It's All Relative (90 Minutes)

Addresses NGSS
Level of Difficulty: 4
Grade Range: 3-5

OVERVIEW

In this activity, students will conduct simple investigations to collect data on erosion rates of different Earth materials (waves, wind, water, glaciers). They will rank their investigations to evaluate the most efficient agent of erosion.

Topic: relative dating

Real World Science Topics

- An exploration of relative dating
- An exploration of soil and rock layers
- An exploration of geologic excavations

Objective

Students will gain an understanding of the ways sediment can form different layers over a large region. They will gain an understanding of relative dating and its applications.

Materials Needed for Teacher Demonstration

- access to the outdoors
- shovel
- one cardboard box, prepared with several layers of sediment, such as clay, sand, gravel, potting soil, and seashells

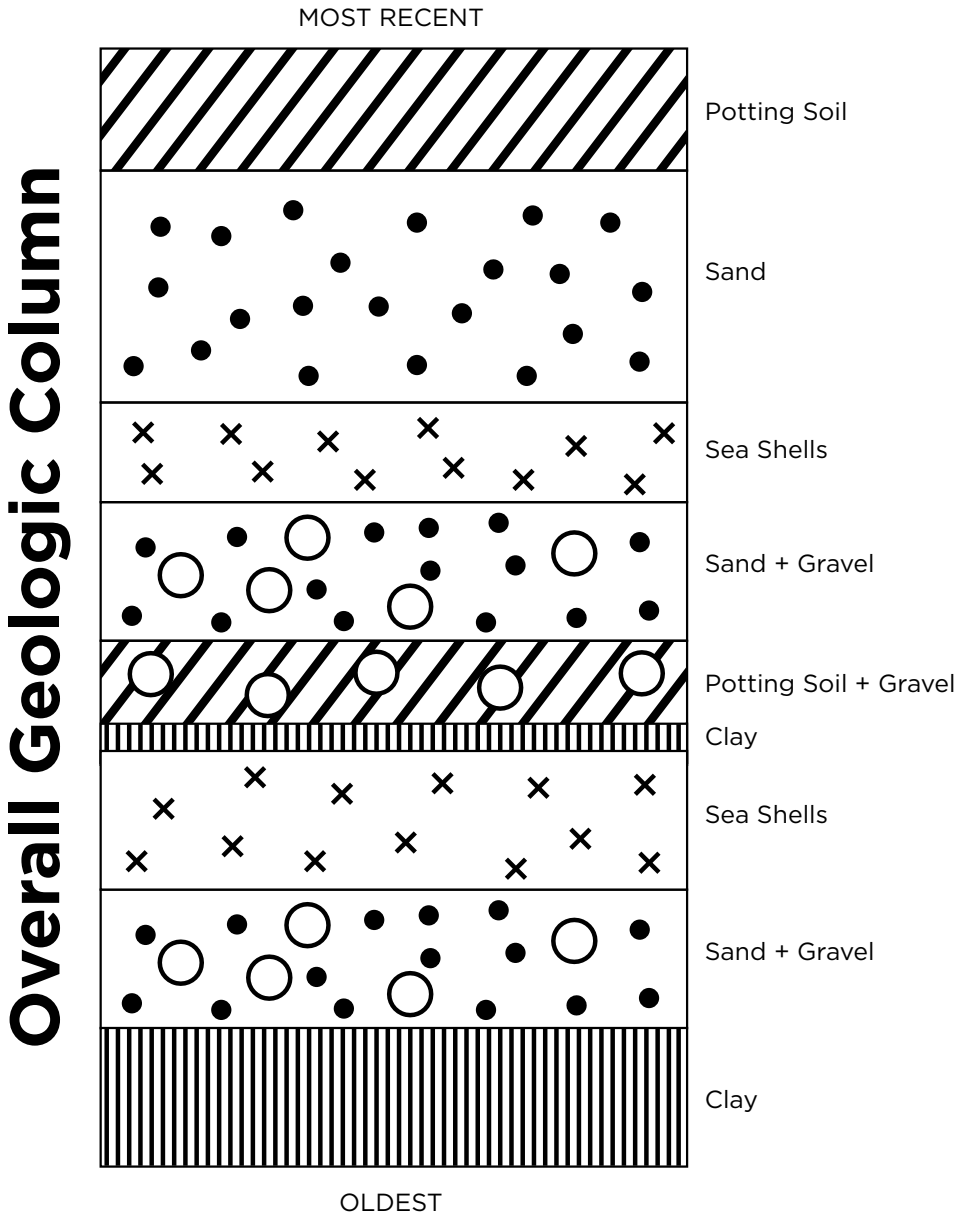
Materials Needed for Student Teams

- small cardboard box, prepared with several layers of sediment, such as clay, sand, gravel, potting soil, and seashells
- four toothpicks
- rubber bands or string
- plastic spoons
- small plastic container
- ruler

Teacher Preparation

Before leading the activity, prepare several small cardboard boxes with layers of sediment, one box per student group. Each box should have at least four layers. It is helpful to first create a diagram of the overall geologic column, as shown in the image on the next page. As you prepare the cardboard boxes, use the overall geologic column to assist you. Each box should have a different arrangement of layers, but they should all be in the correct overall chronological order, from oldest to most recent. In other words, and according to the below image, one box could contain a thick layer of clay, followed by a thick layer of seashells, then a thin layer of clay, and finally a mid-sized layer of sand and gravel. Another box could contain a thin layer of clay, then a mid-sized layer of

sand and gravel, then seashells, and finally potting soil. Whatever the arrangement of layers you place in each box, they should all correspond to the overall geologic column.



Because students are studying relative dating, it is not necessary for the layers to be exactly the same thicknesses from box to box. However, you should take care to make the layers very similar in thickness from box to box. For example, the thin layer of clay should be approximately the same thickness in every box that contains that layer. The image below shows the top layer of soil in a cardboard box. Beneath it are layers of soil that are arranged in chronological order, with the assistance of the diagram of the overall geologic column.

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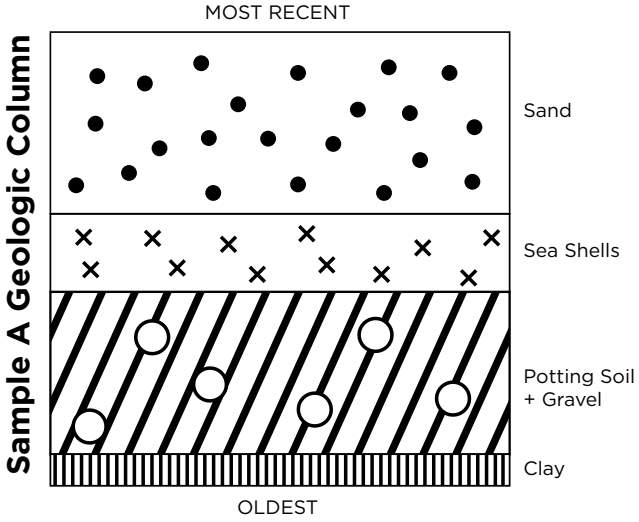
1. **w arm-up Activity:** Take your students outside to an area where you can dig a small hole. Use the shovel to dig one or two shovelfuls of dirt to form a small hole. Tell students to look at the cross section of the hole you just dug and ask them:
   - What do you see in this hole?
   - Is it all the same material?
   - Do you think everything in the hole is the same age, or are some things older than other things in the hole? How can we tell?
   - Do you think a hole dug many miles away from this hole would look the same inside? Why or why not?
2. Bring the class back inside and ask students if they can define the term *relative dating*. Some students may be able to infer a definition, but be sure to offer a concise definition for students. Relative dating is a way of determining the order of past geologic events. It doesn't tell us the exact time a layer of rock or sediment formed, but it does tell us the correct chronological order in which the layers formed.
3. Tell them that they will be working to create a relative dating chart for a large area. (You can name an area of your state or region, such as the Great Lakes region or the Pacific Northwest.) Say that from that large region, you have obtained several different samples of layers of sediment. Explain that each sample came from a different place within that region (Again, you can give each sample a specific location if you wish.) Tell students that each box will have at least four layers of sediment. Tell students that the bottom layer is the oldest layer. Ask for a student volunteer to explain why this is true. Students should infer that the oldest layer was deposited a long time ago, and the layers on top were deposited after the bottom layer. Students should understand that their box represents a period of time, with older layers on the bottom and more recent layers on the top. Explain to students that even though the boxes are all samples from the same region, they do not all contain the same layers. They will explore this concept later in the activity.

4. Divide the class into teams, and provide each team with the listed materials as well as a **Student handout**. Instruct students to use the toothpicks to mark the corners of a square on the top layer of the sediment. (If the boxes are very small, you can skip this step and have students simply excavate the entire box.) Then, instruct students to wrap rubber bands or string around the toothpicks to create the straight lines of the square they will excavate. Tell them that geologists, archeologists, and paleontologists all use a grid system when they conduct excavation so they are able to control the exact size of the dig. They work slowly and carefully to dig down in the shape of the square. The photo below shows a box with a square marked for excavation.

5. Instruct students to slowly scrape off a layer at a time (rather than digging straight down). They should use their spoons to dig, and they should discard the sediment in their plastic tubs. As they dig down through each layer, they should write down the order of the layers (from top to bottom) on their **Student handout**, along with an approximate measurement of the thickness of each layer. In the photo below, the top layer of sand is changing to the next layer of seashells.

6. Once students have excavated all of the layers and recorded information about the thickness and composition of each layer, tell students that they will make a diagram that represents what they uncovered. First, ask for groups to share with the class the different types of materials they uncovered. Tell students that this activity is easier if all groups use the same symbols to denote each layer. Work with your students to develop symbols for each type of layer they encounter (for example, "x" for seashells, straight lines for clay, and so on). You may want to write these symbols on the board in front of the class. Then, instruct groups to make a diagram to show the correct order of their layers and their approximate thicknesses. The image below shows a sample student diagram.

7. Once groups have completed the diagram for their sample, tell them that they will now work as a large group to determine the correct order of all the layers across the entire region. Start by asking, "Who thinks their box contained the oldest layer?" Then ask, "Did anyone else have any layers older (or below) this layer?" Continue in this fashion until the oldest layer is determined. Then, move up the geologic column. Try to hand the discussion of the relative age of the layers over to the students themselves, so that they are asking questions of each other and making discoveries about layers that may not have been included in their sample. As each layer is determined, select student volunteers to come forward and draw one layer at a time on the board. They should use the same symbols from earlier in the lesson to show the composition of each layer. Compare students' overall geologic column with the column you created prior to the start of the activity.



8. **Wrap-up Activity:** Show students the diagram of the overall geologic column you created prior to the activity, and point out any mistakes the students may have made. Alternatively, congratulate the students if they completed the overall geologic column successfully. Prompt a student discussion of the activity by having students think about why it is important to have samples from many different locations in a region. Ask students how they think this helps scientists understand the geology of an entire region.

It's All Relative extension Activity

Provide students with a copy of a geologic time scale, which shows specific time periods and dates, and a geologic column of your region (available via Internet searches). Challenge your students to transform their understanding of relative dating into absolute dating by assigning each layer in the column a time period and date. All groups should work on the same problem and discuss their results with each other at the end of the exercise.

what is relative dating?

Relative dating is a method of determining the order of past geologic events. Relative dating simply says that one depositional event occurred before or after another depositional event. It does not assign an absolute date to an event, but rather allows scientists to obtain the chronological sequence of all the layers within the geologic column. Relative dating allows geologists to correlate depositional events in different locations.

how can some layers of the overall geologic column be missing in certain samples from different locations?

Typically, an overall geologic column will represent a large area, such as the southern portion of the United States. To obtain a detailed column, samples must be taken from many places within that region. It is possible for different locations within a region to have experienced different depositional events. For example, a sample taken from a site might contain a thick layer of gravel, indicating an ancient streambed. A site many kilometers away could be without that layer of gravel because it was not near an ancient stream. Several hundreds of years later, however, both sites could have experienced the same depositional event, such as a massive flood, and so both sites would have a layer of sediment that links both areas to the ancient flood. The similarities in layers from many different sample locations enable geologists to determine the relative ages of the layers. By recognizing the similar layers across a region, geologists are also able to assign a relative date to layers that only exist in some sample locations.

what are the benefits of under tanding the stratigraphy of a region?

Understanding the past depositional events of a region can help paint a more complete picture of the region's history. By learning about the layers of sediment and rock, we can learn more about historical environments, and we can determine what an area looked like at a certain point in time. Some parts of a region that is now a coastal plain may have, in the past, been forested land. Understanding past events can affect our actions today. For example, by learning about the depositional events from thousands of years ago, geologists might determine that a region's aquifer is relatively small. This discovery could then impact water management practices for the region. Relative dating techniques could also help identify active fault lines, which could lead to enhanced earthquake awareness and preparedness for the inhabitants of that region.

Key vocabulary

deposit: a layer of accumulated matter or sediment

excavation: a dig to remove soil or layers of deposits

geologic column: a diagram of all the layers of rock and sediment for a particular region

relative dating: the geologic science of determining past depositional events in relation to each other

1. As your group excavates your sample, describe the layers you uncover. Include approximate thicknesses and descriptions of the material you uncovered.

   [Sample answer: In my sample, the top layer was a thick layer of sand, about 2 inches deep. We then found about 1/2 inch of seashells. The third layer down was about 1 inch of sand and gravel. The bottom layer was about 1/4 inch of clay.]

2. Use the symbols decided upon by your class to draw the geologic column found in your sample.

   [Images will vary.]

3. What challenges did your group encounter, and how did you resolve those challenges?

   [Sample answer: We had a hard time deciding on the relative date of one of our layers. It was hard because no other groups had the layer. We had to discuss the problem with other groups and compare all of our layers. We solved the problem by studying the layers we all had in common. Once we knew the correct order of these layers, we could find the correct sequence for the layer only present in our sample.]

4. Write a sentence to explain why it is important to take samples from several different locations in order to understand the overall geology of a region.

   [Sample answer: It is important to have samples from many areas because different samples can contain different layers. We had to compare them with other samples to be able to put them into the correct sequence.]

5. What might be a benefit to understanding the relative sequence of the layers of rock or sediment in a region?

   [Sample answer: Relative dating can help us see past historical events. For example, if one layer that shows an ancient flood is present in every sample, we know that the ancient flood covered a large area.]

Name:

Date:

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2. Use the symbols decided upon by your class to draw the geologic column found in your sample.

3. What challenges did your group encounter, and how did you resolve those challenges?

4. Write a sentence to explain why it is important to take samples from several different locations in order to understand the overall geology of a region.

5. What might be a benefit to understanding the relative sequence of the layers of rock or sediment in a region?