



## Earth Science, Part 2 Supplemental and Background Information For Teachers and Volunteers

### **Rationale:**

According to the California State Science Content Standards, the rock cycle is introduced in the 4<sup>th</sup> grade. In grade 6, plate tectonics is studied and used to explain geologic features such as mountains, faults, and volcanoes. Topographic and geologic maps are introduced and interpreted. These maps can be used to sequence events and to identify natural phenomena. 7<sup>th</sup> graders integrate all these ideas by connecting the rock cycle to layers of sediment and rock, and inferring the relative ages of the various layers. While the new science standards have not yet been implemented in most schools, these modules were designed to complement these standards.

Specific science standards addressed in this *Earth Science* lesson plan are:

### 4<sup>th</sup> grade:

- Students know how to differentiate among igneous, sedimentary, and metamorphic rocks and know about methods of their formations (rock cycle).

### 6<sup>th</sup> grade:

- Students know that the distribution of fossils, rock types, and ancient climatic zones are evidence of plate tectonics.
- Students can explain major features of California geology (including mountains, faults, and volcanoes) in terms of plate tectonics.
- Students are asked to read a geologic map, interpret a simple scale map, and construct a simple scale model based on the map.
- Students can interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions).
- Students are asked to select and use appropriate tools and technology to display data.

### 7<sup>th</sup> grade:

- Students know that the rock cycle includes the formation of new sediment and rocks and that rocks are often found in layers, with the oldest generally on the bottom.

**Disclaimer:** These activities were adapted from the article “The Art of Geology”<sup>1</sup> by Debra Rockey.

## **Part 2: Model Lithologic Columns**

### **Objectives:**

After participating in the program *Earth Science, Part 2*, students will be able to:

- differentiate among igneous, sedimentary, and metamorphic rocks



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- differentiate among igneous, sedimentary, and metamorphic rocks
- recognize that evidence for plate tectonics is derived in part from the distribution of fossils, rock types, and ancient climatic zones
- report that rocks are often found in layers, with the oldest generally on the bottom
- read a geologic map for evidence provided on the map, and construct and interpret a simple scale model
- interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions)
- select and use appropriate tools and technology to collect and display data

### Vocabulary:

sedimentary rock - rock formed by the deposit of sediment - may be deposited by water or wind

igneous rock - rock formed by the crystallization of molten magma

magma - a body of molten rock found deep within the Earth

metamorphic rock - rock resulting from subjecting igneous rock to high temperatures and pressures within the Earth; the rock may be changed in mineral composition and texture

lithologic column - a model of the vertical structure and composition of a geologic formation - sometimes these are called stratigraphic columns

geologic formation - the structure of the Earth's crust in a given location

geologic cross-section - a diagram showing a side view of a portion of the Earth's crust (depth profile)

stratigraphy - the study of the character of, relative ages of, variations in, and fossils contained in strata over some area of the Earth's crust

lithology - study of the character of rocks

### Lesson Notes:

1. Sedimentary rock sequences are mapped by geologists in order to study them. The various rock layers may be dated relative to each other by studying these sequences. The rock layers are usually stacked horizontally, with the oldest layers generally found on the bottom. Intrusions or faults cut through other rocks, and are assumed to be younger than the layers they cut. A geologic calendar, applicable to the whole Earth, can be developed by correlating rocks of similar ages in different locations. Fossils found in the various strata, give scientists clues about the life forms present during the deposition of particular layers.

Often models are built as an aid in visualizing the various strata. Specific colors and patterns are used to represent various types of rocks and/or sediment layers. Brighter colors than the usual browns and grays of typical rock layers are used to help them understand the particular feature under study. The lithologic column the students will be making is a scaled model of a particular geologic formation (or drill hole or mine core). An example of a color scheme that might be used is: yellow = limestone, blue = sandstone, green = shale, black = coal, purple = clay, etc. The available colors will be determined by the teacher/volunteer. The correlation with the layers present in the



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students' maps can be left up to the student groups. Each group may have a different set of rock types in their maps.

2. After the students decide upon their color scheme, it should be recorded in the worksheet. Then the diagram should be colored in to match their color scheme.

3. The students will probably need to be guided through the scaling process. You should decide whether the models will be made in metric or English units. Often, the geologic maps use English units because of tradition in the coal industry. Provide conversion factors if you want the columns to be in metric units. The length of the column should be correlated with the depth of the map formation. Students should attempt to use the entire column length if possible. (Sometimes when the scaled values are rounded to more convenient units for marking the column, the full length may not be used. In that case the unused portion of the column should be filled with white sand before sealing.) By marking the rock strata on the masking tape, it is easy to see where to begin and end each layer of sand. This also becomes a convenient place to annotate the column with specific features in each rock layer.

4. Make sure students compact the sand between layers. Extra space at the top should be filled with raw sand. After sealing the columns, make sure each is labeled with the site or feature name and location, as well as the scale used to construct the model.

5. The presentation of the finished columns to the class can be as detailed as you desire. The students could present the site, layers involved, and scale used. They could also be required to research the various layers and communicate the results of that research to the class along with the column. Students should be encouraged to draw conclusions and share them with the group. Students can consider the layer type, thickness, and sequence, and inclusions (e.g., fossils) in the layers when drawing their conclusions.

Answers to the worksheet are located in the file:  
**earthsci\_2\_wksht\_key.**

### References and Extension Ideas:

These activities were adapted from the article "The Art of Geology"<sup>1</sup> by Debra Rockey. Some sources for lithologic/geologic maps and geologic cross-sections are listed below:

1. Rockey, D., *The Science Teacher*, April 2000, "The Art of Geology", pp. 20-23.
2. <http://pubs.usgs.gov/openfile/of99-432/of99-432.pdf>
3. <http://www8.myflorida.com/environment/downloads/geology/litholog.html>
4. <http://www.ceie.sunysb.edu/SummerEducationalInterns/Linda/Creati ngastratigraphiccolumn.html>
5. "Geology Illustrated", J. S. Shelton, W. H. Freeman and Company, San Francisco and London, 1966.
6. "Earth Science, 4<sup>th</sup> Ed.", E. J. Tarbuck and F. K. Lutgens, Charles E. Merrill Publishing Company, Columbus, 1985.



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7. "Physical Geology, 3<sup>rd</sup> Ed.", L. D. Leet and S. Judson, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1965.
8. "Geologic Map of the Eastern Part of the Grand Canyon National Park", Breed, Huntoon, and Billingsley in cooperation with the U.S. Geological Survey. This map may be purchased for \$9.95 by calling 1-800-858-2808 or by visiting the website: <http://www.grandcanyon.org>. It has several geologic cross-sections which would be suitable for this lesson.