

# STORIES TOLD by ROCKS

**Grade Level:** 7<sup>th</sup> Grade Science

**Presented by:** Lynne Brown, St. Joseph School, Slaton, Texas

**Length of Unit:** 3-4 weeks

## I. ABSTRACT

Stories Told by Rocks is a unit over paleontology as found in the Seventh Grade section of the *Core Knowledge Sequence*. The students will study fossils to learn about the geologic history of earth. The students will do a variety of activities that will include hands-on lab activities, model making, and graphing. The students will go on a fossil dig and experience life as a paleontologist. The units culminating activities will be for students to create a web of facts about fossils and produce a student-created book over fossils to be shared with the fourth grade class.

## II. OVERVIEW

### A. Concept Objectives

1. The student will understand that natural events and human activities can alter earth systems. (7.14)
2. The student will use scientific inquiry methods during field and laboratory investigations. (7.2)
3. The student will use tools and methods to conduct science inquiry. (7.4)

### B. Content Objectives

1. Paleontology-pg 176
2. Fossils as a record of the earth's history and past life forms. Pg 176
3. How fossils are formed, and types of fossils (mold, cast, trace, true-form). Pg 176

### C. Skill Objectives

1. The student will represent the natural world using models. (7.3c)
2. The student will communicate valid conclusions. (7.2d)
3. The student will collect and analyze information to recognize patterns. (7.4b)
4. The student will draw inferences based on data. (7.3b)
5. The student will construct graphs to organize, examine, and evaluate data. (7.2e)
6. The student will collect data by observing and measuring. (7.2b)

## III. BACKGROUND KNOWLEDGE

### A. For teachers

1. "Round Rocks: Teaching the Principles of Earth Science and Paleontology," by Warren D. Allmon and David H. Griffing.
2. *Eyewitness Science: Fossils*
3. *The Evolution Book* by Sara Stein.

### B. For students

1. The students should have past knowledge of the following: The Earth: What's inside the earth from the First grade *Core Knowledge Sequence*, Geology: The Earth and its changes from Fourth grade *Core Knowledge Sequence*, and Plate Tectonics: The surface of the Earth found in the Sixth grade *Core Knowledge Sequence*.

## IV. RESOURCES

- A. *Holt Earth Science*
- B. *Eyewitness Science: Fossils*
- C. *Collecting Fossils*
- D. *Discovering its History* (film)

E. *Fossils: Evidence of Life* (film)

## V. LESSONS

### Lesson One: Principles of Paleontology (2 days)

#### A. *Daily Objectives*

1. Concept objective(s)
  - a. The student will understand that natural events and human activities can alter earth systems.
2. Lesson content
  - a. Paleontology p.176
3. Skill objective(s)
  - a. The student will represent the natural world using models. (7.3c)
  - b. The student will communicate valid conclusions. (7.2d)

#### B. *Materials*

1. Photo of the Grand Canyon
2. Notebook paper
3. Pen
4. Deck of playing cards
5. Science Journal

#### C. *Key Vocabulary*

1. Paleontology: a science dealing with the life of past geological periods as known from fossil remains
2. Uniform: having always the same form, manner or degree; not varying
3. Principle of Uniformitarianism: the process that occurred in the past times produced the same results as similar processes do today
4. Principle of Superposition: younger rocks are deposited on top of older rocks

#### D. *Procedures/Activities*

1. Introduce the term paleontology to the class. Review the three different types of rocks and how you can learn about the earth's history by studying the rocks.
2. Divide the class into small groups. Give each group a photo of the Grand Canyon. Have each group write a brief description of how they think these rocks might have been formed and what rocks tell us about geologic processes. Have students share ideas with their classmates.
3. Explain that the Grand Canyon can be thought of as an "earth history book" whose "pages" are the rock layers that make up the canyon.
4. Each student will make a list of 20 things that are the same, or uniform, from one day to the next. Compare list with classmates.
5. Introduce concept of principal of uniformitarianism. Example: Animals with shells live in the sea today. Uniformitarianism tells us that long ago the same type of animals lived in the sea as well.
6. Demonstration: Take a deck of cards and let them fall to the floor. Some cards end up under others. Which cards landed first? Which ones landed last? Introduce concept of superposition.

#### E. *Assessment/Evaluation*

1. Journal Writing: What would our world be like without the principle of uniformitarianism?

### Lesson Two: Why is That Rock Round? (3 days)

#### A. *Daily Objective(s)*

1. Concept objective(s): The student will understand that natural events and human activities can alter earth systems.

2. Lesson content
    - a. Paleontology – pg 176
  3. Skill objective(s)
    - a. The student will represent the natural world using models. (7.3c)
    - b. The student will collect and analyze information to recognize patterns. (7.4b)
- B. *Materials*
1. Packet of photos (each packet will contain photographs of people of various ages, cars, and distinctive fashions).
  2. *Discovering its History*, film (15 minutes)
  3. Photo of the Grand Canyon
  4. *Earth Science*, classroom textbook
  5. Notebook paper, pen
  6. Art paper, pencil
  7. Map pencils
- C. *Key Vocabulary*
1. Unconformity: lack of continuity in deposition between rock strata in contact corresponding to non-deposition weathering or erosion
  2. Disconformities: a gap between parallel layers in the rock record
  3. Angular unconformity: the beds below the surface were deformed prior to deposition of the overlying strata
  4. Non-conformity: exists when metamorphic or igneous rocks are overlaid by sedimentary rocks
  5. Principle of cross-cutting relations: any geologic features is younger than anything else it cuts across
- D. *Procedure/Activities*
1. To reinforce the Principle of Superposition, students will work in groups to rank pictures from their individual packets. The students are to order their photos from the oldest to youngest based on what they observe in the photographs. Have each group explain their ranking system.
  2. Students will read pp. 260-262 in textbook.
  3. Teacher will lead discussion over reading.
  4. Show film, *Discovering its History*
  5. Teacher will lead class discussion over film.
  6. Conduct lab experiment: Determining Relative Age of Rocks. (Appendix A)
- E. *Assessment/Evaluation*
1. Have each student describe the principles of superposition and uniformitarianism as they apply to the rocks in the Grand Canyon.
  2. Have each student draw their own diagram showing the period of geological history in rock layers. The students should be creative, but must be accurate.

### **Lesson Three: Dating Rock and Fossils (6 days)**

- A. *Daily objectives*
1. Concept objective(s):
    - a. The student will understand that natural events and human activities can alter earth systems. (7.14)
    - b. The student will use scientific inquiry methods during field and laboratory investigations. (7.2)
    - c. The student will use tools and methods to conduct scientific inquiry. (7.4)
  2. Lesson content:
    - a. Fossils as a record of the Earth’s history and past life forms. pg 176
  3. Skill objective(s)

- a. The student will represent the natural world using models. (7.3c)
  - b. The student will draw inferences based on data. (7.3b)
  - c. The student will construct graphs to organize, examine, and evaluate data.(7.2e)
- B. *Materials*
1. 2 different colors of modeling clay
  2. Popcorn
  3. *Radioactive Dating*, film (15min)
  4. M&M's
  5. Graph paper
  6. Pen
  7. Watch
  8. Piece of paper marked TIME & indicating 2,4,6,8, or 10 minutes,
  9. 128 small cards
  10. 2 sets of sequence cards in random order
  11. Pencil
  12. Paper
  13. Stratigraphic Worksheet
  14. Appendix B
  15. Appendix C
  16. Appendix D
  17. *Earth Science*, textbook
- C. *Key Vocabulary*
1. Half-life: the amount of time that it takes for half of the unstable element to become a more stable element
  2. Isotope: an element that occurs in several different forms
  3. Relative age: how old one layer is in relation to another layer
  4. Absolute age: how old a layer is in terms of actual years
  5. Radioactive decay: unstable isotopes change into more stable forms
- D. *Procedures/Activities*
1. Review parts of an atom: proton, neutron, and electron.
  2. Demonstration: Use two different colors of modeling clay to construct the nuclei of hydrogen, oxygen, and carbon atoms. Have students identify the proton and neutrons in each model. Ask a volunteer to explain the difference between atomic mass and number. Then construct isotopes of the same element. Tell the students that in this section they will learn how the atomic structure of some objects can be used to determine the age of the object.
  3. Students will read textbook, pp. 264-268.
  4. Teacher will lead class discussion over reading.
  5. Have the students recall that half of the atoms present in sample decay in a specific length of time (half-life). However, precisely which atoms will decay is unknown. Draw an analogy between radioactive decay and popping corn. Explain that you don't know which ones will pop during the corn's first "half-life" and "half-lives" of different types of popcorn. Just as a corn kernel changes when it pops, an atom likewise changes when it decays.
  6. Show film, *Radioactive Dating*.
  7. Teacher will lead class discussion over film.
  8. Radiometric Age-Dating lab activity Appendix B
  9. Who's on First?, a Relative dating lab activity Appendix C
  10. Stratigraphic activity Appendix D
- E. *Assessment/Evaluation*

1. Ask the students to name other things that could be used to model half-life. Evaluate the students' ideas for appropriateness.

#### **Lesson Four: Fossils (7 days)**

##### **A. Daily Objectives**

1. Concept Objective(s)
  - a. The student will understand that natural events and human activities can alter earth systems. (7.14)
  - b. The student will use scientific inquiry methods during field and laboratory investigations. (7.2)
2. Lesson content
  - a. Paleontology-pg 176
3. Skill objective(s)
  - a. The student will represent the natural world using models. 7.3c
  - b. The student will communicate valid conclusion. 7.2d
  - c. The student will collect data by observing and measuring. 7.2b

##### **B. Materials**

1. *Fossils: Evidence of Life*, film (36 min)
2. Photos of fossils
3. Paper
4. Pen
5. Drawing paper
6. Map pencils
7. Clay
8. Fossiliferous materials
9. Probe
10. Egg carton
11. Notebook
12. Data recording chart
13. Ruler

##### **C. Key Vocabulary**

1. Fossils: the remains or traces of plants and animals that lived in the past
2. Trace fossils: evidence that these organisms once roamed the planet

##### **D. Procedures/Activities**

1. Show film, *Fossils: Evidence of Life* (36 min)
2. Teacher will lead a class discussion over video.
3. Students will read textbook, pp 268-271.
4. Teacher will lead a class discussion over reading.
5. Students will write a poem that describes one of the fossils shown to the students. Students will illustrate their poem.
6. Thumbprint Fossil activity Appendix E
7. Problem Solving Activity: The story behind animal tracks Appendix F
8. Lab Activity: A Fossil Hunt tells the Age of Sediments Appendix G

##### **E. Assessment/Evaluation**

1. An Indoor Fossil Dig Appendix H
2. Throw Me a Bone Appendix I

## **VI. CULMINATING ACTIVITY**

- A. Student will research more about fossils. Each student will create a web of facts verses opinion on fossils.

- B. Students will design an individual book over paleontology to present to the fourth grade class to help them study fossils.

## VII. HANDOUTS

Appendices A – I

## VIII. BIBLIOGRAPHY

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- N. “An Outdoor Fossil/Archeological Dig.” Available URL: <http://www.state.me.us/doc/nrimc/pubedinf/crest/activity/act>
- O. “Throw Me a Bone.” Available URL: <http://www.asset.asu.edu/asset.sec/ntti/lesson>

**APPENDIX A**  
**DETERMINING RELATIVE AGE OF ROCKS**  
**LAB ACTIVITY**

**PURPOSE AND OBJECTIVE:**

This activity will help students to have a better understanding of the basic principles used to determine the age of rocks and fossils.

**MATERIALS REQUIRED FOR EACH GROUP**

1. Block Diagram (figure 1)

**ACTIVITY**

Each team of 3 to 5 students should discuss together how to determine the relative age of each rock units in the block diagram (figure 1). After students have decided how to establish the relative age of each rock unit, they should list them under the block, from most recent at the top of the list to the oldest at the bottom.

The teacher should tell the students that there are two basic principles used by geologists to determine the sequence of ages of rocks. They are:

**Principle of Superposition:** Younger sedimentary rocks are deposited on top of older sedimentary rocks.

**Principle of cross-cutting relations:** Any geologic feature is younger than anything else it cuts across.

## **APPENDIX B RADIOMETRIC AGE-DATING LAB ACTIVITY**

### **BACKGROUND INFORMATION:**

Some elements have forms (called isotopes) with unstable atomic nuclei that have a tendency to change, or decay. For example, U-235 is an unstable isotope of uranium that has 92 protons and 153 neutrons in the nucleus of each atom. Through a series of changes within the nucleus, it emits several particles, ending up with 82 protons and 125 neutrons. This is a stable condition, and there are no more changes in the atomic nucleus. A nucleus with that number of protons is called lead. The protons (82) and neutrons (125) total 207. This particle form (isotope) of lead is called Pb-207. U-235 is the parent isotope of Pb-207, which is the daughter isotope.

Many rocks contain small amounts of unstable isotopes and the daughter isotopes into which they decay. Where the amounts of parent and daughter isotopes can be accurately measured, the ratio can be used to determine how old the rock is, as shown in the following activities.

At any moment there is a small chance that each of the nuclei of U-235 will suddenly decay. That chance of decay is very small, but it is always present and it never changes. In other words, the nuclei do not “wear out” or get “tired”. If the nucleus has not yet decayed, there is always that same, slight chance that it will change in the near future.

Atomic nuclei are held together by an attraction between the large nuclear particles (protons and neutrons) that is known as the “strong nuclear force”, which must exceed the electrostatic repulsion between the protons within the nucleus. In general, with the exception of the single proton that constitutes the nucleus of the most abundant isotope of hydrogen, the number of neutrons must at least equal the number of protons in an atomic nucleus, because electrostatic repulsion prohibits denser packing of protons. But if there are too many neutrons, the nucleus is potentially unstable and decay may be triggered. This happens at any time, when addition to the fleeting “weak nuclear force” to the ever present electrostatic repulsion exceeds the binding energy required to hold the nucleus together.

Very careful measurement made on VERY LARGE numbers of U-235 atoms, have shown that each of the atoms has a 50:50 chance of decaying during about 704,000,000 years. In other words, during 704 million years, half the U-235 atoms that existed at the beginning of that time will decay to Pb-207. This is known as the half-life of U-235. Many elements have some isotopes that are unstable, essentially because they have too many neutrons to be balanced by the number of protons in the nucleus. Each of these unstable isotopes has its own characteristic half-life. Some half-lives are several billion years long, and others are as short as a ten-thousandth of a second.

### **LAB ACTIVITY – PART ONE**

#### **MATERIALS:**

1. Large cup or container in which M & M's can be shaken.
2. 100 M & M's for each group
3. Graph paper
4. Construct Decay Table
5. Watch or clock that keeps time to seconds.

## **PROCEDURE:**

A tasty way for students to understand about half-life is to give each team 100 pieces of regular M & M candy. On a piece of notebook paper, each piece should be placed with the printed M facing down. This represents the parent isotope. The candy should be poured into a container large enough to bounce around freely, it should be shaken thoroughly, then poured back onto the paper so that it is spread out instead of making a pile. The first time of shaking represents one half-life and all the pieces of candy that have printed M facing up represents a change to the daughter isotope. The team should pick up and set aside only those pieces of candy that have the M facing up. Then count the number of candy left with the M facing down. These are the parent isotopes that did not change during the first half-life.

The teacher should have each team report how many pieces of parent isotope remain, and the first row of the decay table should be filled in and the average number calculated. The same procedure of shaking, counting the “survivors”, and filling in the next row on the decay table should be done eight more times. Each time represents a half-life.

After the results of the final “half-life” of the M & M are collected, the candies are no longer needed.

Each team should graph the number of pieces of candy remaining after each of their “shakes” and connect each successive point on the graph with a light line.

U-235 is found in most igneous rocks. Unless the rock is heated to a very high temperature, both the U-235 and its daughter Pb-207 remain in the rock. A geologist can compare the proportion of U-235 atoms to Pb-207 produced from it and determine the age of the rock. The next exercise shows how this is done.

## **LAB ACTIVITY – PART TWO**

### **MATERIALS:**

1. Pieces of paper marked TIME and indicating 2, 4, 6, 8, or 10 minutes.
2. 128 small cards that may be cut from cardboard or construction paper, preferably with a different color on opposite sides, each marked with U-235 all on one colored side and Pb-207 on the opposite side that has a contrasting color.

### **PROCEDURE:**

Each team receives 128 flat pieces with U-235 written on one side and Pb-207 written on the other side. Each team is given a piece of paper marked TIME, on which is written 2, 4, 6, 8, or 10 minutes.

The team should place each marked piece so that u-235 is showing. This represents Uranium-235, which emits a series of particles from the nucleus as it decays to Lead –207. When each team is ready with the 128 pieces all showing U-235, a times 2 minute interval should start. During this time each team turns over half of the U-235 pieces so that they now show Pb-207. This represents one “half-life” of U-235, which is the time for half the nuclei to change from the parent U-235 to the daughter Pb\_207.

A new two-minute interval begins. During this time the team should turn over HALF OF THE U-235 THAT WAS LEFT AFTER THE FIRST INTERVAL OF TIME. Continue through a total of 4 to 5 timed intervals.

However, each team should STOP turning over pieces at the time marked on their TIME papers. That is, each team should stop according to their TIME paper at the end of the first timed interval or at the end of the second timed interval and so on. After all the time intervals have occurred, teams should exchange

places with one another as instructed by the teacher. The task now for each team is to determine how many timed intervals (that is, how many half-lives) the set of pieces they are looking at has experienced.

The half-life of U-235 is 704 million years.

The students will write a paragraph discussing what they have learned about half-lives of isotopes. They will also determine the amount of years represented by the set that they themselves turned over.

**APPENDIX C**  
**WHO'S ON FIRST? A RELATIVE DATING ACTIVITY**

<http://www.ucmp.berkeley.edu/fosrec/BarBar.html>

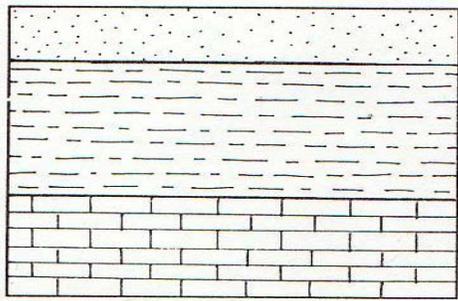
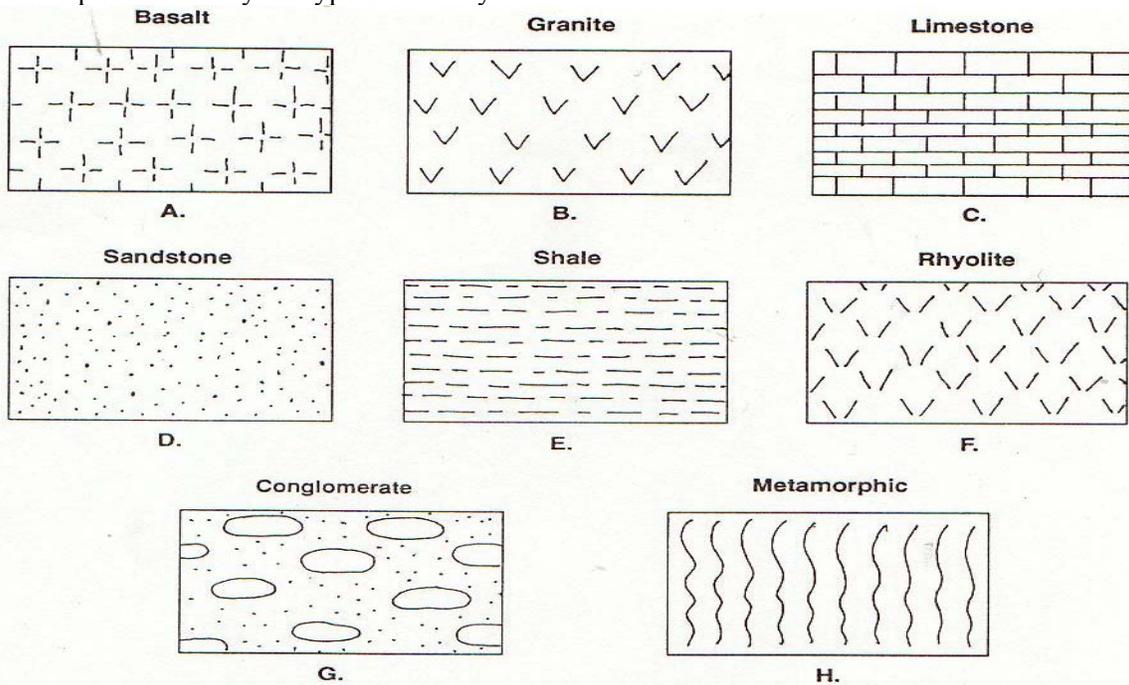
## APPENDIX D STRATGRAPHIC ACTIVITY

- Skill Development**
1. Observation
  2. Inferring
  3. Using scientific rules to classify

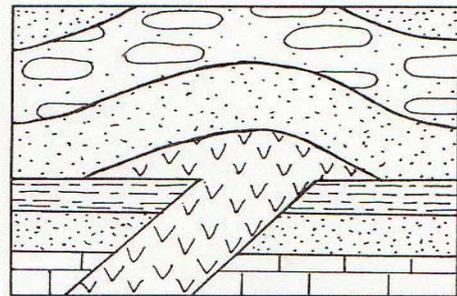
**Materials:** “Relative Dating” student sheets Pencil

**Special Instructions:** This activity should be carried out after the study of the laws of superposition, uniformity, and the principle of unconformity.

**Procedure:** This can be a group or individual investigation. The students should date each layer from oldest to the youngest using the laws and principles stated in the special instructions. The rock symbol key will help them identify the type of each layer.



1.



2.

Adapted from **Discovering Science Series – Earth Science**

**APPENDIX E**  
**THUMBPRINT FOSSIL ACTIVITY**

**Materials:**

- One paper plate per student**
- Molding clay**
- Plaster of Paris**
- Water**

**Give each child a paper plate and a ball of clay. The students will work clay until soft. Place ball of clay onto the plate and press their thumb to make a thumbprint in the clay. Mix the Plaster of Paris according to direction. Pour plaster mix into the thumbprint. Let the print dry. Remove cast from the clay**

**APPENDIX F**  
**PROBLEM SOLVING ACTIVITY: THE STORY BEHIND ANIMAL TRACKS**

Teacher creates the landscape and the students use critical thinking skills to write a scenario about the landscape.

**Materials:**

- ½ inch thick piece of plywood about 3 feet square
- 4- 2x4's about 3 feet in length
- 25 pound of plaster

**Directions to make base of project:**

- The four 2x4's will be used as a border for the plywood.
- Pour in plaster and water
- Mix well and begin to form your landscape

**Landscape:**

A plain with a river running through it. Work quickly. After landscape is made and the plaster is still wet, use a pencil as a stylus and make dinosaur tracks through out your landscape. Have a story line in mind before you start making your tracks. It should show some form of a conflict between two different species of dinosaurs. After landscape has dried, paint your landscape to create the impression of water and grass. Make sure your landscape provides a lot of evidence for a wide variety of interpretation.

**Assessment:**

The students will observe the model and take notes over all that the model is telling them. They will then go to their desk and write a scenario for what they have seen based on the evidence that they find.

Students will be assessed on the basis of accounting for each set of tracks with a full discussion of the type of animal that made them and what information they inferred from the tracks. They will need to delineate the sequence of events from the start of the scenario to the end.

**MODIFIED FROM** <http://www.iit.edu`smile/bi9217.html>

**APPENDIX G**  
**A FOSSIL HUNT TELLS THE AGE OF SEDIMENTS**

**PURPOSE:**

You will identify some common fossils in order to determine their age and the environment in which they live:

**MATERIALS:**

One Pound fossiliferous materials.  
Probe for breaking up material  
Egg carton for sorting fossils  
Pens, notebook, data recording chart, and ruler  
Guide book to fossils

**PROCEDURE:**

1. Break up the material and extract all structures that are obviously fossils or parts of fossils. Place fossils of the same type in one egg carton compartments, different fossils in different compartments. Continue until all material is processed.
2. Using the fossil guidebook identify the types of fossils you have found in your samples.
3. Find the age of the fossil by reading the guidebook. Fill in the data table by placing an X in each time period that a fossil type existed.
4. When the chart is complete, analyze the data and determine the minimum and maximum age of the sediment containing the fossils.

**QUESTIONS:**

1. What do you think is the age of the materials contained in your fossils? How do you know this?
2. What type of environment did these organisms live in? Was it warm or cold, salt water, fresh water, or land? Explain your choices.
3. Did you find many complete fossils or were they mostly broken pieces and parts? What does your answer to this question tell you?

## SOURCE

Activity developed by Curtis Talbot during the 1991 CREST intern program.

FOSSIL	TIME PERIODS								
	Triassic	Jurassic	Cretaceous	Paleocene	Eocene	Oligocene	Miocene	Pliocene	Pleistocene (recent)
Cardium									
Unio									
Pecten									
Asarte									
Turritella									
Polygyra									
Vertigo									
Natica									
Arca									

For more information about this chart and other activities, see:  
<http://www.state.me.us/doc/nrimc/pubedinf/crest/activity/act27.htm>

## **Appendix H**

### **AN INDOOR FOSSIL DIG**

#### **OBJECTIVES**

To engage the students in a simulated fossil hunt or archeological excavation. To have students try to infer information from the material excavated such as the environment these materials excised in, and the events that occurred at the time of burial.

#### **MATERIALS**

Each group of students (4-6 per group) should have a box or container that represents the excavation site. A child's wading pool can be used for an especially ambitious dig. These can be quickly made by taking a paper shipping case (10 reams) and filling it with Styrofoam peanuts or shredded newsprint. A better alternative is to construct a 24" by 36" by 6" wooden frame and use either dry beach sand or washed, screened, gravel for fill. The larger size allows 4-6 students to work at a "site" and provides greater realism. When filled, these units are heavy and need adequate support if they will not be placed on lab counters.

Bury your materials by placing them where you wish and then filling in around them with the sand or gravel. Unless you are constructing a single-event dig, artifacts/fossils should be placed at various levels. For this dig you will also need about 20 plastic or real fossils including bryozoa, horn corals, colonial corals, spirogyra, and so on. Real fossils/artifacts are more exciting than plastic, but can be expensive to purchase from catalogs. Each dig site will also need some plastic buckets to place the excavated soil into, small trowels and scoops for removing soil and debris. Each student will need their notebook, pens, a ruler, and some sticky tags for tagging artifacts/fossils.

#### **PROCEDURE**

Once the dig sites are set up and filled, each group of students can start excavating. While it may slow down the initial stages of the activity, it is very productive for each group to devise its own plan for doing the dig as well as possible divisions of labor. Regardless of these details, each group should tag, number and label, and record the position and details of all fossils/artifacts encountered. They should make site sketches as each layer is removed. When all the objects have been found, and all the information obtained, the group should compose a field report on the dig site. Beyond the factual data, the report should include their inferences and conclusions about the site.

**APPENDIX I**  
**THROW ME A BONE**  
**A FOSSIL MAKING ACTIVITY**

**MATERIALS:**

1. Bag of play sand
2. 100 milliliters of salt
3. 250 milliliters of water
4. 1 small sponge per student
5. 1 large bowl (3lb plastic butter tubs works well or a Styrofoam soup bowl)

Please note: approximately 500 milliliters of play sand per student.

**PROCEDURE:**

Cut sponges into bone shapes. Place 250 milliliters of play sand in the bottom of the bowl. Place the “bone” sponge into the sand in the bowl. Mix salt and water solution. Pour enough of the sand mixture, about 250 milliliters, to bury the “bone”. Pour salt solution over the sand. Place in sunlight for one week. Observe. The sponge absorbs salt and becomes hard and salt-encrusted from pressure and evaporation. The scientific term for this fossilization process is pre-mineralized.