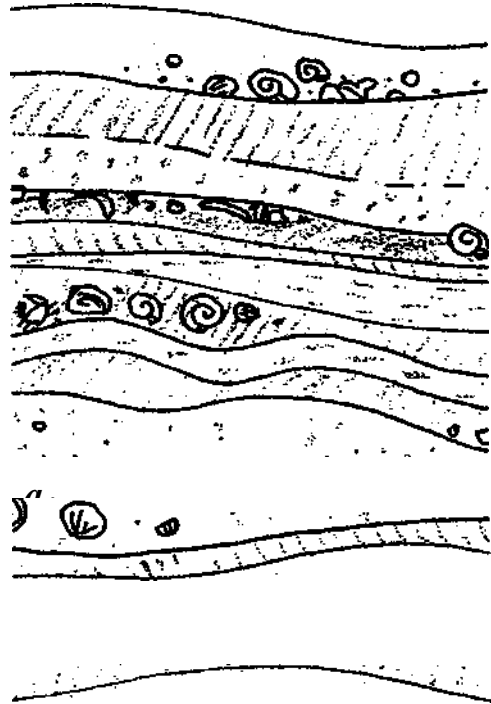


Dig It?

Key Concepts

1. The age of archaeological deposits can be determined through knowledge of rates of sedimentation, the presence of index artifacts, and by measurement of radioactive decay.
2. An index artifact is an artifact about which we have a very clear understanding when it was used or made. The presence of an index artifact enables us to make inferences about the age and/or environmental conditions of the layer in which it is found.
3. By knowing the time and conditions under which artifacts were deposited, we are able to better reconstruct the lifestyle of those individuals who made the deposit.



Background

How can we learn about the history of human habitation of a place such as Seal Rock Campground? The sciences of geology, paleontology, and archaeology are especially useful in determining such history since most of the information comes from the layers of the earth itself. Geology includes the study of earth's crust and rocks, and the age and origins of rocks. Paleontology is the scientific study of forms of life existing in former geologic periods, as represented by their fossils. Archaeology is the systematic recovery by scientific methods of material evidence remaining from human life and culture in past ages, and the detailed study of this evidence. Each of these disciplines contributes to our understanding of the life led by Native American populations at Seal Rock.

Certain geologic principles are especially helpful in determining the age of origin of artifacts found at a site. The **law of original horizontality** states that materials are deposited in horizontal layers. The **principle of superposition** states that when the layers are horizontal, or nearly so, each overlying layer is younger than the one beneath it. And finally, the **principle of uniformitarianism** states that the processes (erosion, deposition of sediments, etc.) which we observe today have been occurring throughout the history of the earth. These three principals let us "read" the layers and determine their relative ages; that is, which is oldest, youngest etc., not their age in years.

Paleontologists also contribute important information through the identification of "index fossils". Index fossils are found in rock layers of only one geologic age. They serve to identify specific rock layers no matter where they are found. Not only do index fossils tell scientists the age of the rock formation in which they are found, they also provide information about the environmental conditions present during the time the rock layer was formed.

Archeologists have developed a set of "index fossils" of their own. These index artifacts let scientists establish an age for the layer in which they are found. Artifacts may be tools or household implements of a specific type, design or material.

By understanding the clues found in strata, we can reconstruct the life of the sites prehistoric inhabitants. It is wise to point out, however, that index artifacts can be transported and redeposited. As such, index artifacts are not a fool-proof method of aging formations. Such observations are the anomalies that make geology, paleontology, and archeology such exciting fields of study.

Materials

For each group of 2-3 students

- one "artifact-bearing" cupcake
- scalpel or sharp knife
- 2 centimeter rulers
- recycled paper cut in quarters

For each student

- "Dig It!" activity pages

Teaching Hints

"Dig It!" provides information about the detective processes of geology, archaeology and paleontology. Students determine the age of an "artifact" in a sample of "strata".

Note that "Dig It!" is not intended to be a comprehensive coverage of stratigraphy. It is intended to provide students with background information useful in interpreting and understanding the archeological report which forms the core for the lesson "Shell Game". Earth science texts provide a good source for additional information about the topics covered in this section.

"Dig It!" is designed to give your students experience determining the age of an artifact in a sample of strata containing artifacts of known ages, known as index artifacts. In this activity, a cupcake or piece of layer cake with layers of colored batter will serve as strata, an m&m candy will be the moonsnail, and peanuts, raisins and chocolate chips will be index artifacts.

An added twist in this activity is that students are not given all information about their sample and its index artifacts outright. They must generate specific questions to ask, much as scientists need to generate questions to find out what is already known about a field prior to embarking on research, as well when they design their actual study.

Directions are given for cupcakes; however, you may find that squares of cake baked in a sheet pan provide more uniform samples. If you choose the latter, be sure to place sufficient m&m specimens in the samples that students can locate one easily.

Preparation

1. Use white cake mix to prepare the artifact-bearing cupcakes. In determining the number of cupcakes needed, recall that this activity is best accomplished by student teams of 2-3. Preheat oven and line muffin tins with paper liners.
2. Prepare the white cake mix according to the package directions. The batter should be the consistency of heavy cream so that objects you add to the batter don't settle out. If it is too thin, add additional flour to the batter. Stir the batter as you add the flour to keep the batter from getting too stiff. If the batter is too stiff, you may find it difficult to form horizontal layers.
3. Divide batter into three parts. Tint one portion red, one portion green, and leave the third white.
4. Assemble the following materials close to where you will be working: peanuts, chocolate chips, raisins, and m&m candies. (If you can find them, white raisins are preferable to dark raisins in that they are easier to distinguish from chocolate chips.)
5. Add 1/4 cup chocolate chips and 1/4 cup peanuts to the green batter and place about a 1/2 inch of this mixture into each tin.
6. Over the green batter, lightly place 4-5 m&m candies, including some so close to the edge that they are likely to be visible once the paper liner is removed.
7. Add 1/4 cup chocolate chips and 1/4 cup of raisins to the white batter and gently place about 1/2 inch of this mixture over the m&ms and green batter.
8. Stir 1/4 cup of raisins into the red batter and place a final 1/2 inch of this batter over the other layers.
9. Bake as directed on package mix.

Procedure

1. Provide each student team with a sample "Seal Rock beach cross section" (cupcake). You may wish to call the cupcake "artifact-bearing strata" or some similar term. Explain to them that they are teams of archeologists trying to determine if and when the Native Americans living at Seal Rock ate moonsnails. (Show them an m&m.) Their job is to pinpoint as nearly as possible the age of the layer in which the moonsnail is found. They will probably have to make use of any and all clues available to them, such as the kind of sedimentary material it is found in, or knowledge of other artifacts used by early Native Americans about which more information is known. As archeologists, they may need to make careful excavations into exposed outcroppings of strata layers to gather more information.
2. Suggest that students begin by finding a specimen of the artifact in their rock sample, but caution them against removing it for fear of destroying important clues.

3. Offer students the use of centimeter rulers and introduce the procedure for **mapping** an outcrop of their "artifact-bearing strata". You may wish to have them use the grid found on their student activity pages to make a full-scale diagram of a vertical "face". Their diagram should show the position of layers, the m&m moonsnail, and additional artifacts (e.g., peanuts, chocolate chips, and raisins) they find in the layers. Students will need to make horizontal and vertical measurements using a centimeter ruler in order to apply all features to the grid paper on their data sheet.
4. Tell students that certain information about these layers is known, but that they will have to make inquiries of "scientific literature" to gain access to this information. To do this, student groups may send one representative to ask you a specific question about a characteristic of the materials in their samples. Stress that you will answer no vague questions. In order to encourage thoughtful and systematic questioning, you may want to limit the number of questions groups can ask to 5. Answer only one question at a time per group, and to eliminate eavesdropping, communicate with student representatives through the written word only. Tell them that some questions do not yet have answers, and therefore you may not be able to answer every question you are asked.

Information you may give out if asked:

- Chocolate chips first appeared about 1,000 years ago and went extinct 400 years ago.
- Peanuts appeared on earth about 1,500 years ago and went extinct about 600 years ago.
- Raisins appeared 400 years ago and are still living today.

In the discussion that follows the activity, you might point out that artifacts can be transported and redeposited, and allow students to suggest possible ways that could happen. Students should understand that index artifacts are not a fool-proof method of aging layers.

Essential Academic Learning Requirements in Science

1. The student understands and uses scientific concepts and principles. (1.3)
2. The student knows and applies the skills and processes of science and technology (2.1, 2.2)
3. The student understands the nature and contexts of science and technology. (3.1, 3.2)

Answer Key

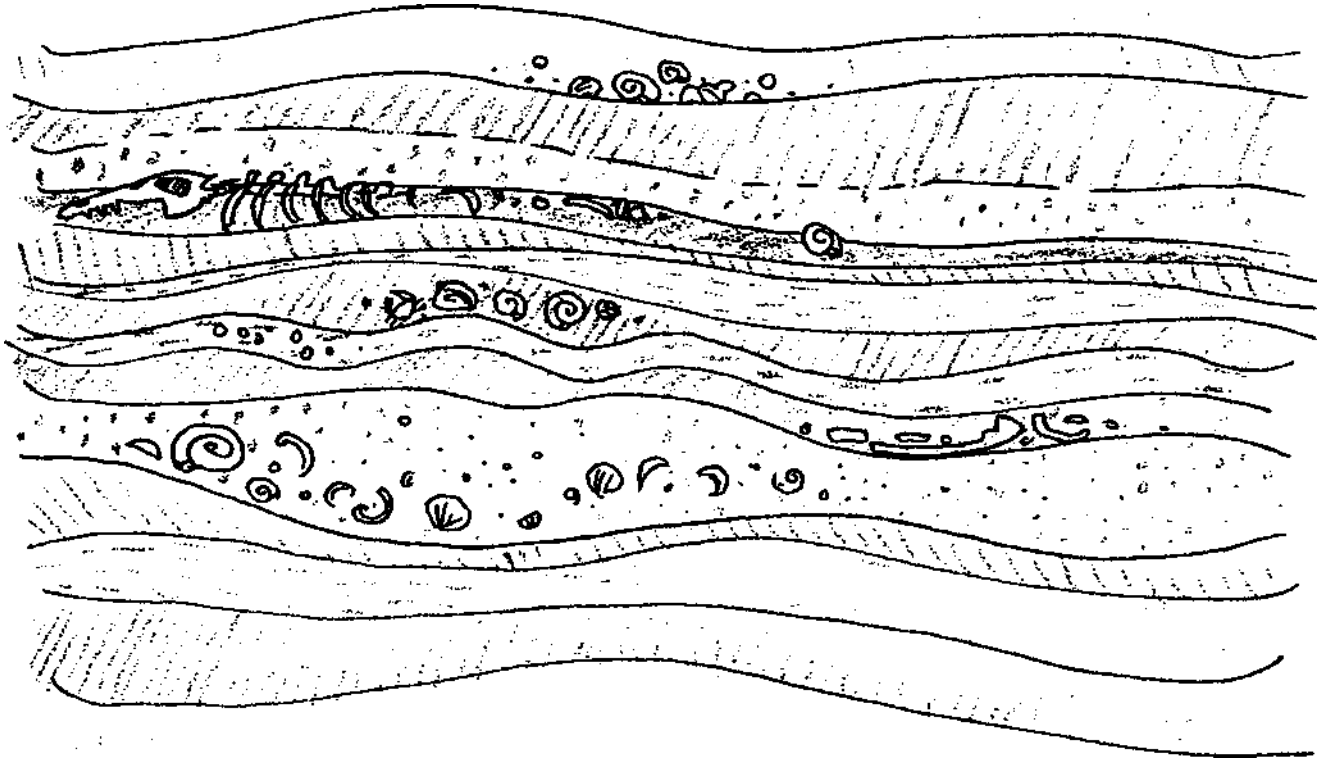
Procedure

2. Student diagrams will vary, depending on the characteristics of their "strata." Students are asked to include the depth of each sediment layer, the placement of the index artifact, and the location and labeling of other artifacts.

Analysis and Interpretation

1. a. If the students' artifacts have remained in the position they were placed during the baking process, they should arrive at the age of 600 years.
b. Answers will vary depending upon the strategies employed to determine the age. Do not be too concerned if dates vary so long as students have followed a rational process to arrive at their answers.
2. The answer will depend somewhat on the properties of the cake. If the artifact is 3 cm below the surface and its age is 600 years, one centimeter of sediment would have taken 200 years to accumulate.
3. a. The presence of an index artifact allows us to apply known information on age and environmental conditions of the index artifact to other artifacts found in the same sediment layer.
b. In this activity the chocolate chips and raisins served as index artifacts for dating the m&ms.

Dig It?



Part 1 - Sweet Stratigraphy

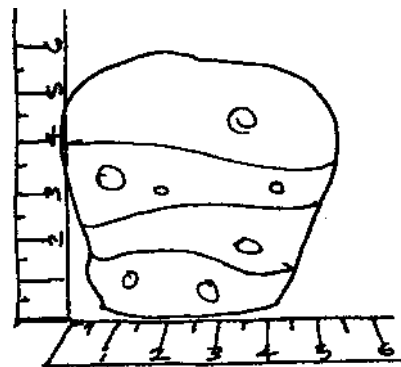
How can you learn about the diet of the Native Americans who once lived at Seal Rock? We can't ask them, they're long dead. So what can be done? You will be given a sample of a beach cross section. The cross section was formed as sediment settled in layers called strata. Discarded objects, such as shells and bones, are also found in the strata. Your is to find out if and when these people ate moonsnails.

How to date your sample:

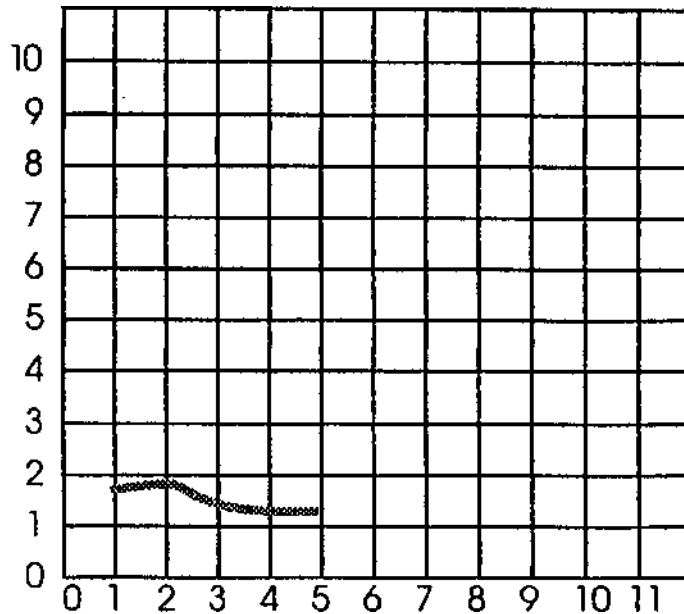
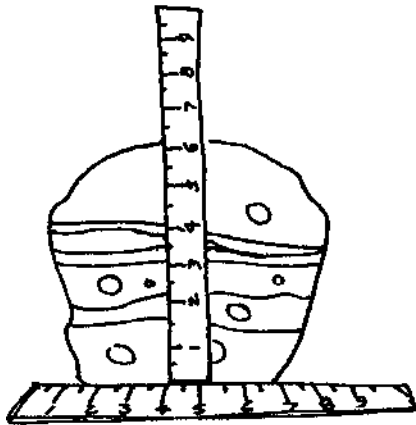
1. Look for the sediment layers. Can you see them clearly? If not, gently cut one rock face so that you can. Find a shell specimen, but leave it in place. You don't want to destroy any important clues!
2. Now, record the depth of each sediment layer in your sample. Use a centimeter ruler to measure each layer. Use this information to make a scale drawing of the sample.

Hint: You can use two centimeter rulers to help you make your drawing. First, place one centimeter ruler along the bottom of your sample. Put the end of the ruler next to the end of the sample.

Hold the second upright so that the 0 point is directly over the end of the first ruler.



Measure the height of each sediment layer. Record this information on your data grid. Continue by moving the upright ruler to the 1 cm mark on the horizontal ruler and repeating your steps.



Continue until all sediment layers are marked.

3. Locate the shell in the strata sample. Accurately place it in your drawing. The ruler may be a help.
4. On your drawing, note the presence of other shells. Label the location with the name of the shell. These other shells may provide important clues. They may help you find when moonsnails were eaten.
5. Some things are known about these layers of sediment. Your teacher has that information. With your group, decide on questions to ask your teacher. Write down each question on a piece of scratch paper. You may give your teacher one question at a time.

As you work, you may learn the ages of some of the features of your strata. Add this information to your drawing.

Analysis and Interpretation

1. a. Age of strata in which the moonsnail is found b. How do you know this?

2. Let's say that no sediments have been removed from the surface. Let's also say that sediments have always built up at the same rate. How long has it taken for a centimeter of sediment to form on your sample?

(Hint: Take the age of the shell and divide that number by its depth in centimeters.)

3. Some artifacts are known as index artifacts. Index artifacts tell us certain things. They may give us a very clear understanding of when that artifact entered the sediments of the site. For example, European trade beads are used to help determine the age of Native American archeological sites around Puget Sound. If the beads are present, the site is most likely a recent one.

- a. How does the presence of an index artifact help us increase our knowledge of other artifacts found in the same sediment layer?

- b. In this activity, which items served as index artifacts for determining the age of the m&m candies?

