INTERPRETING ROCK LAYERS
(MODIFIED FOR ADEED)

Science Concept:

Sedimentary rocks can be aged using the law of superposition. Unconformities can create exceptions to this law.

Objectives:

The student will:

- explain how rocks are dated by relative position (superposition);
- describe how unconformities can affect the position of rocks and their relative age;
- make inferences about the relative age of rock layers; and
- explain in writing how the law of superposition and knowledge of unconformities can help age rock layers.

GLEs Addressed:

Science

[10] SD1.1 The student demonstrates an understanding of geochemical cycles by using a model to explain the processes (i.e., formation, sedimentation, erosion, reformation) of the rock cycle.

[10] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

Writing

[10] W4.2.2 The student writes for a variety of purposes and audiences by writing in a variety of nonfiction forms (e.g., letter, report, biography, autobiography, and/or essay) to inform, describe, or persuade.

Vocabulary:

conformity - A bedding surface separating younger from older strata, along which there is no evidence of subaerial or submarine erosion or of nondeposition, and along which there is no evidence of a significant hiatus. Unconformities (sequence boundaries) and flooding surfaces (parasequence boundaries) pass laterally into correlative conformities, or correlative surfaces

igneous rock - rocks formed are hardened and cooled magma

law of superposition - sedimentary layers are deposited in a time sequence, with the oldest on the bottom and the youngest on the top

metamorphic rock - rocks formed from other rocks as a result of heat and pressure

nonconformity - Nonconformity exists between sedimentary rocks and metamorphic or igneous rocks when the sedimentary rock lies above and was deposited on the pre-existing and eroded metamorphic or igneous rock. Namely, if the rock below the break is igneous or has lost its bedding by metamorphism, the plane of juncture is a nonconformity

sedimentary rock - rocks formed are hardened deposits of sediment

unconformity - An unconformity is a buried erosion surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous. In general the older layer was exposed to erosion for an interval of time before deposition of the younger, but the term is used to describe any break in the sedimentary geologic record

stratigraphy - a discipline involving the description and interpretation of layered sediments and rocks, and especially their correlation and dating

INTERPRETING ROCK LAYERS

Materials:

- Play dough, in six colors
- Clear containers, approximately 8 inches x 6 inches x 8 inches (one per group)
- Tape, paper, or other material to cover the clear containers
- Flour (one spoonful per group)
- Clear drinking straws (six per group)
- Colored pencils
- Sediment of varying sizes and/or colors, such as sand, gravel, silt, etc. (six types)
- Glass jar or beaker
- Rulers (one per group)
- OVERHEAD: "Unconformities"
- TEACHER INFORMATION SHEET: "Answer Key for Core Samples"
- OVERHEAD: "Cross Section Example"
- STUDENT WORKSHEET: "Core Samples

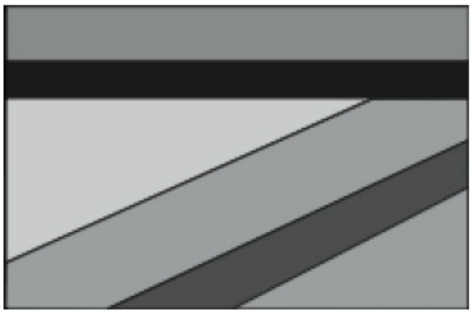
Sources:

Holt, R. (2002). *Earth science*. Holt McDougall.
Concise encyclopedia of Earth science. (2004). McGraw Hill.
Schlumberger Limited. (2009). *Oilfield glossary*. Retrieved from http://www.glossary.oilfield.slb.com/
Wikipedia. (2009). Retrieved from http://www.wikipedia.org/

Activity Preparation:

1. Sprinkle one spoonful of flour on the bottom of each container (one per group).

2. Place the play dough in the containers in layers according to the cross section diagram below. There should be one container per group. Each container should be as similar as possible.



3. Cover the outside of each container with tape, paper, or another material to hide the cross section of layers.

4. Cover the containers and store until the Explore.

Activity Procedure:

Please refer to the assessment task and scoring rubric located at the end of these instructions. Discuss the assessment descriptors with the class before teaching this lesson.

INTERPRETING ROCK LAYERS

Gear Up

Process Skills: observing, inferring, and communicating

1. Ask students to write, in their science journals, what they know about the law of superposition, unconformities, and how they relate to the age of rocks. After they are done writing ask them to share what they wrote with the class. Record responses on the board.
2. Demonstrate the formation of sedimentary rock layers by pouring six different colors and/or sizes of sediment into a clear glass to form layers.
3. Ask students what they observed. Write student responses on the board.
4. Ask students which layer of sediment in the glass is the oldest.
5. Ask students to predict what a six-layer cross-section would look like if they took a core sample from the glass. Ask them to draw this in their science notebooks.

Explore

Process Skills: observing, measuring, and communicating

6. Tell students to imagine they are contracted geologists mapping the rock layer of an area of interest to developers. Explain geologists drill core samples to help them map how rock layers are arranged in large areas. They use these core samples to draw cross sections. Show OVERHEAD: "Cross Section Example."
7. Explain they will be given a play dough container to analyze. Explain the contents of each container are the same. Student will only be able to see the surface of the "rock." Show them how to use a straw to collect a core sample from their container. Explain taking a core sample is expensive; students will only be able to "drill" one spot in their container.
8. Divide students into groups. Distribute play dough containers (see Activity Preparation) and straws, and ask each group to take a core sample.
9. Ask groups to draw a diagram in their science journal that illustrates their cross section and number the layers they found, with 1 being the oldest layer. They should measure the depth of each layer using a ruler and draw their diagram to scale. They should also color the layers to detail the type of rock they find in each layer.

Generalize

Process Skills: observing, inferring, and communicating

10. Ask students the following questions and discuss:
    a. What did you observe about your core sample?
    b. What was the order of colors of your core sample? (Have one student from each group sketch their core samples on the board.)
    c. How were the samples the same? How were they different?
    d. How could this happen if all groups are testing the same cross section of rock?
    e. What could cause different results in the core samples?

Explore

Process Skills: analyzing data and communicating

11. Give each group of students five clear drinking straws and ask them to develop a sampling strategy to determine what the entire cross-section looks like, and then implement their strategy to complete the exploration.
12. Ask students to draw a diagram in their science journal that illustrates their cross section and numbers the layers they find, with 1 being the oldest layer. They should measure the depth of each layer and draw their diagram to scale. They should also color the layers to detail the type of rock they find in each layer.

Generalize 2

Process Skills: inferring and communicating

13. Ask the following questions and discuss:
    a. What strategies did you use to sample and diagram the rock layers?
    b. What did you observe? (Ask students to share their diagrams.)
    c. Take the cover off your container. Compare your diagram with the container.
14. Tell students that what they see is called an unconformity. Show OVERHEAD: "Unconformities."
15. If necessary explain the Law of Superposition and how it helps geologists determine how old rocks are in a cross section. Sedimentary rocks are also created in a horizontal layers. This is called the Principle of Original Horizontality.

Apply

Process Skills: inferring, describing, predicting, and communicating

16. Ask students to explain in their science journals why oil companies take drill samples of potential oil fields and what information the core sample can tell them.

INTERPRETING ROCK LAYERS

RUBRIC

Assessment Task:

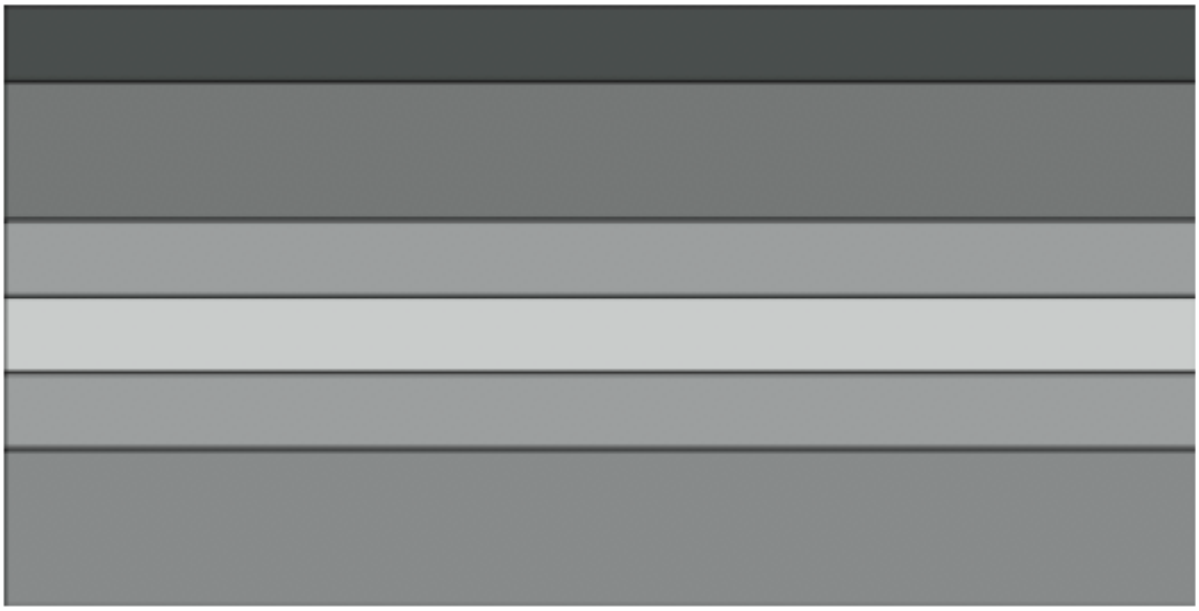
1. Imagine rumor has it there is a gold vein in the oldest layer of bedrock in Mystic Canyon. Determine the arrangement of rock layers below ground in the canyon. You have enough funding to drill five core samples. On the STUDENT WORKSHEET: "Core Sample," fill in the bedrock layers, then identify, label and describe the unconformity. Explain the Law of Superposition. You may also explain how this helps date rocks. Write at least one inference about the relative age of each rock layer, with 1 being the oldest. You ma also write about how this unconformity is an exception to the law of superposition.
2. In your journal, write a letter to the Purple Cat Mining Company to tell them where the oldest layer of rock is and how that was determined using superposition. You may include how rocks are dated. The letter should be written in complete sentences and be a minimum of one paragraph. You may include a labeled diagram of the rock layers you found using the five core samples from Mystic Canyon.

Rubric:

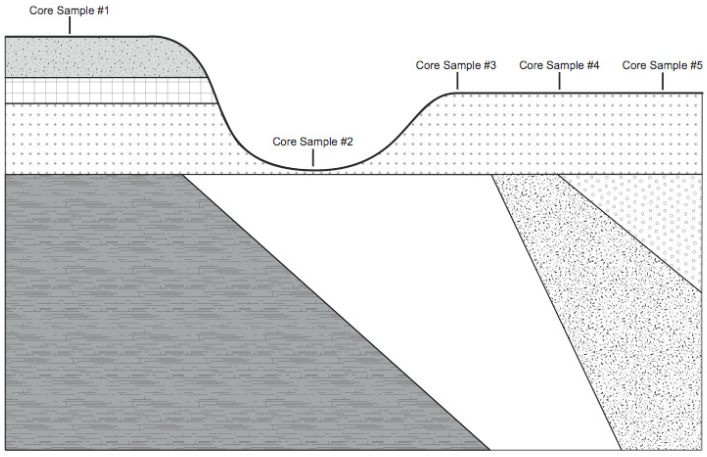
Objective	GLE	Below Proficient	Proficient	Above Proficient
The student explains rocks are aged by relative position (superposition).	[10] SD1.1	The student does not explain how sedimentary rocks are dated.	The student explains that sedimentary rocks on the bottom are older based on the law of superposition.	The student explains that sedimentary rocks on the bottom are older based on the law of superposition and how this helps date rocks.
The student describes how unconformities can affect the position of rocks and their relative age.	[10] SD1.1	The student does not describe the unconformity in the Mystic Canyon sample.	The student accurately describes the unconformity in the Mystic Canyon sample.	The student accurately describes the unconformity in the Mystic Canyon sample and writes about how this unconformity is an exception to the law of superposition.
The student makes inferences about the relative age of rock layers.	[10] SA1.1	The student does not make an inference about the relative age the rock layers and/or labels the bedrock diagram incorrectly.	The student makes one inference about the relative age of the rock layers and labels the bedrock diagram correctly.	The student makes two or more inferences about the relative age of the rock layers and labels the bedrock diagram correctly.
The student explains in writing how the law of superposition and knowledge of unconformities can help age rock layers.	[10] W4.2.2	The student does not write in complete sentences and/or his or her writing is less than one paragraph long.	The student writes a paragraph with complete sentences.	The student writes a paragraph of complete sentences. He or she includes a diagram with labels that show the relative age of each rock layer.

CROSS SECTION EXAMPLE

OVERHEAD



ANSWER KEY FOR CORE SAMPLES

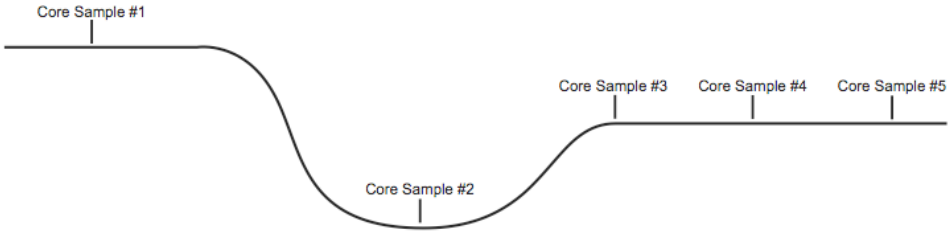


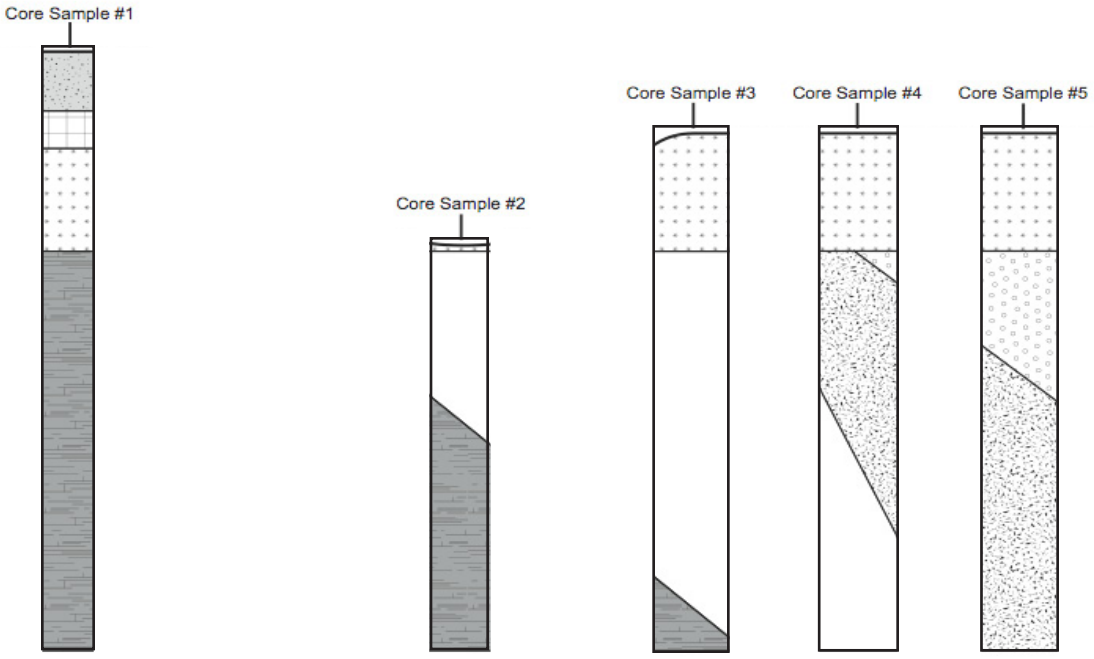
NAME: _____ STUDENT WORKSHEET

CORE SAMPLES

Directions:

1. Fill in the bedrock layers.
2. Identify and label the unconformity.
3. Write at least one inference about the relative age of each rock layer, with 1 being the oldest.
4. Write about how this unconformity is an exception to the law of superposition.





UNCONFORMITIES

OVERHEAD