Dr. Suzanne Banas,NBCT South Miami Middle Community School

Exploring Climate Change Using the Eyes In the Sky

Objective/Description:

Using NEO (NASA Earth Observations) satellite images and NIH ImageJ to animate the images, students will explore various aspects of climate change. From the montage of images, students will write a report describing various areas of climate change.

Grade level: 8 (secondary) Duration: 4-5 sessions

Project Implementation:

1. Introduce the students to NEO (NASA Earth Observations**)**
2. Requirements of the project: Choose at least 3 images (preferably 5) over a period of time.
3. Introduce the students to NIH ImageJ
4. Requirements of the project: Animate image and then choose at least 5 major areas of the world and explain the change depending on the data set of the image. Afterwards create a montage to print the images for the research paper and power point.
5. Home Learning
    a. Using NEO decide on the data set desired to work on.
    b. Animate images and Using ONE NOTE write notes of global changes sharing with your group members.
    c. Create a montage using ImageJ
    d. Using WORD develop a rough draft of the global changes from the images
6. Class Discussion
7. Each group creates a POWER POINT using the best images and research findings
8. Final Requirements: After deciding on what changes are occurring globally based on the data set, students will research various aspects of climate change as related to their data set (pros & cons). Develop a conclusion based on their findings and what the scientific community reports about the specific climate change (whether positive or negative impact).
9. Presentations

Technology

1. **NASA Earth Observations http://neo.sci.gsfc.nasa.gov/Search.html**
   NASA Earth Observations. Our mission is to help you picture climate change and environmental changes happening on our home planet. Here you can search for and retrieve satellite images of Earth. Download them; export them to GoogleEarth; perform basic analysis. Tracking regional and global changes around the world just got easier
2. **Image J http://rsbweb.nih.gov/ij/download.html**
   ImageJ is a public domain, Java-based image processing program developed at the National Institutes of Health. ImageJ was designed with an open architecture that provides extensibility via Java plugins and recordable macros. Custom acquisition, analysis and processing plugins can be developed using ImageJ's built-in editor and a Java compiler. User-written plugins make it possible to solve many image processing and analysis problems, from three-dimensional live-cell imaging to radiological image processing, and multiple imaging system data. ImageJ's plugin architecture and built in development environment has made it a popular platform for teaching image processing.
3. Microsoft One Note for sjaring research and infromation.
4. Microsoft Word is used for the research paper
5. Power Point is used for the group presentations

Background Information

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Satellite imaging, or remote sensing, is the scanning of the earth by satellite or high-flying aircraft in order to obtain information about it. There are many different satellites scanning the Earth, each with its own unique purpose. Satellites use different kinds of sensors to collect electromagnetic radiation reflected from the Earth. Passive sensors collect radiation which the Sun emits and the Earth reflects, and don't require energy. Active sensors emit radiation themselves, and analyze it after it is reflected back from the Earth. Active sensors require a significant amount of energy to emit radiation, but they are useful because they can be used during any season and time of day (passive sensors cannot be used on a part of Earth that is in shadow) and because they can emit types of radiation that the Sun does not provide. While humans can perceive only a small portion of the EM spectrum (visible light), satellite sensors can use other types, like infrared light, ultraviolet light, or even microwaves. When satellite images are made, these invisible types of light are assigned a visible color. That is why satellite images, like the one on the right, often have "unnatural" colors.

Imaging spectroscopy is a new tool that can be used to map specific materials by detecting specific chemical bonds. As a result, it is an excellent tool for environmental assessments, mineral mapping and exploration, vegetation communities/species and health studies, and general land management studies. The premier imaging spectrometer is the NASA/JPL AVIRIS system, covering a 10.5 km swath with 17-meter pixel spacing. AVIRIS collects data at a rate of 2 square kilometers per second! Imaging spectroscopy is the application of reflectance/emittance spectroscopy to every pixel in a spatial image. Spectroscopy can be used to detect individual absorption features due to specific chemical bonds in a solid, liquid, or gas. Solids can be either crystalline (i.e. minerals) or amorphous (like glasses). Every material is formed by chemical bonds, and has the potential for detection with spectroscopy. Actual detection is dependent on the spectral coverage, spectral resolution, and signal-to-noise of the spectrometer, the abundance of the material and the strength of absorption features for that material in the wavelength region measured. In remote sensing situations, the surface materials mapped must be exposed in the optical surface (e.g., to map surface mineralogy it must not be covered with vegetation), and the diagnostic absorption features must be in regions of the spectrum that are reasonably transparent to the atmosphere (the atmosphere can be corrected for all but the strongest absorptions). The optical surface is the same as what the geologist sees in the field with his or her eyes. Spectroscopy can be used in laboratories on hand samples, in the field with portable field spectrometers (spatial resolution in the millimeter to several meter range), from aircraft, and in the future from satellites. The aircraft systems now operational can image large areas in short time (~2 sq. km per second!), producing spectra for each pixel that can be analyzed for specific absorption bands and thus specific materials. Information retrieved from USGS Spectroscopy Lab **https://speclab.cr.usgs.gov/aboutimsp.html**

Lessons learned

The Climate Change Unit is designed to create an engaging, interdisciplinary project that links schoolwork to real life. Research states that learning takes place both in school and in the community.

- Students reported aspects of climate change.
- Students investigated various aspects of climate change
- Students collected data on patterns from the data sets

The Climate Change Unit is designed to enable students to acquire skills in computer technology, instrument interfacing, data interpretation, and word processing

- With other students in a small group, students developed and presented their research.
- Students prepared and constructed an informational research paper on aspects of climate change.
- Students interacted on the electronic network.
- Students accessed information from various data systems.
- Students located, interpreted, and applied information found in order to perform tasks.

The Climate Change Unit provides opportunities for students to develop necessary skills for effective critical thinking, problem solving, and decision-making in order to acquire the tools necessary for improved academic achievement.

- Students gathered information to answer questions and make conclusions from existing information.
- Working in a group, the students assimilated their information and discussed implications of their findings.
- Students applied various problem solving processes to the scientific method to create a real-world action plan.

Project standards alignment

Florida Sunshine State Standards:

The scientific theory of the evolution of Earth states that changes in our planet are driven by the flow of energy and the cycling of matter through dynamic interactions among the atmosphere, hydrosphere, cryosphere, geosphere, and biosphere, and the resources used to sustain human civilization on Earth.

- SC.912.E.7.7: Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change
- SC.912.E.6.6: Analyze past, present, and potential future consequences to the environment resulting from various energy production technologies
- SC.912.E.7.3: Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere.

21st-century skills

This project integrates the 21st-century skills very well. The project's major aspect is global awareness in which students begin to understand global issues in order to take environmental action. Within environmental literacy; students begin to demonstrate a knowledge and understanding of the environment circumstances and conditions affecting it, particularly as it relates to air, climate, land, food, energy, water and ecosystems. They develop an understanding of society's impact on the natural world. Their investigations and analyses of environmental issues start them on the road to finding solutions. This project also allows students to critically think through effect reasoning skills, systems thinking (seeing the Earth as a whole construct). They begin to make judgments and decisions based on real data and not inferences. The project requires the students to develop informational literacy by using advanced technologies to access information accurately. Finally the students will collaborate with their peers and communicate to their own community as well as to the scientific community at large.

Project results

Assessment strategies

The implementation of pre/post tests on knowledge of animals changes in climate. I had the students Think about the following and answer briefly:

1. What is climate?
2. How is climate studied?
3. What factors determine climate?
4. How has climate differed in the past?
5. What can cause climate to change?
6. Then Construct a concept map of their ideas about climate.

Also students were assessed on performance such as student-created products and/or construction of a response that demonstrates a skill or an understanding. Rubrics were designed for each aspect of the Unit. There was also a rubric for the research paper (word document) and for the group/team power point and oral presentation.

Student products

Each student created a montage of images selected from NEO and was formatted in ImageJ. Through careful observations the students developed a research paper using WORD and added their images to the text. From

these individual papers then students teamed up with others who had similar sets of images and created a power point presentation. The presentation was a synthesis of the individual data with a consensus developed conclusion. Finally the teams communicated their results to the entire class. In late May the students will participate in a virtual/online conference with other students in the Nation, sharing their investigations about climate change.

Significant learning

The overall outcome of the Climate Change Unit is student-generated research culminating in multimedia presentations, in which students communicate in a professional and creative manner while being challenged to solve real-life environmental issues. The academic needs that need met include enhancement of academic skills, such as: reading, research, problem solving skills data analysis and communication skills. The Climate Change Unit as designed was able to create an engaging, interdisciplinary project that links schoolwork to real life. It enabled the students to acquire skills in computer technology, instrument interfacing, data interpretation, and word processing. It also provided many opportunities for students to develop necessary skills for effective critical thinking, problem solving, and decision-making in order to acquire the tools necessary for improved academic achievement.

Student achievement

Based on the pre/pot test, students appeared to have had a basic understanding of climate change. Through the Unit the (approximately 87%) students were able to elaborate more deeply and extensively than they had prior to the Unit. The students began to develop success as information managers and as effective communicators. This helps them reach and become successful with high academic standards. This Climate Change Unit affected the quality/innovation of instruction by promoting the investigative skills of students and teachers. It makes learning more engaging and enables students to learn to communicate effectively with other people. Many of the students expressed that they enjoyed learning this way and felt they better understood the realities of climate change. Our school' s mission is to improve upon students' abilities to read, write, comprehend, and articulate through an integrated curriculum, which will prepare all students for the diversely multicultural and technological world of the twenty-first century. This Climate Change Unit provides opportunities for students to apply knowledge to real life situations.