Everyday Science Mysteries: Karst Landscapes

Project Proposal

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Overview

"Everyday Science Mysteries" are a series of teacher education workshops offered by the American Geosciences Institute (AGI) to teachers at the National Earth Science Teachers (NESTA) Regional Conference. The Earth Science Literacy Initiative (ESLI), funded by the National Science Foundation, drives the geoscience inquiry approach in this program. ESLI has gathered and codified the underlying understandings of Earth sciences to the following literacy principles and concepts[1]:

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
2. Earth is 4.6 billion years old.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continuously changing.
5. Earth is the water planet.
6. Life evolves on a dynamic Earth and continuously modifies Earth.
7. Humans depend on Earth for resources.
8. Natural hazards pose risks to humans.
9. Humans significantly alter the Earth.

The "Everyday Science Mysteries" Workshops are guided by the ESLI Principles and draws inspiration from geoscience related news and events at the national and local levels. This Constructivist Learning Environment (CLE) focuses on observing a phenomena that occurs in the natural world and determining how or why that phenomena happened. Furthermore, this program hopes to provide future Earth science educators with a diverse range of real world challenges that engage their students in hands-on opportunities and reinforce STEM learning across multiple subject areas.

In this series, participants will explore "Karst Landscapes" through an investigation, while focusing on Principles 1, 3, 4, 8, and 9.

Target Audience

The "Everyday Science Mysteries: Karst Landscape" session is designed and developed for pre-service secondary education majors that will attend the NESTA Conference in San Antonio, TX at the end the Summer of 2013.

According to a pre-course attendance survey, students are primarily freshmen and sophomores who have avoided taking science in high school and have not had an Earth science course in middle school.[2]

Before the course, students were asked to reflect on their prior experiences in learning science as well as their ideal way to teach science. Based on this attitudinal survey, student responses revolved around the following themes:

[1] American Geosciences Institute (2012). Earth science literacy initiative. Retrieved from http://www.earthscienceliteracy.org/index.html

- Science is a monolithic process that must be rigorously followed.
- Science has a very rigid structure that many students find off-putting.
- Science inquiry is limited to conducting laboratory experiments[3].

Pedagogical Model

The constructivist-based pedagogical model for this workshop is Problem-Based Learning (PBL). This model supports experiential and exploratory learning through a complex problem solving activity. Students will be presented with a real-world scenario that will engage them in reasoning and critical thinking. Problem solving is the primary goal and focus of the instruction.

The session facilitators' roles are to aid in the participant's problem-solving process and provide them with the appropriate resources.

Learners in this model will:

- Have no formal prior knowledge of Karst formation and processes.
- Take ownership of the learning process by:
    - defining the problem and learning needs,
    - determining an action plan,
    - setting goals,
    - search and identifying relevant resources,
    - generating hypotheses,
    - and finding a viable solution.
- Work collaboratively in a group.
- Self-reflect through as they go through the authentic task[4].

[3] Gray, K., (2012). Teaching geoscience to elementary education majors. Retrieved from http://serc.carleton.edu/integrate/workshops/methods2012/essays/gray.html
[4] Dabbagh & Bannan-Ritland (2005). Online Learning: Concepts, Strategies, and Application. Pearson.

Learning Need & Problem

The U.S. science education is structured around the National Science Education Standards (NSES). The latest standards were released on Tuesday, April 9, 2013, after development by 26 states and several national scientific organizations. To serve the broader education community, the Earth Science Literacy Principles have been aligned with these standards. Teachers and school boards are encouraged to use it to shape class instruction ranging from individual lessons to whole curricula to build an enduring understanding of Earth science concepts.

For this session of "Everyday Science Mysteries: Karst Landscapes," participating pre-service student teachers lack formal knowledge of Earth science content, especially dealing with basic Earth systems and processes related to karst. They also have limited experience in collecting and analyzing data, as well as constructing explanations based on known scientific principles.

General Knowledge Domains

The CLE will support the following subject domains and practice of:

- Geology
- Geography
- Environmental Science
- Biology
- Team Building

Learning Outcomes

After taking this session, students will be able to:

- Practice collecting and analyzing multiple lines of evidence (Principle 1).
- Compare past to present conditions to forecast future events (Principle 1).
- Identify that Earth systems are comprised of rock, water, air, and life (Principle 3).
- Recognize the Earth systems undergo changes in which one system can cause new changes to that system or to other systems (Principle 3 and 4).
- Explain how human activities can cause natural hazards (Principles 8 and 9).

Learning Activities

Students will be presented an "Everyday Science Mystery" image of an unidentified karst landscape. Through a PBL investigation, student groups will work each other and engage in scientific inquiry through a similar scenario below. At the end of the week, students will present and discuss their findings.

Problem:

You and three other students have recently been hired to work as interns for Preservation Resource, Inc., an environmental consulting company in Louisiana. You are assigned to a small team to go out in the field and canvass a study site.

On the first day of the assignment, you used Google Earth to generate imagery of the study site for your report (Figure 1). Four days later, you arrive at the site and find a very different scene (Figure 2).

Figure 1
Image generated in Google Earth

Figure 2

The environmental manager assigns your team to fill out a report template to the Louisiana Geological Survey (Figure 3).

Louisiana Geological Survey
Report Form

Date: _____

Location (City, County): _____ Latitude _____ Longitude_____

Description of environmental/geologic anomaly or event:

_____

_____

Weather and average rainfall during the last seven days: _____

General geology of area (prominent rock types):

_____

_____

Underlying aquifers: _____

Flora and fauna: _____

Land use of area that you observe:

_____

_____

Structures and/or operations within 20-mile radius:

_____

_____

Potential risks and causes:

_____

_____

Figure 3

Your team will have access to maps, archived articles, previous reports, personal accounts from area contacts, and the Internet.

Your team will research and analyze the current and past condition of the study area and submit your findings at the close of business at the end of the week.

Assessment

Students will be asked to self-reflect as the primary assessment tool. Students will judge their contributions to the group and assess how well they achieved their goals at the task at hand. They will also be asked to recall their initial responses to the initial survey administered before the course.

Additionally, students within of the same group will collaboratively evaluate their peers and provide feedback on others groups' method or approach in assessing their scenario.