Stories in Stone
Field Trip Program

Grand Canyon Focus: Geology
School Subjects: Science, Reading, & Social Studies
Grade Levels: 3rd – 7th
Duration: 2 hours (including walking time)
AZ Standards Addressed: (see list at end of lesson plan for details)

Science: Inquiry Process
Observations, Questions, Hypotheses
Scientific testing
Analysis and Conclusions
Communication

Earth and Space
Properties of Earth materials
Earth's Processes and Systems
Structure of the Earth

Reading: Acquire and use new vocabulary in relevant contexts.

Specific standards are located after corresponding objectives and procedures listed below.
(Subject Grade: Strand Concept: Objective)

Theme

Fossil evidence in the rock layers at Grand Canyon uncovers interesting stories in Grand Canyon's geologic history.

Lesson Overview

Over billions of years, geologic processes such as deposition, uplift and erosion have shaped the surface of planet Earth. By studying the geologic history of Grand Canyon, students will gain a better understanding of many universal geologic principles and processes. By studying the rock layers of Grand Canyon and learning about the fossils they contain, we can learn about the environments that existed well before there was a canyon. This glimpse into the past can also help us to learn about today's environments.

Lesson Objectives

Students will be able to:

1. Name the 3 rock types and how they form (SC03-S6C1-02; SC07-S6C1-01; SC07-S6C2-02)
2. Explain what a fossil is (SC03-S6C1-04; SC04-S6C2-06)
3. Explain what clues a fossil tells about ancient environments (SC04-S6C2-06; SC07-S6C1-04)
4. List tools important to paleontologists

Materials

- Stories in Stone Booklets
- First Aid Kit
- Optional: colored pencils

Program Procedure

Objectives: Students will be able to:

- Explain the concept of geologic time versus regular time (SC07-S6C1-04)
- Define environment
- Describe how fossils are formed (SC03-S6C1-04; SC04-S6C2-06)
- Explain the value of recording observations in a journal (SC03/04/05/06/07-S1C2-05)
- Make inferences to determine the environment that was present during Kaibab formation

(SC04-S1C3-02)

Activities: Fossil hunt

Materials: Journals and clipboards

Procedures:

- Safety briefing and behavior expectations. (Running, rock-throwing, squirrels, on-trail, with chaperones/parents, water, sunscreen)
- Explain that we will be discussing geologic time and environments.
- Today is the students' chance to be paleontologists and identify fossils in this rock layer to learn more about the ancient environment that formed this layer
- Introduce what fossils are and what geologists and paleontologists do. (SC03-S6C1-04)
- Give instructions of fossil activity protocol. Ask and discuss why recording observations is important. (SC03/04/05-S1C2-05; SC06/07-S1C2-05; W03/04/05-S3C2-01)
- Fossil activity: Identify fossils (SC06-S1C2-03), sketch two or three, and hypothesize/infer what crinoid looked like with its soft parts. (SC04-S1C3-02)
- Wrap up: Discuss what scientists know about this environment. (SC04-S1C3-02; SC04/05-S1C4-01; SC05-S1C4-03; SC06-S1C4-03; SC06-S1C4-05)

Background Information:

Fossils:

The Kaibab Limestone was deposited by a shallow, warm water sea (100-200' deep) with mild currents. It has been dated at approximately 270 MYO. Most of the fossils found are filter feeders that lived on the sea floor (sponges, brachiopods, corals, bryozoan, crinoid). Sharks teeth have been found as well.

A fossil is any evidence of ancient life. This evidence may be the actual remains, such as bone, teeth, shells or plant tissues; chemically altered remains; or traces of the activities of organisms, such as burrows and tracks. Paleontology is the study of fossils, and scientists who study fossils are paleontologists. Paleontologists use fossils to reconstruct ancient life, using what we know about the present to understand the past and drawing upon the sciences of geology and biology. Paleontology is often confused with archaeology, which is the study of ancient humans and their cultures. The focus of paleontology is the history of life on earth, from its beginnings approximately 3.6 billion years ago, up to the advent of human culture about 10,000 years ago. Except for rare occurrences, fossils are found only in sedimentary rocks.

Upon death, most plant and animal remains are soon digested by bacteria and other living organisms. Thus some of the organic elements of life are recycled to build new organisms. Rare and special circumstances are necessary for any parts or traces of an organism to be preserved as a fossil. Preservation usually requires that an organism or its remains be buried rapidly, be insulated from oxygen and decay-producing organisms, and remain buried and undisturbed. Under even the best of conditions, the preservation of soft parts is exceptionally rare. Usually only hard skeletal elements are preserved as fossils.

Fossils are not always the actual remains of living organisms. Many fossils are just copies called imprints, molds, or casts. Imprints are impressions made by organisms in soft sediment that were preserved when the sediment solidified. Imprints can be traces of an animal's activity, rather than its actual remains. The hardened tracks of animals or the burrows of prehistoric worms in solidified mud are examples of fossil imprints. Molds are made when organisms are totally or partially buried in sediment that hardens into rock. Over time, ground water may dissolve the organisms, leaving cavities shaped like their bodies. Both

imprints and molds are mirror images of the organisms. If a mold was later filled with mud or mineral material, the hardened filling is called a cast. It is a reproduction that has the same outer shape as the organism. A cast looks like the organism itself, not like its imprint. Paleontologists make casts of fossil molds by filling them with liquids, such as plaster, that harden.

Geologic Time:

The earth is very old — about 4½ billion years — according to recent estimates. This vast span of time, called geologic time by earth scientists, is difficult to comprehend in the familiar time units of months and years, or even centuries. How then do scientists reckon geologic time, and why do they believe the Earth is so old? The evidence for an ancient Earth is concealed in the rocks that form the Earth's crust and surface. The rocks are not all the same age—or even nearly so—but, like the pages in a long and complicated history, they record the Earth-shaping events and life of the past. The record, however, is incomplete. Many pages, especially in the early parts, are missing and many others are tattered, torn, and difficult to decipher. But enough of the pages are preserved to reward the reader with accounts of astounding episodes which certify that the Earth is billions of years old.

The oldest known rocks on Earth are close to four billion years old. They are found on the shores of Great Slave Lake in Canada's Northwest Territory and in remote areas of Greenland. The rock layers of Grand Canyon range in age from 1800 million years old at the bottom of the canyon to 270 million years old at the top. The metamorphic rocks, found at the bottom of the canyon formed when sedimentary rocks were subjected to igneous intrusions followed by deep burial. Subsequent flooding by inland seas and windy desert conditions deposited and then reworked the sedimentary rock layers above them. The canyon seen today is relatively young, having been sculpted in just the last 5-6 million years. The Colorado River carved through many rock layers to create Grand Canyon. Lateral erosion widened the canyon.

Arizona State Teaching Standards Addressed

The "Stories in Stone" program addresses the following Arizona Standards:*

Science

SC03/04/05-S1C2-05: Record data in an organized and appropriate format
SC03-S6C1-02: Describe the different types of rocks and how they are formed: metamorphic, igneous, sedimentary
SC03-S6C1-04: Describe fossils as a record of past life forms
SC04-S1C3-02: Formulate conclusions based upon identified trends in data.
SC04/05-S1C4-01: Communicate verbally or in writing the results of an inquiry.
SC04-S6C2-06: Analyze evidence that indicates life and environmental conditions have changed (e.g., tree rings, fish fossils in desert regions, ice cores)
SC05-S1C4-03: Communicate with other groups or individuals to compare the results of a common investigation.
SC06-S1C2-05: Keep a record of all observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.
SC06-S1C4-03: Communicate the results of an investigation with appropriate use of qualitative and quantitative information.
SC06-S1C4-05: Communicate the results and conclusion of the investigation.
SC07-S6C1-04: Describe how the rock and fossil record show that environmental conditions have changed over geologic and recent time.

Language Arts

W03/04/05/06/07-S3C1-02: Write in a variety of expressive forms (e.g., poetry, skit) that may employ: figurative language, rhythm, dialogue, characterization, plot, appropriate format
W03/04/05-S3C2-01: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

National Science Education Standards addressed (Content Standard D):
Grades 5-8: Structure of the earth system and Earth's history

*Although our programs address the curriculum standards, it remains the responsibility of the individual teacher to determine the extent to which the standards have been met based on program content, pre- and post-visit activities, and appropriate evaluation of student learning and understanding.

* **Standards last updated in December, 2009**