

## **Investigating Climate Change Issues with Google Earth and Web-based activities**

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### **Abstract:**

Teaching and learning about climate change science is essential for developing future citizens who must understand how their personal and societal decisions will ultimately affect the future of the environment. To address the lack of a well-designed middle school science climate change curriculum that can be used to help teachers promote the teaching and learning of important climate change concepts, we developed a 20-day Environmental Literacy and Inquiry: Climate Change curriculum in partnership with a local area urban school district. This work is part of an ongoing systemic curriculum reform initiative to promote environmental literacy and inquiry and foster the development of geospatial thinking and reasoning using geospatial technologies as an essential component of the middle school science curriculum. The curriculum is designed to align instructional materials and assessments with climate change science learning goals from the *Climate Literacy: The Essential Principles of Climate Sciences* (U.S. Global Change Research Program, 2009) and the *AAAS Project 2061 Communicating and Learning About Global Climate Change* (AAAS, 2007) frameworks. The curriculum is a coherent sequence of learning activities that include climate change investigations with Google Earth, Web-based interactivities that include an online carbon emissions calculator and a Web-based geologic time-line, and inquiry-based (“hands-on”) laboratories. The climate change science topics include the atmosphere, Earth system energy balance, weather, greenhouse gases, paleoclimatology, and climate and you. The curriculum includes embedded support material designed to assist teachers’ development of both climate change content knowledge and pedagogical content knowledge for effective curriculum enactment. Implementation results showed that urban middle school students significantly increased their knowledge about climate change science after using the curriculum.

### **The ASTE Experiential Session:**

The curriculum is freely available at:

**<http://www.ei.lehigh.edu/eli/cc/>**

To access the assessments, use login: **eliteacher**; password: **87dja92**.

Below is a brief description of the learning curriculum learning activities featured in this session. The Web address listed above contains additional information about each learning activity including teacher guides, student guides, assessments, and teacher support materials.

### **Investigating Weather and Climate with Google Earth**

**<http://www.ei.lehigh.edu/eli/cc/sequence/day2.html>**

The curriculum begins with an investigation using Google Earth to explore global temperature changes during a recent 50 - 58 year period. Students explore, analyze, and interpret climate patterns of 13 different cities, and analyze differences between weather and climate patterns. At the completion of this activity, students understand that changes in climate are variable based on location and that the magnitude of observable climate change temperature is quite small.

### **Instructional Sequence Days 3-14**

**<http://www.ei.lehigh.edu/eli/cc/sequence>**

Next, students are introduced to the four main Earth spheres (atmosphere, lithosphere, hydrosphere, and biosphere) and explore the structure and composition of the atmosphere with an emphasis on greenhouse gases and the role that ozone plays in the troposphere and stratosphere. Students explore and investigate concepts pertaining to Earth system energy balance including albedo, and surface and atmospheric absorption and reflection. In the next learning activity (Day 9), students use Google Earth to determine how latitude, elevation, proximity to bodies of water, and mountain ranges affect a location's climate.

Next, student learning activities focus on the carbon cycle and the importance of greenhouse gases in our atmosphere. Students also learn about proxies and complete a paleoclimate reconstruction lab in which they reconstruct past climates using lake varves as a proxy to interpret long-term climate patterns and understand annual sediment deposition and how it relates to weather and climate patterns.

### **Interactive Geologic Timeline Activity**

**<http://www.ei.lehigh.edu/eli/cc/sequence/day15.html>**

Students use a Web-based geologic timeline to examine temperature, CO<sub>2</sub> concentration, and ice cover data to investigate how climate has changed during the last 715 million years. At the completion of these activities, they understand that long-term climate patterns provide evidence for fluctuating CO<sub>2</sub> concentrations.

### **Carbon Calculator Activity**

**<http://www.ei.lehigh.edu/eli/cc/sequence/day16.html>**

Students use a Web-based carbon calculator to determine their carbon footprint and examine their personal and household habits and choices in relation to their carbon footprint. The calculator generates graphical data displays for students to compare their personal carbon footprint to the average U.S. and global citizen.

### **Investigating Earth's Climate Hot Spots**

**<http://www.ei.lehigh.edu/eli/cc/sequence/day17.html>**

Students use Google Earth to investigate geographical areas and populations affected by recent changes in climate patterns. Spatial data includes changes in habitat ranges and analysis of time-sequenced photography of glaciated areas.

### **Investigating Future Worlds with Google Earth (Parts 1 and 2)**

**<http://www.ei.lehigh.edu/eli/cc/sequence/day18.html>**

**<http://www.ei.lehigh.edu/eli/cc/sequence/day19.html>**

In the culminating two-day investigation, students use Google Earth to explore evidence of climate change during 1980 – 2010 including changes in Arctic Sea ice extent and changes in the distribution of coral reefs in the Caribbean Sea. Students begin to understand that there have been some rapid changes in the environment in recent history. During the second day of the activity, students are presented with the IPCC's worst-case scenario of a 2-meter rise in sea level. They then use Google Earth to explore future world scenarios by examining the effects of a 2-meter rise in sea level on the existing landscape (using the Google Earth elevation profile tool) through low-lying locations that could be affected by sea level rise. They then observe 1-meter and 2-meter sea level rise IPCC scenarios in the Chesapeake Bay watershed with embedded GIS data in Google Earth.

### **Carbon Reduction Strategies - <http://www.ei.lehigh.edu/eli/cc/sequence/day20.html>**

In the final learning activity, students explore strategies at personal and societal levels to help reduce atmospheric carbon emissions levels.