HUNTING INVERTEBRATE FOSSILS IN THE CLASSROOM

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Level: Elementary to junior high

Anticipated Learning Outcomes

- The student will acquire a general knowledge of fossils and paleontology, the study of evidence of life in the past.
- The student will be able to identify the major invertebrate groups (phyla) commonly found in the fossil record.
- The student will learn how fossils tell us about the history of the earth.

Introduction

This activity is designed to provide a general knowledge about evidence of life in the past and paleontology, or more simply, fossils, with an emphasis on the invertebrate phyla which include over 95% of all animal species. A general knowledge of life is all the students need; even many five year olds know what a clam, snail, insect, starfish, or octopus is and where these kinds of animals may live. The activity will introduce the student to the science of paleontology and its intimate relationship to sedimentary geology. The main concept here is that the organism interacted with the rock-forming environment. Information is preserved in the sedimentary rocks and the fossil remains. The information in one is very important in our understanding of the other. The activity also introduces the student to what the professional paleontologist does to earn a living.

Background

Your state geological survey, local geology society or natural history museum often publish good introductory guides to the local rocks or sell general introductory books for the hobbyist. Ideally, I recommend the instructor take at least one introductory course in geology or read a few introductory books on the subject. Many universities offer introductory geology courses in the summer. I do believe a general knowledge of biology and a long evening of reading would suffice for the simpler parts of the exercise, especially if you can find a local geologist willing to help.
Materials

- Rocks - Obtain good examples of sandstone, shale and limestone, the three main kinds of rocks fossils occur in. Ideally the rocks will contain a few fossils.
- Tools - A hand lens or magnifying glass for each student can be very useful, the cheap ones ($2-$5) are very durable and just as good as the more expensive kinds for most purposes. I think the student feels more like an explorer or scientist with a hand lens to magnify the very small but often abundant fossils. Hammers are overrated and usually do more damage than good in most activities.
- Fossil material - This can be a real problem. Fossil collections from Wards Scientific or similar businesses are often expensive and inadequate for use by more than two or three students at a time. They are also easily damaged and lost. I advise using disposable material if at all possible. The state geological survey, the geology department at a local university or the local natural history museum often has a person who is formally or informally assigned to public education. This person can often help you find free fossil material or will help teach the session and bring their own material. Some museums have rock and/or fossil kits that they will loan out to the local schools which often include teaching aids as well as specimens. The objective is a complete selection of most of the major invertebrate groups, that is 8 to 12 different groups (phyla). If you have trouble finding a specific group, a modern representative is acceptable; the student still learns to identify the organism. In general I feel the student should learn to identify and distinguish from other groups: protozoans (microfossils), sponges, coelenterates (corals etc.), bryozoans, brachiopods, annelids (mostly just worm tracks or borings), arthropods (trilobites, insects, crustaceans, etc.), echinoderms (sea urchins, starfish, crinoids, etc.), mollusks (snails, clams, cephalopods, etc.). The bold-face groups are the most common and easily recognized.

Many areas are rich in fossiliferous shales and limestones. For example, here in the midwest a gallon of the appropriate shale layer contains thousands of different kinds of small fossils in the 1-cm and smaller range. Often outcrops of weathered limestone and shale are covered with a fine layer of fossil material which can be swept up with a sturdy broom (consult your local geologist about localities). Collect about five gallons plus of material for every 20 students. Wash this material through some sort of screen to remove the mud but keep the larger parts (>1 mm) (see part 3 of procedures). Ideally, you and the class go out and do the collecting.

- Reference material - Any introductory book to fossils covers the above topics in more detail than you will need. I find the Golden Guide® Fossils to be very inexpensive and complete. The Golden Guide® Fossils is complete enough to be used as a text and handy identification guide for a one or two week segment in a general science course. It also covers all the topics listed under the activities below. It is even used in the paleontology for non-majors course at the University of Wisconsin, Madison.

Procedures

This is a classroom activity on invertebrate fossils, but if you have the time and money to go on a field trip, it is always the richer learning experience for the student. This is especially true of
geology and paleontology which are fundamentally field sciences. The best activities are those that simulate a field trip and have the same sense of exploration for the student.

1. Before starting a unit on fossils, a general knowledge of sedimentary rocks and how these rocks have formed can be very helpful. (For example, what is a sandstone? It is rock made of sand grains like one would find on a beach or in a river.) The student can associate the environment the rock formed in with the kinds of environments the fossilized animal originally lived in. For example, shale usually starts as a soft muddy bottom sediment in quiet water where fine mud can settle out. Animal fossils found in shale are those that swam in the water above the muddy bottom or were specially adapted to live on or in soft soupy mud. Have the students think about how and where each kind of rock forms, and what kinds of animals live in those environments.

2. First introduce the students to the major invertebrate phyla as listed above. If the students have already had a good introductory biology class, you may only need to review. Often modern specimens can be substituted here. You might want the student to keep a lab notebook, with a drawing of a representative organism from each group and a list of features which distinguish that group from others. This notebook can be used by the student to identify fossils in other exercises. For example, the student could draw a snail, labeling the opening and spire portions, also listing features such as: spirally coiled shell, interior is a single open chamber (which distinguishes most snails or gastropods). Ideally the students will have a variety of specimens they can pick up and examine closely. Ask questions which make the student think about the group of features that determine which phyla a fossil belongs in.

3. If you have access to fossiliferous limestones and shales in your area that can be collected as described under materials, the following exercise is almost as good as a field trip. Spread a thin layer of this material out in a tray and have the students (in groups of two or three) use a hand lens to pick and identify the major groups of fossils they find. As an incentive let them keep anything they can identify. This activity works very well after the major fossil groups (such as clams, snails, brachiopods, echinoderms, etc.) have been introduced. The students are doing exactly what many paleontologists spend lots of time doing. It helps if each student can have a magnifying glass for the exercise, a tray or surface to spread out the material and a zip-lock plastic bag to put the fossils in to take them home. Good bright light is very important.

4. An alternative or additional exercise is to acquire several (one per every three or four students) plates of fossil bearing rock, at least a foot square. Paleozoic age limestones commonly occur as thin flag stones covered with a variety of fossils. Ask your local geologist about where to find such material.

5. In exercises 3 and 4 students identified the various fossils. They could also note the association of certain organisms with certain types of rock. For example, corals live in a marine environment. If you find fossil corals in the local rocks, this is evidence that the area was under an ocean when the coral was alive, and maybe the area was once a little like the Bahamas are today. Have the students read about modern coral reefs and the ocean around the Bahamas or the Florida Keys. Have them think about the kinds of organisms that live in the ocean today and whether they are similar to the fossils they are learning about. Is it reasonable to think that 100s of millions of years ago the midwest
was like the Bahamas? (Many geologists think that is a good analogue for certain times in the past.)

6. Once the students can identify the major groups have them pick a favorite specimen and do a small research project. They could find out where the same kind of animal lives today and what type of environment it prefers. Many paleontologists are more interested in what the fossil can tell about the ancient environment than in the fossil itself. Have the student give a short talk to their classmates about the fossil. For example, if they have a fossil coral they can say it probably lived in warm, clear water somewhere near the equator. If the fossil was collected here in Kansas (and they are) how could there have been coral reefs here in Kansas? The midwest certainly looks nothing like the Bahamas do today; we don't even have an ocean! This makes the students realize that environments in a particular location change through time.

7. Some fossils represent organisms that only lived for a specific span of time in the past or have only just appeared here on the earth. The concepts of geologic time and biostratigraphic ranges (a fossil found in a rock can represent a specific chunk of geologic time) can be difficult to teach. It requires a fair background in geology and paleontology. If you have the time and the material, you can illustrate the concept fairly well. For example a rock with trilobite fossils in it must be between 245-530 million years old (Paleozoic Era). (The Precambrian/Paleozoic boundary is conventionally assigned an age of 570 million years; however, recent studies indicate it is probably 530-540 million years ago.) If you have specimens of the appropriate fossils students can learn to make an approximate guess about the age of the rock each fossil was found in. Dinosaur bones occur in Mesozoic age rocks, 65-245 million years old. This is an important concept since it is on this idea that geologists originally constructed the history of the earth. The book Golden Guide® Fossils covers this topic very well.

Results and Discussion

I have tested these activities with students between six and nine years old and they have been very successful. The activities would also work well with older students. For background, students need to have only a general knowledge of nature.

While dinosaurs will always be popular, invertebrate fossils can generate an equal amount of student interest for several reasons. The invertebrates living in the time of the dinosaurs can often tell more about the environment than the dinosaur fossils themselves. Invertebrate fossils are common. Often the student can collect and keep for their very own invertebrate fossils they have found near their home. Like a dinosaur, an invertebrate fossil is something from the distant past; some are 100s of millions of years older than the earliest dinosaurs. I have found even the youngest students can imagine the ancient ocean that was once here in the midwest when they find a fossil oyster.

The principle objective of this activity is to help students identify fossils they may find on a camping trip or in the gravel of a parking lot. Not only might they pick up a fossil and go "wow a trilobite", they will also have a sense of the ocean that must have covered the area and how very long ago the trilobite lived.
Selected References

Rhodes, F. R. T., Zim, H. S., and Shaffer, P. R., 1962, Fossils: a guide to prehistoric life: Golden Press, New York, 160 p. (At $4 this is an inexpensive and comprehensive guide to fossils, with good color illustrations.)