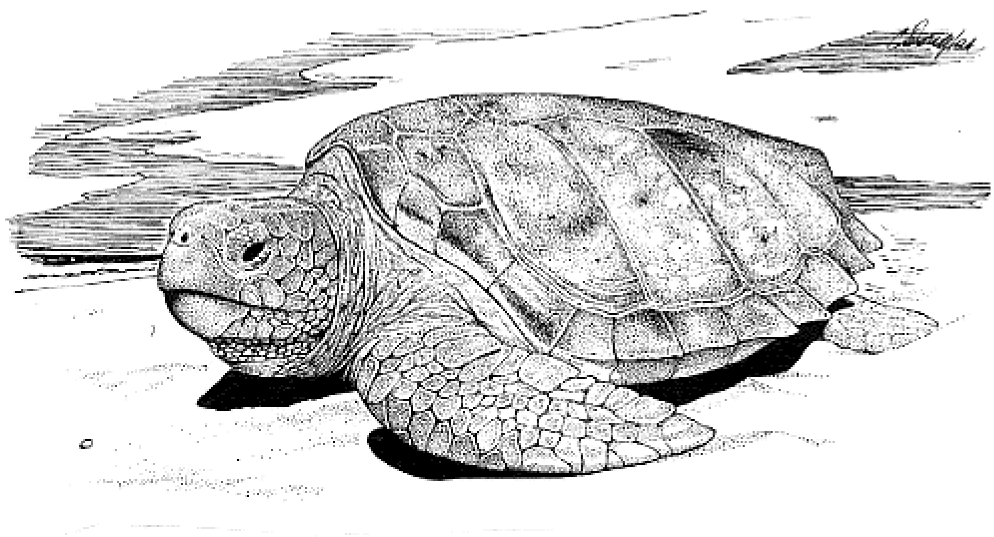

A CASE FOR A FORENSIC GEOSCIENTIST: WHERE DID THE SEA TURTLE LAY HER EGGS?

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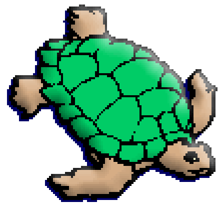
TABLE OF CONTENTS

GOALS AND OBJECTIVES

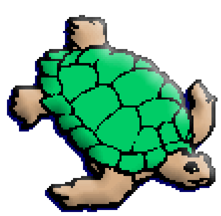


Florida Sunshine State Standards

SC.A.1. (FL - SC.A. The Nature of Matter) The student understands that all matter has observable measurable properties.
SC.B.2. (FL - SC.B. Energy) The student understands the interaction of matter and energy.
SC.C.1. (FL - SC.C. Force and Motion) The student understands that types of motion may be described measured and predicted.
SC.C.2. (FL - SC.C. Force and Motion) The student understands that the types of force that act on an object and the effect of that force can be described measured and predicted.
SC.D.1. (FL - SC.D. Processes that Shape the Earth) The student recognizes that processes in the lithosphere atmosphere hydrosphere and biosphere interact to shape the Earth.
SC.D.2. (FL - SC.D. Processes that Shape the Earth) The student understands the need for protection of the natural systems on Earth.
SC.F.1. (FL - SC.F. Processes of Life) The student describes patterns of structure and function in living things.
SC.G.1. (FL - SC.G. How Living Things Interact with Their Environment) The student understands the competitive interdependent cyclic nature of living things in the environment.
SC.G.2. (FL - SC.G. How Living Things Interact with Their Environment) The student understands the consequences of using limited natural resources.
SC.H.1. (FL - SC.H. The Nature of Science) The student uses the scientific processes and habits of mind to solve problems.
SC.H.2. (FL - SC.H. The Nature of Science) The student understands that most natural events occur in comprehensible consistent patterns.
SC.H.3. (FL - SC.H. The Nature of Science) The student understands that science technology and society are interwoven and interdependent.

OVERVIEW

A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs? is a progression of hands-on, minds-on activities that blend the geological, marine, earth, biological, and physical sciences in an ecological investigation. The students begin working as scientists by experiencing the process skill of classifying. A cooperative learning atmosphere is encouraged, as the students must generate their own progression of qualitative characteristics after classifying nuts, screws and bolts, and then an assortment of rocks to solve several problems. After considering the ecological importance of a beach habitat, the young scientists consider the beach profile origin of several sand samples and the natural forces that could cause their formation. From their previous learning, the students are ready to accept the challenge of determining where a sea turtle nests on a beach profile by comparing the sand samples.



LESSON PLAN

Lesson Plan

- **Title:** A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?

- **Subject:** Middle School Sciences

- **Course(s):** Comprehensive Science 1, Comprehensive Science 2, Comprehensive Science 3

- **Grade level(s):** Grade 6, Grade 7, Grade 8

- **Length:** About 2 Days

- **Abstract or goal of lesson:**

  This lesson is composed of a series of group activities that engage the students as *Forensic Geoscientists.*

- **Products:**

  Writing
  Reports
  Group Project

- **Pre-Assessment Strategies:**

  Background Knowledge

- **Action Plan:**

  This lesson is composed of a series of group activities that engage the students as **Forensic Geoscientists** as they *investigate various geological samples and collect qualitative and quantitative data.*

- **Student Reflection:**

  Please see narrative under the **Activity** heading entitled, *A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?*

- **Career / Work:**

  Please see narrative under the **Activity** heading entitled, *A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?*

Interdisciplinary/differentiation strategies:

Suggested instructional strategies for the Limited English Proficient (LEP) student can include:

- Small group peer interaction
- Use of questioning techniques for thinking, predicting, elaborating, and synthesizing
- Simplification of text using paraphrasing and soliciting background of prior knowledge
- Reading any text material aloud.

Activity

Activity Type:

Small Group

Procedures for conducting the activity:

Please see narrative under the **Activity** heading entitled, *A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?*

Student Procedures:

Please see narrative under the **Activity** heading entitled, *A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?*

Resources/Materials needed:

- Plastic sandwich baggies filled with an assortment of screws, nuts, bolts, washers, hexnuts, and wingnuts
- Plastic sandwich baggies filled with an assortment of rocks/minerals
- posterboard or the backs sides of discarded posters or butcher paper
- Water-based markers
- Per group: three different samples of beach sand from a beach profile (which are glued to double-stick tape on index cards); and one card of "mystery sand" collected from the sample closest to a dune or upland.
- Double-stick tape
- 3"X5" index cards
- Magnifying glasses and dissecting microscope, available
- Acetic acid (vinegar) in small cups
- Medicine droppers
- Safety goggles [not required when using household vinegar]
- Sand Gauge

A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?

A Narrative of a Geoscience Laboratory Investigation

A Case for a Forensic Geoscientist: Where did the sea turtle lay her eggs?

A Narrative of a Geoscience Laboratory Investigation

The Landscape of this Learning Community

This is a class of seventh graders, ages 12 and 13, engaging in a Middle School Comprehensive Science course.

Five of the students immigrated to this country during the school year. They seem to be learning the English language and participating in the group settings of instruction. All of the students appear eager to engage in the sciences if the instructional activities are presented as interesting. For example, students working as forensic geoscientists in the classroom may experience a connection to a future career mental image (i.e., legal field, police work, forensic sciences).

All of the students in the class fall within the stanine 1-7 range in the reading comprehension portion of the Stanford Achievement Test. However, if properly prodded, the cultural diversity in the composition of the class lends itself to the students' expression of a vast number of individual experiences. Presenting concepts in a spiraling sequence with a combination of visual, oral, and kinetic instructional strategies is designed to support successful cognitive achievement by these students.

Goals and Planning.

Earth and space science content standards recommend that students in grade 7 should conduct studies about the structure of the earth system. Specifically, students should have an understanding that land forms as a result of constructive and destructive forces. These natural forces are organized as part of the earth system. Since the school district is located near a beach, this context could be familiar to my students' experiences. As members of a scientific learning community, we want to acquire knowledge about the interactive land formation system through inquiry. The nature of the investigation would make the material relevant to students' lives, ensure the practice of a classification process skill, experiencing natural things in the process of change, and the logical analyzation of the collected data as young scientists who feel responsible for their learning.

I want my students to learn through this direct experience how to question, think, and reason like a scientist. The goals of this lesson will serve the overall goal of each student becoming a scientifically literate member of our community (i.e., the ability to communicate and contribute their science learning) and a continuous learner of the sciences as each student matures.

The students are arranged in 6 study groups with about 4-5 students per group. The collaborative grouping strategy alleviates linguistic and reading weaknesses of individuals, while taking advantage of the strength of the diversity of the group interaction. Initially, the groups were given plastic baggies filled with an assortment of screws, nuts, bolts, washers, hexnuts, and wingnuts. The problem was to place the items found in the bag in their natural grouping. When the groups finished the task, I asked the whole class, "How did you group them? What characteristics did you observe to group/organize them? How does this natural grouping or organizing relate to science?" The students responded with reasons for their grouping, stated an assortment of characteristics, initiated discussion of their prior knowledge of the classification system, and concluded that living and non-living things in nature can be classified or grouped according to characteristics. The study groups then received baggies of an assortment of rocks and revisited the original problem. This additional activity required the students to list on poster board with water-based markers the "qualitative characteristics" that helped each group to distinguish the rocks. In whole class discussion, each group reported on their data and the characteristics were listed on the chalkboard and the similarities were noted. I asked, "What natural forces can serve to destruct…construct the rocks? Prescribed "wait time" became silent time, as the students seemed confused. I added to the description of the question by suggesting that they think of "what could effect you if you were a rock sitting outside, or if you were a bunch of little rocks, what forces could make you into one bigger rock?" The students replied by offering suggested natural forces (e.g., bodies of water, rain, rivers, wind, atmospheric chemical composition, and more).

I then asked the students to look at the powder-like material that our study of the rocks left on each group's table. I asked what we could call this material and we began to discuss the different types of sand, was offered some physical and chemical properties by the students, while eliciting qualitative characteristics that could be used to distinguish sand. We concluded with a list that the students based upon not only the preceding activities, but also their previous knowledge, such as the characteristics of the locally predominant limestone.

I drew a cut-away profile of a beach-dune on the chalkboard and continued the whole class discussion seeking the names of living organisms that they are aware of that live/depend on the beach sand as well as non-living things. A few individuals offered sea turtles as an organism that is dependent on the beach and I subsequently queried the class to add any specific details about patterns of sea turtle behavior. I asked if "the sea turtle and her nest might be a force that effects the beach…in what way?" I also asked the students if the composition of the sand might effect the organisms that depend on the beach.

Three (different) samples of beach sand from the beach profile, which are glued to double stick tape on index cards, were distributed to the study groups with magnifying glasses and posterboard. The students were told that I would shortly be distributing a sample of sand from last year's nest of a sea turtle. This time I added a story that we will be acting as forensic geoscientists in our inquiry: we want to determine in which sample of beach sand did the sea turtle lay her eggs? Continuing to guide the students toward their design of our investigation, I asked how we should report our data. It was suggested that qualitative characteristics of each sample be noted (on the posterboard).

Guiding Discussion.

It is recommended that the teacher *listen* and monitor the small group interactions of the students to *guide* the students' engagement as scientists: that they are participating in the group discussions, and that the students' observations have not strayed too far from a rationale outcome. In this lesson, an additional manner of assessing student progress was by checking on the construction of the tables/charts at each group as they collected the data. I only assert my presence on a group when I can *facilitate* progress with a probing question, distribute additional equipment, or answer a question in a manner that results in further student inquiry. As an example, a student asked me for a direct answer to their question. I replied, "Did you ask other members of your group?" Which the student began to do. In the whole class discussion, each group should be encouraged to participate and contribute to the science of our learning community.

When I was at the front chalkboard beginning to ask the students to compare the three original sand samples, I had originally intended to simply have the students come to a conclusion without "going into each one" of the sand characteristics. However, I realized that I could generate more science discussion and encourage the students to risk participation if we constructed a class table that listed the sand characteristics on the chalkboard as a whole class.

Again, at all times, students were encouraged to participate or contribute to the discussion.

While asking the students to determine how we could determine the exact sand placement on the beach, one student replied, "Now you tell the truth," meaning "to give us the answer." Wanting to reinforce that the analyzation of the incomplete data that we collected is not a mistake but an opportunity to gain understanding, I asked for ways to establish the proper beach formation with the result that their choice of force may differ because there are many possible forces in the earth system. It was here that the students came to realize that more than a simplified consensus would help us make sense of our data; we needed additional evidence to come to a logical conclusion.

Some of the discussion was open-ended questioning; questions that entailed the recall of collected data were usually met with a short answer; the beach formation and forces discussion resulted in a longer reply from the students.

I also noted a concern for safety to my students by recommending safety goggles to protect the eyes when using an acid. (Acetic acid or vinegar was used by the students when, using their prior knowledge, they asked for a weak acid to identify the presence of calcium carbonate.) I demonstrated respect for living organisms by mentioning that I am using sand from "last year's turtle nest" implying that I am not disturbing a viable nest.

I used questions to encourage the group to analyze the beach formation by logically assessing the possible forces that could cause that formation.

At the front chalkboard in a whole class discussion of our learning community, we reached a consensus of the qualitative characteristics of the sand samples. I listened and watched for any disagreement from group members, even asking, "Everybody agree with that?" I consistently looked for and responded to any query or contribution from any student.

Analyzing the sand samples at the side chalkboard in a whole class discussion, we determined possible beach formations and the students' rationale for the forces that effected the proffered formation. These suggestions appeared to be based on each student's past experiences. However, I should have asked the students to elaborate more on the rationale of their choice of sand sample on the beach profile.

I want the students to think without me giving them the answer - to work as scientists and to have a sense of the science community that their conclusions are real and valid and are subject to change.

In a continuation of the lesson we constructed a web diagram of some of the earth systemic forces that can effect beach/land formation and we categorized these systemic forces as "Atmosphere, Hydrosphere, and Biosphere."

Instructional Strategies.

I encourage the students to make connections between their previous understandings and everyday experiences and the scientific principles. For example, when at a side chalkboard during the whole class discussion, I sought the past observations of a student who said "it depends on which beach you go to." ["Why?" I asked.] My focus is that the students will gain a deep understanding of earth system forces from this simple hands-on experience. They can now transfer their new knowledge when studying and thinking about the many interactive earth systems.

This overall inquiry strategy is intended to give students the opportunity to garner earth science concepts as they participated in a student-driven project that gave them a sense of ownership of their science learning. I'll consistently ask the class, "How are we going to resolve this?…How would a scientist resolve this?"

Students at this level in their thinking may misconceive that the characteristics and formation of land/sand as being an innate property. This lesson is intended to guide the students to recognize the properties of land/sand while helping the students to understand the interactive biotic, atmospheric, and hydrospheric forces of the earth system.

We now have the option of taking a field trip to examine the conditions at an actual beach site and conclude a method of systemic beach/land formation. If this is impractical, access to a National Oceanic and Atmospheric Administration videotape on barrier island formation and another on ocean currents and tides. With this additional information, the students could then write a creative essay on how they thought the beach formed from the sands that we studied in our lesson. Furthermore, students could now research in greater detail any of the other forces that are a part of the earth system, such as the lithospheric plates, and transfer that knowledge to their local land formation.

I use a study group strategy as I find that as a group they can communicate and share their cultural and "with-family" experiences as they are gathering data, making observations, or coming to conclusions. This helps to enrich the analysis that leads to the conclusions. I try to incorporate lessons/activities that invite active learning and to construct a deep understanding, working in this lesson as a geoscientist, while replacing or reconciling previously understood material.

It should be noted that most of study groups should be balanced, ethnically and by gender. Recent immigrants should be evenly dispersed among the groups.

Although I recognize students that voluntarily contribute to the class, I will also try to call upon students who have not appeared to be orally contributing. For example, while engaged in the whole class discussion, I purposefully brought into the discussion an apparently (to me) disinterested study group in the back of the class, only to find that they were listening to the discussion and were quick to contribute when I inquired, "Hello, in the back?"

I consistently walk around the classroom assuring a sharing of duties by the students in the group (i.e., some working on the table/chart recording the data, others making observations and reporting orally). I also assure that there is the sharing of equipment and materials. I try to create an atmosphere of inclusion by actively encouraging the students in a group to discuss the science that they are doing. It’s important to listen to the students' knowledge of the world, such as when we listened to the observations of a student who offered their experience of sea turtle nests.

Reflection

The lesson appeared to successfully nurture the students toward organized and systematic thinking as they had to determine what data to collect and how to collect it as well as independently deciding what order to record and present their work. This inquiry guided them to analyze their data and contemplate sand comparisons, consider earth systemic forces and land formation. They realized a connection between the science that they were doing and their everyday experiences by offering stories of their past. They appeared enthused as they conducted their scientific work as forensic geoscientists and contributed to the learning community.

Overall, student engagement and individual and group contribution to the whole class and group discussions as well as the investigation was very effective in terms of reaching the goals with this group of students. The group construction of the tables/charts provided me with an immediate visual assessment of the groups' work as I listened to the quality of group conversation as a further assessment of progress. The students appeared to use a hands-on experience as evidence of land formation and systemic earth forces.

Future instruction should have had at least a few of the groups summarize their posters and creatively communicate their conclusions. I should attempt to rotate from lesson to lesson, the student from each group giving the synopsis, with perhaps a group displaying their product to the whole class, while encouraging oral engagement from the other groups in an effort to achieve a consensus. I also should give more time to product construction and for individuals to complete their examination of the materials under study.

When originally designing the lesson, I wanted to include the quantitative measurement of the sand grains using an actual geoscientist's tool, a *sand gauge*. I hesitated in order to focus on qualitative data collection. However, when a study group requested to quantitatively measure the sand, I immediately gave them the tool, with a very brief explanation as to its use. Their partial success has encouraged me to include this measuring device in the future.

One group rightfully insisted on a "texture" characteristic to their table/chart. We should include additional group characteristics into the discussion when appropriate.

I was quite pleased with the number and variety of student responses. Usually I provide immediate positive feedback with a point system awarded for oral contributions, especially when verbal input during whole class discussion becomes stagnant; I will continue this policy that encourages all individuals to contribute (in any language) to whole class discussion.

I should also note that I used a videocamera in the classroom as a self-assessment tool. Its presence consistently affects a small number of students. But, I would use this self-assessment tool again.

Finally, the chalkboard work at a side chalkboard had students' backs facing the proceedings and should be avoided.

RESOURCES

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