What is a fossil & what does it tell us?

Fossil Finders Curriculum, University of Georgia- Spring 2013

Lesson Description

This lesson engages students in an exploration of fossils. In this lesson, students will be introduced to the work of paleontologists by working in pairs to observe, draw, and make inferences about fossils. Students will use their observations and their prior knowledge of the environment and modern day processes to make inferences about the environments in which fossilized organisms once lived. Student pairs make predictions, compare results, and discuss their findings. Students will also learn about aspects of nature of science, including subjectivity, observations and inferences.

Time Estimate: 50 Minutes

Essential Questions

What is a fossil? What kind of information can be inferred from a fossil? What can a fossil tell us about an environment? Why do some things become fossils, but not all?

Learning Outcomes: The students will…

- Distinguish between observations and inferences
- Describe the concept of uniformitarianism
- Recognize that fossils are evidence of the past
- Discuss how science involves creativity and subjectivity

Next Generation Science Standards

MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Scientific and Engineering Practices

4. Analyzing and interpreting data
6. Constructing explanations
8. Obtaining, evaluating and communicating information

Crosscutting Concepts

1. Patterns
2. Cause and Effect

NGSS Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Vocabulary

Observing- the process of using one or more of your senses to gather information

Inferring- Process of making an inference, an interpretation based on observations and prior knowledge

Quantitative- observations that use numbers which can be measured such as: height, length, width, area, volume, temperature, speed, humidity and cost.

Qualitative- type of observation describing things that are difficult to measure. These observations use qualities or characteristics such as smell, taste, texture, color.

Uniformitarianism- Thought of as the "present is the key to the past." The idea that the natural laws and processes that are happening in the universe now are the same as those that have happened in the past. (ex: sedimentary rocks are formed the same ways today as they were throughout geologic history)

Fossil- the remains or trace of a living animal or plant from a long time ago. There are many ways in which fossils are preserved including being buried in sediment, trapped in amber or frozen.

Paleontologist- a scientist that studies fossils for information about life in the past.

Materials

- Rock with fossils
- Rock Observation Work Sheet, What is a Fossil KWL (both available at www.fossilfinders.org), or scratch paper
- Hand lens, magnifying glass, or stereoscope (optional)

Safety

- Remind students to be careful with rocks since if they have sharp edges the rocks may cut skin.
- If students are using a glass hand lens or magnifying glass remind them if the glass breaks not to touch it and to ask the teacher for help.

Preparation

Make sure there are enough rock samples with fossils so that each student group has one (we recommend putting students in twos or threes).

Engage (5-10 minutes)

Pass out a rock sample to each group of students and a Rock Observation Work Sheet, What is a Fossil KWL, or scratch paper. **Ask students to draw what they see in the rock or write down observations** (both qualitative and quantitative). Allow time for each group of students to describe briefly what they see in their samples. Encourage students to make careful observations and spend time on their drawings.

Possible student responses may include: The rock is dark in color, hard, jagged, etc. There are shells or fossils inside the rock. Introduce the term fossil, preserved

remains, and trace fossil. Students may also include inferences. Be sure to re-address the difference between inferences and observations.

Living Fossils (10-15 minutes)

Ask students to **draw a picture of what they think one of their fossils might have looked like when it was alive** (here you are asking them to make an interpretation/inference). Tell them to include its **environment or surroundings**. Also have students write on the back a **justification for what they** drew. Students should explain their reasoning for what they think the organism looked like and the environment. If students struggle with this you may want to provide pictures of organisms that may be similar to aid them in this. Paleoportal may be a helpful website (http://www.paleoportal.org/). If this has not been previously addressed, explain what a paleontologist is and explain how what they are doing is similar to what a paleontologist does.

Explanation (10 minutes)

What is the basis for your interpretation? **Have students get into small groups to share their drawings and explain why they drew them the way they did. Then have a discussion as a class.**

Possible questions include: How do we know it was a living organism? Discuss internal structure etc… Then lead into a discussion about what it could be. What has growth lines like this (tress, clams, etc…)? What does it look more like? Where could these organisms have lived? How do you know this? Another way to get at this is to use student drawings (where they draw the fossil in its living environment), and ask questions such as: Why did they put the organism in water? Why did they put legs on that organism? Where might they have seen things like this before?

Point out that in historical sciences like paleontology much of what we know comes from modern organisms. Through this address how geologists use the concept of uniformitarianism, the idea that the same natural processes that operate in the world today, have always operated in the world in the past, and at the same rates, or more simply, the present is the key to the past. To help students think about this, it might be helpful to draw on processes they have seen (like rainstorms instead of mountain building and sedimentation), and ask them if they think there were rain and storms in the past (show students pictures from Google images of raindrop imprints in modern mud and imprints preserved in rock). It might be fruitful to ask students what are some of the effects of modern rainstorms (erosion, flooding, etc.) and how might they find evidence of this in the fossil record?

To highlight the concept of uniformitarianism, lead a discussion on how students can use what they know about modern organisms to make inferences about the past. Ask questions like: Where are shells and corals found today? How did they get in this rock? What must this area have been like in the past in order for there to be shells and corals in the rocks? (e.g. Since shells and corals are found in the sea today and students are seeing these creatures in rocks from New York, at some time in the past New York was probably covered by a sea). A teacher may want to talk about how the fresh water Finger Lakes present in central New York today are much younger than the saltwater sea that once covered the area.

It may also be helpful to lead a discussion on what the weather is like in places where you find corals today and use this knowledge to determine what it must have been like in NY a long time ago… Discuss the confluence of evidence, compiling multiple kinds of independent evidence to back the idea that students are testing (important idea to historical sciences). This is different than much of physics and chemistry where they test hypotheses in the modern day. Connect to other historical sciences and forensics.

NOS: Connect what your students did with the work of scientists. Just as students used their knowledge to think about what the fossils were like during life, scientists like paleontologists (scientists who study ancient life by looking at fossils) use the present to study the past because they cannot go back in time to learn about how things were. Also, that an aspect of the nature of science is the difference between observations and inferences.

Concluding Discussion (5-10 minutes)

It is important for students to understand certain organisms are more likely to become fossilized than others and that many living organisms will never become fossils. In essence the fossil record is incomplete (some organisms were never fossilized) and is biased (some species are better represented than others).

Have students guess what type of organism they think is more likely to become a fossil. As a class, make a list of fossils of plants or animals that students have seen in the past and what parts were fossilized (ex: a student may say they saw a mastodon at the museum, but only the bones were fossilized). You might want to make the list on a white board or chalkboard so that all students can see. Hopefully, the students list will show a bias toward certain types of organisms. If students are having difficulty you might show them examples of fossils from the Paleoportal website.

Discuss with students that in order to create a body fossil the decay must be slowed or retarded and that the organism will most likely (but not always) have hard parts. Explain that because of this the aquatic organisms with hard parts are most likely to become fossils. If the list that students made on the board was biased toward something else like dinosaurs or mammals explain that museums and other organizations display these fossils since they are interesting for people to see, but they are pretty rare compared to marine organisms.

*For teacher knowledge, ways that decay can be slowed or retarded include:

1. Remains must be very cold (ex. Frozen baby mammoth)
2. Remains must be ultra dry (land environments)
3. Keep oxygen away from remains (water environments)
4. Be in an ultra-saline (salty) environment
5. Chemically alter or change remains
6. Encase remains (amber, tar, ice, sediment)

Assessment

Assess the drawing that students made of what their fossil may have looked like when it was alive and what the environment would have been like. Read the students' justifications. For this exercise, students should be assessed on whether they made reasonable inferences using the data available as opposed to strictly on being correct.

Handouts

- Rock Observation Handout- This sheet gives students an opportunity to write down their observations and to use inference skills in making a drawing of what the organism may have looked like when it was alive.
- What is a Fossil K-W-L - This chart supports students in activating prior knowledge, establishing relevancy, and encouraging reflection.
- Frayer Model- Aims to provide structured support to students in developing conceptual understandings. It draws on student knowledge of terms and tying classroom learning to student home experiences and knowledge. In this way, students are encouraged to bring cultural knowledge into the classroom.
- Discussion Map- Encourages students to use evidence in developing an argument or position. This model is useful for structuring responses to questions related to readings or reflective assessments of classroom learning.

Additional Readings

- National Academy of Sciences (1998). *Teaching about Evolution and the Nature of Science.* Washington, D.C.: National Academy Press. (ISBN: 0309063647)
- Pojeta, J. & Springer, D. (2001). *Evolution and the Fossil Record.* Alexandria: American Geological Institute. (ISBN: 0922152578)
- Hester, P. (2008). Taking steps to understand geologic time. Science Scope, 32(2), 54-56.

Teacher's Tips

- This lesson really worked in supporting my students to be comfortable in identify fossils. My "cherry picked" fossils were great resources in preparing my students to analyze the sample rocks for recording fossil data, too.
- They were learning a lot of new vocabulary so we did some vocabulary Jeopardy to help reinforce the new words.
- I had students do a blind sketch, then a contour sketch, and finally a detailed sketch of a fossil. This helped them focus on detail. Next time I am going to have them do a sketch before and then another one after and discuss changes.
- I think it might be helpful for younger students, to focus on observations first [during this lesson] and introduce the inferences later on, after the Fossil Finders investigation. This way, students focus on observations now, and inferences later, to assist in student confusion.
- I had my students complete a fossil KWL. After they wrote down what they knew about fossils I asked them to write down what they wanted to know about fossils. Then, I showed them a 5 minute video clip (downloaded from Discovery School Science) about fossils. Then they filled in what they learned.
- I used this activity as a warm-up for when students looked at the real fossils. So I also asked students to measure and identify their fossils.
- I liked this activity, but I made some changes to the handout. I had them choose one fossil and tell a story in a drawing. They were to provide evidence for their drawings from the rock.
- I used background information from the website: http://www.discoveringfossils.co.uk/whatisafossil.htm which provided great background information for the activity. I think it was useful.

Additional Websites:
http://www.ucmp.berkeley.edu/fosrec/Learning.html
http://www.newyorkscienceteacher.com/sci/files/download.php?id=727&file=onlinefossils.pdf

ELL Adaptations

1) Include a variety of cultural experiences and materials in instruction.
   - Where else in the world can fossils be found?
   - How do other cultures understand the geologic past? Ask students how other cultures may interpret the past.
   - Provide reading materials in students' native languages.
2) Share scientific authority
   - Respond to student questions with further probing questions.
   - Employ the use of a student journal
     - *Journal can follow the Bybee 5E format and include reflection questions that engage students and encourage them to explore, elaborate, explain, and evaluate.*
     - *Include space for parent involvement by engaging students in interviewing their families and assigning collaborative projects.*
3) Encourage the use of students' home language to enhance understanding in classroom instruction
   - Supplement KWL charts and graphic organizers with use of native language and student sketches
     - Frayer Model- Aims to provide structured support to students in developing conceptual understandings. It draws on student knowledge of terms and tying classroom learning to student home experiences and knowledge. In this way, students are encouraged to bring cultural knowledge into the classroom.
   - Invite the use of native language for classroom discussion, reading, note-taking
   - Group students to communicate in native language when using reciprocal teaching and other instructional strategies
4) Tailor verbal communication (in English) to enhance students' understanding
   - Provide visual aids when introducing students to new vocabulary and concepts.

For example, use a drawing that would depict "sedimentation."
[See Teacher Resources for examples]

- Encourage students to supplement note taking with drawings, or "cartoon notes" during direct instruction
- Use hand and facial gestures

ELL References

- Barton, M. L., & Jordan, D. L. (2001). Teaching Reading in Science: A supplement to the Second Edition of Teaching Reading in the Content Areas Teacher's Manual. Aurora, CO: Mid-continent Research for Education and Learning.
- Luykx, A., & Lee, O. (2007). Measuring instructional congruence in elementary science classrooms: Pedagogical and methodological components of a theoretical framework. Journal of Research in Science Teaching, 44(3), 424-447.