Integrating Technology-based Tools to Investigate Environmental Change

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Session Description:
Learn about inquiry-based activities that incorporate Google Earth, Web-based GIS, and NASA satellite imagery to investigate local and global environmental issues.

Table 1. Description of investigations in the *Human footprints on Earth as seen by NASA scientists* Mission Geography module

Investigation	Description
1. Let's go to the mall	Introduces a case study of the spatial and environmental aspects of a shopping mall in Huntsville, Alabama. Students explore how a mall is spatially related to the location of other land use zoning areas (e.g. residential, commercial and recreational areas). Instructional materials prompt learners to think about advantages and disadvantages of having commercial and residential areas being located near a mall. Students then analyze a 1994 black and white NASA remotely sensed ATLAS (Advanced Terrestrial Land Applications Sensor) image to identify the mall and surrounding features.
2. What's hot at the mall?	Students investigate how natural landscapes change as a result of mall construction. They are introduced to the concept of hot spots – heat build-ups in areas that contain buildings and pavement. They then examine ATLAS thermal images of the Huntsville shopping mall to examine the heat differences between trees and pavement.
3. Why is the city hot?	The city of Atlanta, Georgia is used as a case study to investigate urban heat islands that result from sprawl and deforestation in urban environments. Students use series of land use classification maps of the Atlanta metropolitan area from 1973-1997 to identify changes of time.
4. Where in the world are major environmental changes?	Students are asked to consider significant environmental changes in different parts of the world. NASA satellite images of Rondonia, Brazil are used to provide a case study of deforestation as one type of a major environmental change.

Table 2. Instructional activity outline for the implemented rapid-prototype land use change unit.

Day	Activity
1	Began *Let's go to the mall*. Discuss important land use features near a mall. Mission Geography materials used as intended. **http://www.missiongeography.org/**
2	Google Earth used to investigate human-built and natural features in the area surrounding the Madison Square Mall in Huntsville, Alabama.
3	Began *What's hot at the mall?* Satellite photos of Madison Square Mall accessed on teacher's Web site. Heat absorption of buildings and pavement emphasized. Urban heat island formations introduced.
4	Google Earth unstructured exploration of students' area. Developed guided worksheet on the "Electromagnetic Spectrum". NASA educational resources at **http://imagers.gsfc.nasa.gov/ems/** used.
5	Developed "Urban Sprawl" worksheet used in place of *Why is the city hot?* materials. Emphasis on population growth and land use. Used Google Earth to locate and study Atlanta, Georgia. Land use change investigated with a NASA time-lapse movie of land use classification maps of Atlanta from **http://svs.gsfc.nasa.gov/search/Keyword/Atlanta.html**
6	Continued work on the "Urban Sprawl" worksheet. Google Earth exploration of Atlanta. Emphasis on developing the concept of an urban heat island.
7	Developed guided worksheet on "Remote Sensing". Pennsylvania Sprawl and Remote Sensing online modules from the ESSE Web site at Lehigh University (**http://www.ei.lehigh.edu/esse**/) used as content resources. Emphasis on using aerial photographs over time to detect land use change and how land use classification maps are developed.
8	Continued work on the "Remote Sensing" worksheet. Emphasis on land use change in a sub-basin of the students' watershed and understanding the main processes involved with remote sensing.
9	Concluded "Remote Sensing" worksheet. Tracked satellites at NASA Earth Observatory Web site (**http://earthobservatory.nasa.gov**/). Emphasis on satellites that house remote sensing instrumentation and data processing and image generation.
10	Began *Where in the world are major environmental changes?* Environmental changes and issues were discussed. Investigated land use changes in Rondonia, Brazil. Satellite images accessed online at **http://edcwww.cr.usgs.gov/earthshots/slow/Rondonia/Rondonia**
11	Land use change over time analysis with satellite images. Developed handouts for Riyadh, Saudi Arabia, the Mississippi River, and Las Vegas, Nevada. Google Earth and Web-based materials from USGS Earthshots (**http://edcwww.cr.usgs.gov/earthshots/slow/tableofcontents**) and NASA's El Niño Southern Oscillation project (**http://education.gsfc.nasa.gov/ESSSProject/NewLessons/hydrosphere/ENSO**/)
12	Concluded work on the land use change over time analysis activity.
13	Urban changes: Spread of a city activity sheet from Earth Systems Connections (**http://www.earthsystemsconnections.com/).** Students analyzed a data set of populations and land area of 16 urban areas between 1970 and 1990.
14	Summative assessment administered.