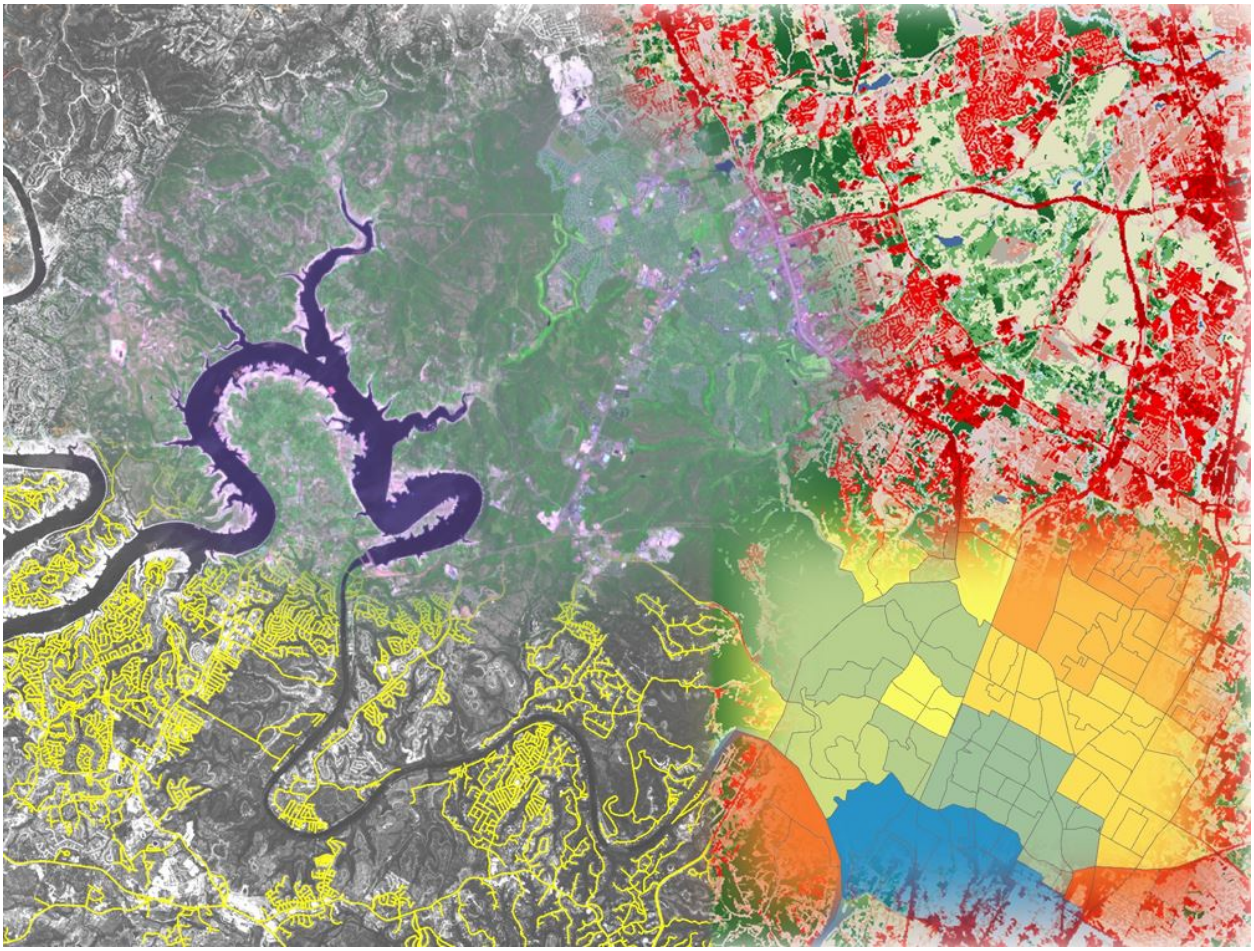

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**"Geo-literacy is a natural fit with STEM education. Having a geo-literate populace is critical for maintaining economic competitiveness, quality of life, and national security in our modern, interconnected world. Likewise, STEM education focuses on supporting the development of high-quality science, technology, engineering, and math knowledge and skills for all students, in order to ensure society as a whole can continue to prosper in the 21st-century technology-based economy."**

***-National Geographic STEM Education Collection***

Geo-literacy is the ability to make decisions based on an understanding of the systems and connections in the world. GeoSTEM combines STEM knowledge and geo-literacy to help prepares student for our 21st century technology-based world. Although geospatial technology education is often overlooked as a STEM field, it indeed combines many components of STEM education. The challenge is moving away from viewing geospatial resources simply as tools, but more of an inclusive part of overall STEM education (Moore et al., 2012).

Several national initiatives have been implemented to improve STEM education and competencies throughout the U.S. such as the Next Generation Science Standards (NGSS), "Preparing the Next Generation of STEM Innovators" (NSB), and "Framework for K-12 Science Education" (NAS). Many of these standards and guidelines as they relate to earth and space sciences require spatial thinking and reasoning. Spatial thinking skills include concepts such as location (Where?), condition (What?), connection, (How are things linked?), correlation (Are patterns similar?), etc. Geospatial resources and technologies can help students develop and refine these necessary spatial skills, which have been associated success in STEM education (Shea et al., 2001; Wai et al. 2009).

There is a common misconception that implementing geospatial data and technologies in the classroom requires extensive training or expensive hardware/software resources. Fortunately, this is not the case. There are a variety of web-based interactive platforms available for phones, tablets, netbooks, and workstations that can be accessed freely. Still, the integration of satellite imagery and remote sensing technologies along with computer visualization, real-time data, global positioning systems (GPS), and geographic information science (GIS) remains a largely untapped resource for STEM education in the classroom due in part to the challenges of finding relevant, related materials.

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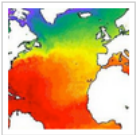
To overcome these challenges, a series of resources are provided and described to encourage increased use of geospatial technologies and resources in the classroom in support of STEM education.

## GEOSPATIAL RESOURCES WITH ASSOCIATED LESSON PLANS

### NASA Wavelength http://nasawavelength.org/

NASA Wavelength is a pathway into a digital collection of space and Earth science lesson plans for preK-12 and higher education teachers as well as professional development and informal education. The search term "remote sensing" returns 158 results for kindergarten through activities ranging from "Remote Sensing Math" to "How do Satellites Work?" and "Interpeting Satellite Images." Educators can also access user lists of resources by educational standards.

**"…every precollege student be provided the opportunity to learn about the Earth as a system through the incorporation of cutting-edge technologies as part of STEM education, providing students with meaningful STEM learning experiences."**
***-American Meteorolgical Society***



MY NASA DATA: Comparing Graphs of Temperature and Radiation

In this activity, students will analyze plots of temperature and radiation data to determine change over time. Step-by-step instructions for use of the MY NASA DATA Live Access Server (LAS) guide students through selecting a data set, importing the data into a spreadsheet, creating graphs, and analyzing data plots. The lesson provides detailed procedures, related links and sample graphs, follow-up questions, extensions, and teacher notes. Designed for student use, MY NASA DATA LAS samples micro datasets from large scientific data archives, and provides structured investigations engaging students in exploration of real data to answer real world questions. (View Less)

**Keywords:** Electromagnetic spectrum; Longwave radiation; Shortwave radiation; Radiation balance model; Flux
**Audience:** Middle school
**Materials Cost:** Free per group of students

Earth Science | Add to List | Go To Resource | View Resource Details

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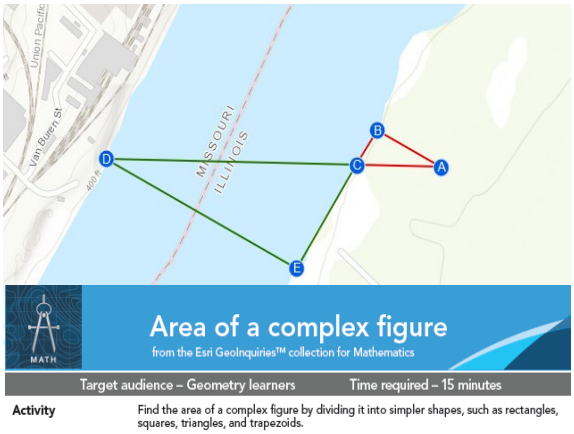
**"Individuals with spatial abilities are routinely overlooked because these abilities are rarely measured and, if they are, the results often are not given the proper attention. This is an untapped pool of talent critical for our highly technological society."**

***-National Science Board***

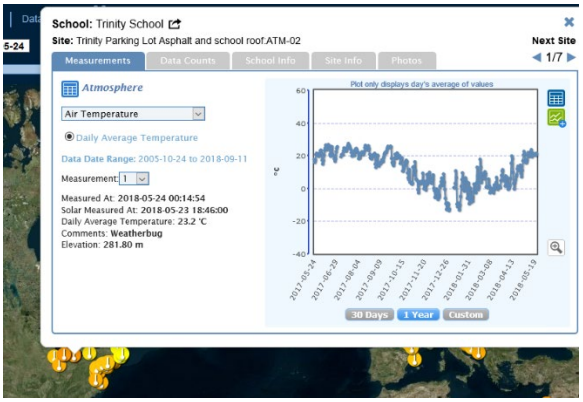
**GeoInquiries https://www.esri.com/en-us/industries/education/schools/geoinquiries-collections**

Geoinquiries are short, standards-based inquiry activities and lessons for teaching map-based content. Activities are designed using a common inquiry model and can be presented from a single computer and projector or modified for hands-on engagement by students. Earth science, environmental science, and mathematics are featured activities.




**The GLOBE Program https://www.globe.gov/**

The Global Learning and Observations to Benefit the Environment (GLOBE) Program is an international science and education program that provides students and the public worldwide with the opportunity to participate in data collection and the scientific process. GLOBE provides project-based learning with field guides, data sheets, and associated learning

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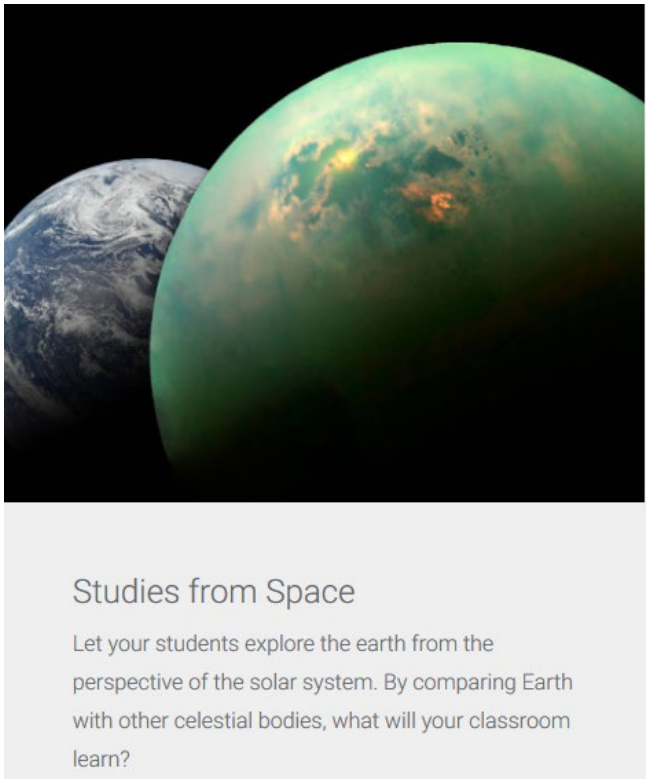
activities. Measurement data can be uploaded, accessed, and mapped through the GLOBE Visualization System.

**Google Earth Education**
https://www.google.com/earth/education/resources/

Google provides step-by-step guides and tutorials for their GeoTools to enable students to make connections with imagery for mathematics, space science, and earth science applications. Most classroom activities are geared toward K-8 and include guiding questions as well as suggested NGSS standards.

**Spatial thinking allows students to comprehend and analyze phenomena related to the places and spaces around them—and at scales from what they can touch and see in a room or their neighborhood to a world map or globe.**

***-National Geographic Society***




Recently, Google Earth teamed up with the National Geographic Society to develop resources, activities, lessons, and mapping resources to engage students in learning through exploration.

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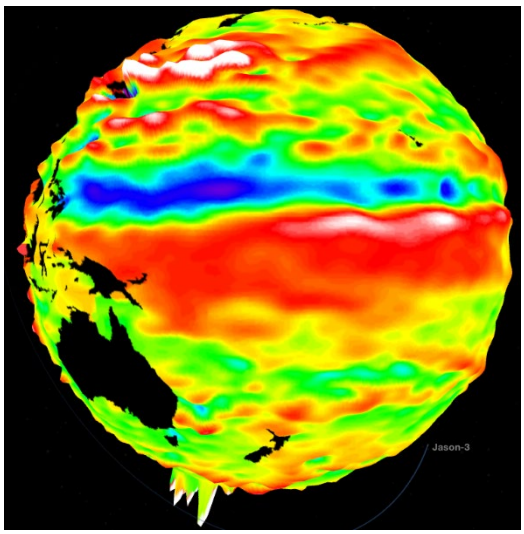
## RESOURCES TO ACCOMPANY STEM EDUCATION: IMAGES, DATA, GEOVISUALIZATIONS

### Earth Observatory http://earthobservatory.nasa.gov


Earth Observatory is a continuously updated repository of images, stories, and discoveries that emerge from NASA Earth Science research. Each image or image sequence has a description of the corresponding Earth surface phenomenon or process. Topics include atmosphere, heat, land, natural events, and snow and ice. These images can be used to enhance existing lessons. Images can be downloaded in multiple formats and resolutions.

### NASA's Eyes
https://eyes.nasa.gov/




NASA's Eyes includes Eyes on the Earth, Eyes on the Solar System and Eyes on Exoplanets. It's an immersive app for Mac, PC, and mobile devices that allows users to explore sea level height, Antarctic ozone, dust storms, fires on Earth as well realistic, simulated views of spacecraft, planets, and distant stars.

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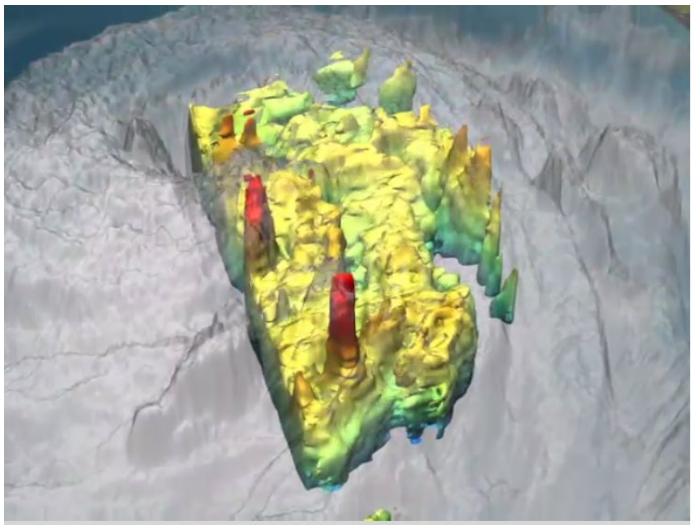
**NASA Scientific Visualization Studio**
https://svs.gsfc.nasa.gov/

With over 7,200 visuals, NASA's Scientific Visualization Studio (SVS) provides educators with high quality images, videos, animations, and datasets related to Earth and Space Sciences. Additionally, the SVS includes collections on carbon and climate, exoplanets, solar snapshots, an astrophysics gallery and more. Content is easy to access and download.



Energy-releasing deep convective clouds (to 16 km) in the eyewall of Hurricane Katrina on August 28 occurred while the storm was intensifying to a category 5 classification. Download

For more information about NASA EPDC visit https://www.txstate-epdc.net/.

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## REFERENCES

National Research Council. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press.

National Science Board. 2010. Preparing the Next Generation of STEM Innovators: Identifying and Developing our Nation's Human Capital, National Science Foundation, Virginia, NSB 10-167.

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By State*s. Washington, DC: The National Academies Press.

Moore, J.D., Dorofy, P., Holzer, M., Hopkins, J. 2012. Making the Case for GeoSTEM Education. *The Earth Scientist*, National Earth Science Teachers Association, 28(4), pp. 25-31

Shea, D., Lubinski, D, Benbow, C. 2001. Importance of Assessing Spatial Ability in Intellectually Talented Young Adolescents: A 20-Year Longitudinal Study. *Journal of Educational Psychology*, 93, pp. 604-614.

STEM Education; Fostering 21st Century Skills Through Integrated STEM Resources https://www.nationalgeographic.org/education/stem-education/

Wei, J., Lubinski, D., Benbow, C. Spatial Ability for STEM Domains: Aligning of 50 years of Cumulative Psychological Knowledge Solidifies its Importance. 2009. *Journal of Educational Psychology*, 101, pp. 817-835

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