**General Topic:** The use of geographic tools to analyze humans’ impact on the environment

**Compelling Question:** How can different geographic tools and technologies be used to visualize and analyze how people impact the environment?

**Grade Level:** 7th Grade

**Unit:** Environmental Geography or Geography of North America

**Timeframe:** 3 weeks (15 class periods)

**Rationale for the text set for this topic:**

- In many states, geography is commonly taught at the 7th or 8th grade level so this increases the chances this will be adopted nationally
- Environmental focus could also be used in Environmental Studies (science), either as a stand-alone unit or crosscurricular between geography and science
- North America focus so this could be used in World Geography (regional) or Human Geography/Geography (thematic)
- Integrates geospatial technologies (aerial photos, satellite imagery, etc.) with human-environment
- Addresses both human-environment standards and mapping/technology standards

**Anchor Text:** NOVA “Earth From Space”. 2013. Public Broadcasting Service (PBS).

**Text Set**

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Text #1 Description of how Google Earth has been used to raise awareness of the strip mining of coal in Appalachia

Source: Google Earth Outreach Stories
https://www.google.com/earth/outreach/stories/app_voices.html

Appalachian Voices is an environmental nonprofit organization committed to protecting the land, air, water and communities of the central and southern Appalachian region. Focused on reducing coal’s impact and advancing a vision of a cleaner energy future, we use Google Earth and Google Maps to further our cause.

Mountaintop removal mining uses explosives to mine coal seams that would otherwise be difficult to access. The practice is irreversibly detrimental to the surrounding environment, polluting nearby drinking water sources and permanently destroying the mountains themselves and is strongly linked to cancer and other diseases in nearby communities.

Appalachian Voices has educated millions of people, from policy-makers and legislators to ordinary citizens, about this destructive process. How? By transporting them to more than 500 destroyed mountains in Appalachia using Google Earth and Google Maps.

How they did it

Mountaintop removal coal mining is changing the American landscape on a scale that is hard to comprehend unless you see it from the air. Anyone who has ever flown in a small aircraft over southern West Virginia or eastern Kentucky will never forget the experience of seeing the massive scale of destruction — mountain after mountain blown up and dumped into valleys as far as the eye can see. Appalachian people working to save their communities long dreamed of a way to fly reporters, decision-makers, and thousands of other Americans over the Appalachian coalfields to see this destruction first hand — and then take them to visit their communities to hear the stories of people who endure the consequences of what some have called "cheap energy."

With Google Earth, Appalachian Voices created an approximation of that tour, accessible to anyone with a computer and a high-speed internet connection, extending our reach by millions of people. Visitors to the Google Earth layer can take a high-resolution tour of a large mine site, watch first-hand video stories about the mountains and their communities, and access before-and-after overlays for hundreds of mountains destroyed by mountaintop removal. They can also bring the experience closer to home by overlaying the 15-square-mile Hobet mining complex in West Virginia on top of 36 different U.S. cities to understand the sheer scale of the devastation.
Little Wall Lake is located just outside Jewell, IA and is a popular campground and recreational area. It was formed as a result of glacial movements across the area, and is fed into by a small watershed. Because of this, it wants to be more of a marsh than an open body of water, but due to artificial efforts, such as dredging, this has yet to happen. Little Wall Lake has suffered from high phosphorus levels (220.3 ug/L as of August, 2014), possibly due to animal waste runoff from surrounding farmland. The lake has also experienced regular algae blooms that occur as a result.
Text #3 High-altitude Balloon Photo of Confined-Animal Feeding Operations (CAFOs) near Jewell, Iowa
Source: UNI INSPIRE program funded by NASA-ISGC

The little white rectangles in this photograph are confined-animal feeding operations, or CAFOs, which are agricultural operations where animals (typically hogs, cattle, chickens, or turkeys) are kept and raised in confined conditions. CAFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures or fields. CAFOs are an economically efficient way to raise animals, but can cause environmental problems. If not disposed of properly, animal waste and leak into the soil and surface water. Nutrients (such as phosphorus) in this CAFO waste can cause bright-green algae blooms in ditches, streams, and lakes. As these surface-water algae blooms die off, the oxygen in the water is depleted.
Text #4 High-altitude balloon track in Google Earth, from Jewell, Iowa to Deep River, Iowa
For the past half century, algae blooms have been a regular occurrence on Lake Erie, where chemical nutrients (mainly phosphorous and nitrogen) are plentiful due to decades of runoff from farms and cities. In August, 2014 however, those blooms caused the water supply in Toledo, OH to be shut off completely. The dominant organism in the Lake Erie bloom is a type of freshwater blue-green algae that produces a toxin harmful to humans. If consumed, it can cause numbness, nausea, dizziness, vomiting, liver damage, and death. The City of Toledo warned residents not to drink or cook with tap water; boiling is not effective against the toxin. Treatment facilities have since added extra filtering steps (including activated carbon), and public water sources are now declared 100% safe. It should be noted that the 2014 bloom was not necessarily larger or more intense than any other recent year; it simply had a more direct human impact because of its location in Maumee Bay, right around the water intake system for the city of Toledo.
Oil is dangerous to the environment because its chemical components are poisonous. These poisons can harm fish, birds, mammals, plant life, single-celled organisms, etc. Entire ecosystems can be wiped out, and damages can last for decades. Even areas outside of the water can be harmed. When an oil spill reaches shore, it clings to every rock and grain of sand. If it washes up into wetlands, plants and grasses absorb the oil. Oil spills can also negatively affect humans. When the fish die, what do the fishermen do? How about the people whose diets rely on fish or water creatures? How do seaside towns cope when their beaches are ruined? Is tourism affected? The list goes on and on.
Text #7 Urbanization in Ankeny, Iowa (2004, 2013)
Source: USDA NAIP and Iowa Geographic Map Server 2004; 2013
Text #8 Deforestation in the US over time (1620, 1850, 1920)
Source: University of Michigan, Global Change Program
http://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html
Particulate matter concentrations (PM) across the United States (2001-2006)
Source: NASA and Aaron Van Donkelaar, Dalhousie University
http://www.nasa.gov/topics/earth/features/health-sapping.html
Text #10 Map of unhealthy ozone days by city in 2006
Source: Dr. Jeff Masters blog and US EPA
http://www.wunderground.com/blog/JeffMasters/ozone-pollution-improving-in-the-us
Text #11 Video on geospatial technologies for understanding climate change
Source: Penn State Public Broadcasting, 2010
http://geospatialrevolution.psu.edu/episode4/chapter1

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