Effective Computer Based Resources for Teaching Inquiry Based Science: The GLOBE Program

Sherry S. Herron

University of Southern Mississippi, sherry.herron@usm.edu

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EFFECTIVE COMPUTER-BASED RESOURCES FOR TEACHING INQUIRY-BASED SCIENCE: THE GLOBE PROGRAM

University of the Philippines
National Institute for Science and Mathematics Education Development
NISMED International Conference
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Sherry S. Herron, Ph.D.
University of Southern Mississippi
DEDICATION

My major professor and mentor, Dr. Rosalina ‘Lina’ Villavicencio Hairston, who first introduced me to NSTA, NARST, BSCS and GLOBE.

My Filipino family: Pia Campo, Josephine Estrera, Peter Orbita, and Miliza Romero.
COMPUTERS ARE HERE

More than half of the teachers surveyed across the U.S. reported that using digital technologies has strongly influenced the ways they teach.

~ 80% see computer use as important to the success of their professional work - for administration, communication, planning, and instruction.

Yet only 37% of the same sample reported using computers with their students daily. (p. 18).

John Thornton, a retired biology professor who was a pioneer in the field of investigative laboratories, said:

“The general notion that you should engage students in investigations as a vehicle to teaching them science wasn’t anything new 25 years ago. What was new then, and is still new now, is the idea that you can use this approach with all students”.

Howard Hughes Medical Institute Report, 1997, p. 32

Math and Science Standards promote inquiry and the use of authentic data.
COMPUTER TECHNOLOGIES FACILITATE INQUIRY

PhET: University of Colorado, Boulder: phet.colorado.edu/
- Free online educational simulations covering a diverse topics designed by the University of Colorado Boulder available in many languages.

HHMI: Howard Hughes Medical Institute
Dolan DNA Learning Center: Cold Spring Harbor

http://www.dnalc.org/resources;
http://www.dnalc.org/websites

Learn.Genetics: University of Utah

http://learn.genetics.utah.edu

Free Apple Apps, including Augmented Reality
Texas Instruments Graphing Calculators combined with sensors and probes
Example: Digital coast “More Than Just Data”

How can data be collected if you can’t get to far away spots? “Adopt a Drifter”!

Drop an instrument overboard and let the current take it where it will. Ground true-thing in the ocean! A class can adopt an instrument, follow its path, and record the data it is collecting.

http://www.noaa.gov/climate
www.estuaries.noaa.gov
http://dataintheclassroom.org
www.climate.gov
Global Learning and Observations to Benefit the Environment
http://www.globe.gov/

• Began on Earth Day 1995
  – 112 participating countries
  – 58,000 GLOBE-trained teachers
  – → 25,000 schools
  – → 1.5 million students
  – → 23 million measurements
Fourteen Countries Meet in Africa to Discuss GLOBE Student Research Achievements

Antananarivo, Madagascar served as the location of the 7th GLOBE Africa Regional Meeting in February 2012. Leaders from the 22 GLOBE countries in Africa met to discuss important issues related to implementation of GLOBE in their countries and to work towards greater participation.

Welcome to GLOBE

The Global Learning and Observations to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program.

Learn More about GLOBE ➤
GLOBE Teacher’s Guide

Overview

In the GLOBE Teacher’s Guide, protocols and learning activities are related to the standards they address. In the United States, there is growing insistence that teaching be directed to address specific standards. Many countries in GLOBE and virtually every state in the United States have adopted standards for education, including science education. These standards vary, and it is not presently possible to provide a correspondence between GLOBE elements and every set of standards. However, there is much in common among the different sets of standards for science education.

For this Teacher’s Guide, GLOBE has chosen to use the National Science Education Standards published by the US National Academy of Sciences, selected additional content standards that GLOBE scientists and educators feel might make appropriate additions to standards, and the National Geography Standards prepared by the (US) National Education Standards Project.

GLOBE provides five scientific investigation areas, each providing background information, measurement protocols and learning activities. Resources from the five areas can be combined in many ways, providing students and educators with many options for building meaningful scientific investigations. Also provided are data sheets and field guides to assist in the accurate collection of data.
GLOBE Learning Expedition held in August 2014, Delhi, India

https://www.youtube.com/watch?v=osSollSKq4o&list=PLfpnkASIlNYBUCwa0uZP53YutlHIlcgf

GLOBE Salute to Teachers

https://www.youtube.com/channel/UCWSToq833hSt2meu8PWhrjQ
GLOBE Satellite Partnerships

Connecting Students to GLOBE Partner Satellite Missions
Satellite Partnerships

Along with our current CloudSat and CALIPSO Missions, 2014 will be an exciting year for NASA Missions and GLOBE. Here are four opportunities to take part in GLOBE Campaigns related to NASA Missions: CloudSat, CALIPSO, Global Precipitation Measurement (GPM) and Soil Moisture Active Passive Mission (SMAP).

CloudSat

Clouds influence Earth’s weather and climate. They bring water from the air to the ground and from one region of the globe to another. Clouds also have a large impact on Earth’s radiation budget; even small changes in cloud abundance or distribution could affect climate.

GLOBE students and teachers can collect and enter data that will be compared to CloudSat measurements. CloudSat, in turn, contributes Earth science learning opportunities to lifelong learners and shares the results of CloudSat’s scientific research mission to improve our understanding of clouds and global climate change.

CALIPSO

CALIPSO, a joint mission between NASA and the French Space Agency, CNES, provides new insight into the role that clouds and atmospheric aerosols (airborne particulates) play in regulating Earth’s weather, climate, and air quality.

CALIPSO combines an active lidar instrument with passive infrared and visible imagers to probe the vertical structure and properties of thin clouds and aerosols over the globe.

Global Precipitation Measurement (GPM)

The Global Precipitation Measurement (GPM) satellite mission “will use multiple satellites orbiting Earth to collect rain, snow and other precipitation data worldwide every three hours.” In GLOBE, students also take regular precipitation data. Updates here.
GLOBE students at Marana High School in Tuscon, AZ worked with Landsat images and data within the Land Cover investigation, conducting ground-truth measurements of land cover types.

**Infrared** Landsat image of Marana High School

The land cover map created by GLOBE students
GLOBE students in the U.S. and Germany did ground-truthing of the MODIS sensor flying on the Terra satellite. This research was also a winning 2003 GLE student report
CloudSat and CALIPSO missions became satellite partnerships with GLOBE.

Teachers learn how to use sun photometers to collect aerosol data and observe clouds in four quadrants of the sky.

Students gather around a CloudSat convex mirror.
These first images show precipitation falling inside a cyclone over the northwest Pacific Ocean, 1700 km east of Japan.
SMAP: Soil Moisture Active Passive
Scheduled to launch in November 2014

2 sensors – both in the Microwave range, will allow the satellite instruments to collect data regardless of cloud cover and light.

Active/Passive Mission:
Active (Radar) provides high resolution (3 km);
Passive (Radiometer) provides high accuracy resolution (40 km)

Continuous 1000 km swath allows for each site to be reimaged every 3rd day
SMAP will fly at a sun-synchronous (6am/6pm) orbit
Models disagree; in situ and remotely sensed data could bring agreement among the models.
SMAP will also quantify seasonal freeze/thaw state transitions

Why? Soil moisture plays a major role in determining the length of the growing season. Carbon uptake and release is determined by the growing season. Understanding the long-term trends is key in estimating terrestrial carbon sources and sinks.
GLOBE schools can help calibrate and validate SMAP data
Learn about soil and how different kinds of soil hold moisture. See how NASA plans to use measurements from the Soil Moisture Active Passive Mission, or SMAP, to make Our World a better place to live.

What is the connection between water, soil and carbon cycles? The answer may be in the soil beneath your feet. See how NASA plans to measure soil moisture from space with the Soil Moisture Active Passive Mission, or SMAP. Learn to calculate soil moisture in your own backyard and discover the real world applications for this data.

Learn how NASA’s Soil Moisture Active Passive Mission, or SMAP, will use new technologies to help answer questions raised in the National Research Councils’ Decadal Survey. See what kind of modeling and forecasting applications the data from this mission will provide as it measures the soil moisture that cools Earth’s surface and provides water to the atmosphere and plants.

https://smap.jpl.nasa.gov/educationpublicoutreach/
Data collection materials for the SMAP Block Pattern
Soil Moisture Protocol

A scale (0.1 g sensitivity & 400 g capacity)

500 mL graduated cylinder

500 mL graduated cylinder

Soil sample can with lid

GPS Receiver

Oven mitts or hot pads

Hammer and nail

Meter stick or centimeter ruler

Wood block

Drying oven

pencil

… and soil!
SMAP Block Pattern
Sample Site and Sampling Procedure
Formal and Informal Environmental Education (FIEE)

- Funded by the Gulf of Mexico Program - Environmental Protection Agency for $326,910
- Three year project for underrepresented and underserved students
- Target audiences are schools (teachers and students) of Alabama, Louisiana, and Mississippi
- Outreach component for general public

WITH FUNDING FROM NOAA AND EPA...
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STUDENT SCIENTISTS

Tupelo Middle students measure trees, collect water samples

Their data will be logged on websites that scientists around the world can access.

BY CHRIS KEFFER

TUPelo — Science proved to be one week that Tupelo Middle School eighth-grader Kimora Jarvis expected.

After spending a class period ensuring the trees on the boys athletic field Jarvis said she was surprised by being counting tree branches and getting paid by limbs.

"It was a good experience," she said, "but I didn't like climbing through the trees."

Jarvis was among about 300 students participating in a hands-on activity Wednesday with science teachers from the University of Southern Mississippi.

The students, from Holly Faiy's seventh-grade science class and Judy Hardison's eighth-grade science class, were at the farm through a tube-shaped instrument called a densiometer; used measuring tape to determine circumference of trunks; and carted equipment to record data.

They will log that information throughout the year and record it on an online database that allows scientists to use the results throughout the world.

"Hopefully they will gain an awareness of how science works and what scientists do," said Terry Morris, professor and director of the Center for Science and Mathematics Education at USM.

Harris joined Shelia Brown at the school Wednesday to give his students a lesson on collecting data. Brown is an education/technology at Gulf Coast Research Laboratory Marine Education Center in Ocean Springs, part of

Kate Wheeler and George Patterson measure and record the size of a section of one of the trees. Below, Shelia Brown assists Tupelo Middle School students, from left, Whitney Harling, Marissa Lewis, Lucas Hargis and Jessi Garrett, with their recording of scientific data.

The activity is part of a grant that Hardison received for the Coastal and Inland Environmental Education program. The two classes who rebelled the only ones at Tupelo Middle working with USM scientists.

Brown was also at the school on Tuesday leading a lesson for seventh-grade math teacher Connie Gurnett and art teacher Leah Peterson.

"That lesson was just about fish, pressure waves and fishy electromagnetic senses is part of a B-WET grant that Gurnett has received. B-WET is an acronym for the Wetlands Education and Training.

"Gurnett's classes will collect water samples throughout the year and test their pH and levels of oxygen, phosphates and nitrates.

"Like Hardison and Bailey's science classes, they will log their findings in GLOBE and use samples to analyze data to observe conditions throughout their area."

Two groups of students will also go to the Gulf Coast during the spring for even more experience in marine biology.

"It is a great that the students get to work with real scientists," Hardison said. "It is wonderful for them to meet and talk to people who do this for a living."

Harris and Bailey's students will also work with real scientists.
MY UNDERGRADUATE AND GRADUATE STUDENTS
LONGLEAF PINE *PINUS PALUSTRIS*

These once dominant trees have largely been replaced by loblolly and slash pines across the southeastern U.S. My students study climate change, the effects of controlled burning in maintaining the longleaf population, compare biomass, and many other studies.
USING GPS

We compare each Land Cover Sample Site on the ground to the corresponding area on the satellite image.
MEASURING AND MARKING OFF A STUDY SITE IS HARDER THAN YOU THINK!
Measuring Tree Height with a Home-made Clinometer
TAPE MEASURE IS USED TO MEASURE DIAMETER AT BREAST HEIGHT (DBH)

\[ \pi = 3.14 \]
\[ D = \frac{C}{\pi} \]
\[ \text{Area} = \pi r^2 \]
In order to compare your data to data collected by others, our calculation of biomass per plot will be converted to biomass per square meter. This conversion requires some information that you will enter here about your plot size. Enter data into either 1 or 2 below in meters:

1. If your plot is rectangular, enter the LENGTH of a SHORT and LONG side
2. If your plot is circular, enter the plot RADIUS
3. If you have an odd sized plot (for instance you've sampled your entire schoolyard, calculate the entire area in m^2, and add it here)

Calculated plot size in m^2
## Carbon Cycle

### Table summarizing the tree data

<table>
<thead>
<tr>
<th>Tree #</th>
<th>Species Group</th>
<th>Circumference/CBH (cm)</th>
<th>Plot Biomass (kg/plot)</th>
<th>Biomass (g/m2)</th>
<th>Carbon (g C/m2)</th>
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</thead>
<tbody>
<tr>
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</table>
Examples of My Students’ Presentations
ACKNOWLEDGEMENTS
DR. ROSALINA ‘LINA’ VILLAVICENCIO HAIRSTON