
Students get to the "core" of stratigraphic principles and learn about geologic sampling.

By Rebecca Tedford and Sophie Warny

Though you can't tell just by looking at them, layers of sediments tell us much about Earth's history—when the ocean flooded continents, when mountains were formed, when climate was warmer or cooler, and so much more. *Stratigraphy,* the study of sediment layers and the relationships between rocks and fossils with time, has done much to help us understand Earth. While heading out to real-life dig sites with your students is not so realistic, there is a safe, fun, effective way to introduce geology concepts to elementary school children of all ages: "coring" layer cakes! All it takes is some simple baking to create a model of sediment layers and their fossil record. Exploring this topic in the classroom allows your students to learn about how geologists work while they explore Earth science.

Our twist on this classic activity includes fossils embedded in the sediment layers—students are absorbed with the content each time. This article describes an exploration of stratigraphy and paleontology with upper-elementary students as they test their observation and measurement skills, collect data, and practice deductive reasoning while investigating a layer-cake Earth. See "Making the Cake Model," page 42, to learn how to prepare the model. Be sure to check for food allergies or other dietary restrictions among your students if you plan on serving cake after the activity. As students should not eat in a science laboratory,


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schedule the activity in a nonlab setting and require hand washing.

## Learning About Layers

This activity addresses National Science Education Standards that relate to introducing the structure of the Earth system and understanding Earth's history. Stratigraphic principles form the basis for interpreting Earth and its rock layers. Therefore, this activity is perfect for introducing the concepts and challenges that geologists face and at the same time strengthening students' inferential, observational, and problem-solving skills.

The day before beginning the activity, we introduce the following concepts: the four main principles of stratigraphy, the definition of *faults*, and what is a *core*. The science of stratigraphy includes the following principles that govern geologic processes:

- *Principle of Superposition:* Rocks are formed one layer at a time, each layer being deposited on top of the older layer. So, if a rock bed has not been disturbed since it was formed, it is younger than the layer of rock below it.
- *Principle of Original Horizontality:* At first, sediments are deposited horizontally as they accumulate on the sea floor or in river's beds.
- *Principle of Lateral Continuity:* Sediments are deposited initially in a layer that extends horizontally in all directions. As a result, if you drill at different locations, you should find the same rock or sediment types, unless these layers were not deposited in these other locations.
- *Principle of Faunal and Floral Succession:* Unless disturbed, the oldest fossils in a rock bed should be at the bottom.

A good analogy to use when describing these concepts is to imagine baking a cake. The cake batter behaves much like sediment. As it is poured into the cake pan, it moves out in a horizontal direction and fills the pan (Original Horizontality). We know that the oldest batter is found at the bottom of the pan (Superposition). Another helpful analogy is the trash you find in a trashcan. It slowly builds up as trash is thrown away, with the oldest trash at the bottom.

Next we discuss what might cause the layers to be "disturbed," such as faulting and unconformities. A *fault* is a large break in the rocks when one side of the rocks move relative to the other. An *unconformity* occurs when sediment deposited is not preserved or is eroded, and you do not have a complete succession (see Principle of Faunal and Floral Succession, above) anymore.

We also make sure students understand the concept of relative age in geology (youngest, oldest) and explain the usefulness of fossils as age (e.g., Jurassic versus Tertiary) and environmental markers (e.g., land versus marine deposition). We explain by stating that dinosaurs and modern mammals did not coexist—dinosaurs were actually living about 100 million years before say, horses. Therefore, a layer of rocks with dinosaur fossils will not contain horse fossils. Similarly, fish fossils and bird fossils are not found in the same rock deposits because they do not exist in the same environment. This can be further explained by stating that groups of marine fossils (i.e., fish, shells, etc.) would indicate that they were deposited in a marine setting such as an ocean.

Finally, we discuss how core sampling is used in geology. One way to understand Earth layers is to collect a representative core sample. This method requires drilling holes into the Earth and removing the sediment. It is a practical way of determining what lies below, and it is used in oil exploration, mineral exploration, and ground water monitoring for pollution.

## Geologic Investigation

After a review of the pertinent Earth science concepts introduced the day before, we bring out the cake and explain that the cake represents a portion of the Earth's crust with each different-colored layer representing a separate sedimentary layer within the Earth's crust. (The sides of the cake are wrapped in foil so that only the surface is visible.) We explain to the students that they will conduct their own scientific exploration by "drilling" into the cake, using a rolled piece of transparency taped into a coring device. They will collect their own "core sample" in small groups of four to six students, measure the sample (to determine how thick the layers are), and record other data (color of the "sediment," "fossil" content, etc.). Then, students will draw the core and propose possible scenarios of deposition by interpreting their observation. We tell them drilling is how geologists approach interpreting the history of Earth's layers. This is especially useful when road cuts, railroad cuts, natural canyons, or other natural rock exposures (outcrops) are not available for view—as is the case in states like Louisiana, but wouldn't be an issue in states like Colorado.

Next, students are divided into groups and assigned a coring site on the cake. This is where the colored toothpicks come in handy. Collect and distribute the following materials to each group of students:

- A metric ruler,
- One or two transparencies,
- Scotch tape,

## Making the Cake Model

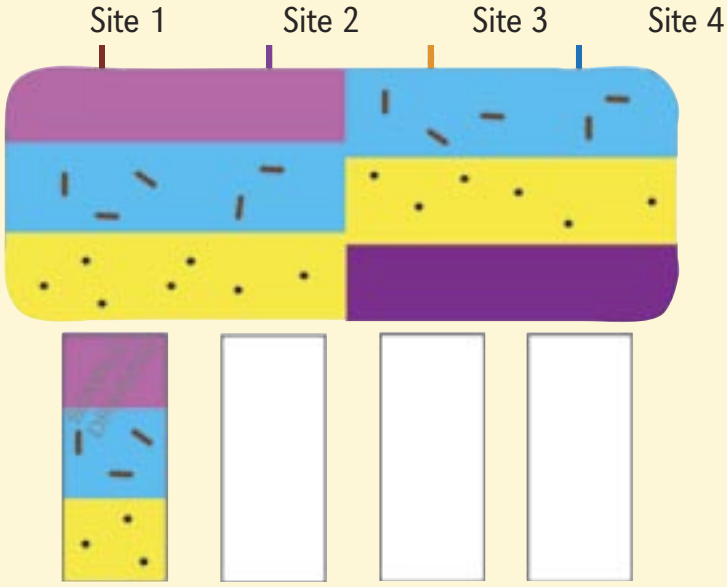
The bulk of the preparation for this activity begins at the teacher's home the night before. Be sure to check for food allergies among your students before selecting your ingredients. To create an Earth layer cake, the following materials will be needed:

CAUTION

- 3 packages of white cake mix
- 1 container of chocolate frosting
- 4 rectangular foil baking pans
- Food coloring
- Aluminum foil
- Toothpicks
- Pecans
- Raisins
- Chocolate chips

The layer-cake Earth is composed of at least four layers of colored strata, which is made by initially dividing the cake batter into four parts. Setting one part aside, take the remaining three parts of the batter and color them individually. Now you have four different colors of batter that will represent four different stratigraphic layers. You may also introduce the concept of fossils by adding nuts or dried fruit to a layer. To make it easier for students, it might be better to use the same ingredients (pecan, raisin, or chocolate chip) per color. Avoid using small ingredients such as sunflower seeds, as students had a more difficult time locating them.

**Figure 1.**
Illustration of the cake layers and "drilling sites."




Now, pour each batter into a cake pan and cook them. Bake times and temperatures may vary depending on the cake mixes used. After the cake mixes are done, remove them from the oven and allow them to cool. Once they have cooled, you may begin to assemble your cake by stacking them one on top of the other.

If you would like to add "faults" or "unconformities" to your activity, you may cut the individual cakes in half and rearrange the layers. For instance, removing a cake layer from one side of the cake can create an unconformity, and conversely, having the cake layer higher on one side than the other would represent a fault (see figure 1 for example). Determining your stratigraphic sequence is best achieved by sketching a stacking guide or stratigraphy "key" (See Figure 3, page 44). Once you have finished stacking the cakes, wrap the sides of the cake with foil and cover the top with icing. The icing will represent a layer of topsoil.

Finally, identify North and place four toothpicks along a transect moving from west to east on the cake. These toothpicks will correspond to the coring sites that students will be assigned. Colored toothpicks have been found to work best enabling each site to be easily identified. In class, divide students into four groups and assign each group a "core site" to analyze.

- Paper plates,
- Colored pencils,
- Activity sheet (Figure 2).

Each group's first task is to create their coring apparatus. This involves rolling and taping their transparency into a tube with a 2.5 cm (one-inch) diameter. (You can save time by making these ahead of time.) Then, the groups will choose one person to be the "driller." This student will come up to the cake and core their assigned site by pushing the transparency tube into the cake. To prevent a mess, have students bring the intact core back to their group with a paper plate underneath the core sample and coring apparatus. Returning to their group, the students will then begin to measure and draw what they see in their core. To remove the core they must slowly twist and pull up the transparency tube. After making measurements, they take samples of "sediments" every centimeter to look for "fossils." Allow students 10–15 minutes to describe the core sample and record this information on their activity sheets. Once they have finished with their core, have the groups rotate until each group has seen and described all four cores.

## "Core" Concepts

In the second part of the activity, students *correlate* the cores. Correlating means that the students need to decide which rocks from different areas (in this case, from each group's core)—have the same age. Using the drawings of all of the cores from the first part of the activity, students draw lines between the layers they believe to be related. Remind the students to look for similar colors and for any "fossils" that may be present in the strata.

In their groups, the students will use the core descriptions to put the layers in stratigraphic order and interpret what processes might have affected the order. Remind students of the basic stratigraphic principles; they will apply these to the different layers present in the cores. For example, the oldest layers are those laid down first, so the bottom layer of the cake represents the oldest sediment layer.

Encourage higher-order thinking skills by presenting students with questions such as:

- What layer was deposited first? (The layer on the bottom of the cake.)
- Are there any faults or disturbances in the sediments? (Yes, the cores from the two sides of the cake had different layers (different colors), indicating that these sediments were moved. This proves the existence of a fault.)
- Do you see "fossils" in any of the strata? (No, the core only represented a small fraction of Earth so fossils may not have been sampled; or Yes, some layers contained fossils [represented by nuts, chocolate chips, etc.] while others did not—they may not have been preserved.)

**Figure 2.**

Layer-cake Earth activity sheet.

Core description chart

Core illustration

| Color | Thickness of layer (cm) | Fossils present yes no | Order of desposition |
|---|---|---|---|
| | | | |
| | | | |

Additional notes:

**Figure 3.**

Key to cake treats or "fossil symbols."

| Fossil symbol | Fossil | Symbol | Age | Relative Age | Environment |
|---|---|---|---|---|---|
| Chocolate chip | Shark tooth |  | Tertiary/Cenozoic | Youngest | Marine |
| Pecan nut | Dinosaur bone |  | Jurassic/Mesozoic | | Land |
| Raisin | Trilobite |  | Cambrian/Paleozoic | Oldest | Marine |

When replying to these questions, students will start to carefully look at their core descriptions and consider how to interpret the geologic history.

Students should understand that the bottom layer should contain the oldest fossil and the top layer should contain the youngest fossil. Using a "fossil" key (Figure 3), students will be able to act like paleontologists digging for fossils and predict the age of the rock and past climate and environmental conditions based on the information in the table. Fossils are keyed out by using the fossil table. The table contains the fossil symbol represented in the cake and its correlating information: fossil name, symbol, age, and environment. If a student finds a nut in one of their cake layers, then they can look on the chart to see that it represents a dinosaur bone and find information on the relative age. This further enables students to realize that the cake layers under the bone are older, while the cake layers above it are younger.

After students grasp the ages of the rocks, the notion of environmental significance can be added. For example, the layer with "dinosaur bone" (pecans) was possibly deposited in the bed of a river, in the middle of a nice green forest where dinosaurs roamed. The layer with the "shark tooth" (chocolate chip) was deposited when the Earth was covered by an ocean. We tell students in Louisiana that we could not find dinosaur bones because at that time, sea level was higher and Louisiana was under water, so the only fossils we could find in Louisiana during that time would be marine fossils, not dinosaurs.

## Extensions and Assessment

Once the activity is done, teachers can reinforce the lesson and assess student understanding by asking:

- What do students now know about the Earth? What do they know about stratigraphy? (The Earth is made of rocks and dirt. There are also different layers. The layers are stacked on top of each other. The oldest rocks are on the bottom. The rocks contain fossils.)
- Why are the (cake) layers different? (Earth is composed of different layers of rocks—sandstone, limestone, etc.)
- Why are the cores different in Site 1, Site 2, and Site 3? (The layers are affected by faults, erosion, etc.)
- How do you know how old the layers are? (By looking at the "fossils" on the key to decide which one is the "oldest" (relative age) and comparing the different layers.)

## Exposing the Subsurface Earth

The great advantage to using the layer cake is that after the students have discussed and interpreted their cores you will be able to "unveil" the stratigraphic layers to further support or dispute their conclusions (remember that the layers are hidden below soil—or frosting). You can do this by removing the foil wrapped around the cake and exposing the stacked cake layers. The students can now see the different layers and any faults that might have been acting upon them. An extra bonus is that at the end of the lesson, you may decide to treat the students to a piece of the cake! ■

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### Resources

National Research Council (NRC). 1996. *National science education standards.* Washington, DC: National Academy Press.

## Connecting to the Standards

This article relates to the following National Science Education Standards (NRC 1996):

### Content Standard

**Standard D:** Earth and Space Science

- Structure of the Earth system (5–8)
- Earth's history (5–8)