**Simulated Fossil Dig**

**Field Trip Program**

*Revised November, 2014*

**Petrified Forest Focus:** Geology and Paleontology

**School Subjects:** Science & Math

**Grade Levels: 1st – 5th**

**Duration:** 90 – 120 minutes

**AZ Science Standards**

* **SC01-S1C1**: compare common objects using multiple senses
* **SC01-S1C2**: Ask questions based on experiences with objects, organisms, and events in the environment.
* **SC01-S1C2**: Scientific testing (investigating and Modeling) Participate in planning and conducting investigations and recording data.
* **SC01-S1C4**, **SC02-S1C4, SC03-S1C4, SC04-S1C4, SC05-S1C4**: Communication; communicate results of investigations
* **SC01-S1C2, SC02-S2C2, SC03-S2C2, SC04-S2C2, SC05-S2C2**: Nature of scientific knowledge; Understand how science is a process for generating knowledge.
* **SC01 – S3C2-02**: Describe how suitable tools (e.g. magnifiers, thermometers) help make better observations.
* **SC01-S1C2-01, SC02-S1C2-01, SC03-S1C2-01, SC04-S1C2-01, SC05-S1C2-01**: Demonstrate safe behavior and appropriate procedures.
* **SC02-S1C1, SC03-S2C1-02, SC04-S1C1**: Observations, Questions, and Hypotheses: Observe, ask questions, and make predictions.
* **SC02-S2C1-02, SC03-S2C1-02, SC04-S2C1-02**: Identify science related career opportunities
* **SC03-S1C2-04, SC04-S1C1, SC05-S1C2-04**: Use metric and U.S. customary units to measure objects; measure using appropriate tools and units of measure.
* **SC03-S1C2-05, SC04-S1C2-05, SC05-S1C2-05**: Record data in an organized and appropriate format.
* **SC03-S1C4-03, SC04-S1C4-03, SC05-S1C4-03**: Communicate with other groups or individuals to compare the results of a common investigation.
* SC03-S4C1-01: Identify animal structures that serve different functions
* **SC01-S6C1-05:** Identify ways to conserve natural resources (eg. Reduce, reuse, recycle, find alternatives.)
* **SC01-S5C1-01:** Classify objects using the following observable properties; shape, texture, size, color, weight

**AZCCR Standards**

* (3.MP.7) Look for and make use of pattern.
* (3.MD.B.4) Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.
* For Informational Text:
	+ (3.RL.1) Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
	+ (3.RI.7) Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text
	+ (3.SL.3)Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.
	+ (3.SL.1)Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others’ ideas and expressing their own clearly.
	+ (3.SL.6)Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification.
	+ (4.RL.1) Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
	+ (4.RI.7)Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
	+ (5.RI.7) Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
	+ (5.RL.1) Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

**Lesson Overview**

Students will participate in a simulated paleontological field exercise discovering real and replica fossils. They will map, measure, and identify fossilized remains of Triassic animals and plants. Students will also take field notes and make hypotheses and conclusions about their discoveries. This program is the culmination of the Rocking through the Ages curriculum but can also be conducted as a stand-alone activity. Group size is limited to 25 students.

**Background Knowledge** (for teachers and students)

Paleontology is a science that investigates the remains of ancient life and the changing forms of life through time. Paleontologists must have an understanding of geology, biology, and ecology to interpret the clues of the ancient past. They piece together information from rocks - how rocks form, how they change over time, and what environments they represent - in order to know which layers of rock might contain fossils. They must understand animal and plant anatomy, physiology, and behavior in order to interpret the fossils they find. With an understanding of the relationships between organisms and their environment, paleontologists become paleo-ecologists and can create images of entire ancient ecosystems. Because the past can never be recreated, paleontological resources are considered nonrenewable and are in need of protection and preservation.

Petrified Forest National Park contains a wealth of fossils from the Late Triassic epoch that are over 200 million years old. These fossils are contained in the layers of the Chinle Formation, also known as The Painted Desert. The process of science and field work is very important to telling the story of Petrified Forest NP because the first paleontological research began in the early 1900’s and continues today. Both the geology and paleontology within the park have been and continue to be extensively studied. The park strives to foster public appreciation for the new information that is learned as part of a larger appreciation for protecting and learning in public lands.

Geology is a science that concentrates on the origin, structure, and processes of the earth. Geologists study the composition, distribution, formation, and changes of rocks in order to better understand the earth and its ancient and modern environments. Without geology, paleontologists would have little understanding of the fossilized remains of ancient life.

The earth is composed of three major rock types: igneous, sedimentary, and metamorphic.

* Igneous rocks are heat-formed rocks, originating from magma, or molten rock, found underground. Lava is magma that has flowed onto the Earth’s surface. (Obsidian and pumice are examples or igneous rock.)
* Sedimentary rocks are formed from sediment, or small particles (clay, silt, sand, gravel) of existing rock. The sediment is cemented together over time. Sediment is transported and deposited by earth forces such as water, wind, gravity, and ice movements. Fossils are most often found in sedimentary rock, where organic material was deposited along with the sediment. (Sandstone and shale are examples of sedimentary rock.)
* Metamorphic rocks were formed under intense heat and pressure, squashing, stretching, and/or cooking existing igneous or sedimentary rock, changing the appearance and mineral composition. (Marble is an example of a metamorphic rock that used to the sedimentary rock limestone.)

The Bidahochi Formation consists of igneous rock formed in more recent times, 4-8 million years ago, during the Tertiary Period of the Cenozoic Era. A large lake basin covered most of northeastern Arizona. Inside and outside the lake basin volcanoes formed and erupted, spreading ash and lava over land and into the lake. Exposed in the park are volcanic landforms that began forming under water, such as Pilot Rock. Where the Bidahochi Formation meets the Chinle Formation is an unconformity, a break in the rock record. Due to erosion occurring before the Bidahochi formed, 200million years of time represented by rock layers is missing! The hardness of the basaltic rock of the Bidahochi protects the softer rock of the Chinle Formation from erosion.

By studying the geology and the fossils in the park, scientists can create an image of the past environment of the Late Triassic. Different sedimentary layers of sandstone, mudstone, conglomerates, and bentonite clay (clay and volcanic ash), as well as the different minerals with these rocks tell us that a large body of moving water existed for about 18 million years, changing in size and depth throughout that time. Fossils of fresh water animals such as mussels, snails, crayfish, sharks, and lungfish show that this body of water was an extensive river system. Fossils of plants such as ferns, cycads, giant horsetails, gingkoes, and tropical conifer trees (the petrified wood) show that the Late Triassic environment, in what is now Northern AZ, was a sub-tropical forest. Fossils of larger vertebrate animals show reptiles (not dinosaurs) to be the dominant fauna of the time. Some very early dinosaur bones have been found in some of the youngest layers in the park showing that dinosaurs began to evolve at the very end of the Triassic. Each summer new fossils are collected from within the park showing either new species never found anywhere in the world, new species not previously found within the park, or additional fossils of known species that tell us more about those animals or plants.

**Lesson Goals**

* develop an understanding of the science of paleontology by learning the skills and concepts involved
* be introduced to geological time periods represented at the park
* explore an aspect of paleontology through participation in a field exploration
* become aware of the importance of preservation of paleontological resources
* understand the role of the National Park Service in the preservation and protection of natural and cultural resources.

**Learning Objectives**

* describe paleontology as the study of ancient life on earth through fossils
* list geological time periods represented at the park
* explain why choices have consequences
* use scientific methods adopted by paleontologists
* recognize that paleontological resources are nonrenewable
* describe at least one thing they learned about Petrified Forest National Park and/or the National Park Service.

**Related Vocabulary**

* **Chinle Formation** - rock formation within Petrified Forest National Park and the larger area of the Painted Desert, containing several distinct rock layers, dating to over 200 million years ago; represents the Late Triassic Period
* **Clay** - fine-grained material, slippery when wet, widely used in making bricks, tiles, and pottery, particle size is < 1/256 millimeters; found in mudstone and shale
* **Deposition** - a natural process in which sediments are laid down layer by layer through wind, water, gravity, or ice movements
* **Erosion** - the movement of earth material from one place to another due to forces such as water, wind, gravity, or ice movements
* **Epoch** – a division of geologic time that is a subdivision of a *period* and is itself subdivided into *ages* (the Triassic Period has contains three epochs; the Early, Middle, and Late Triassic.)
* **Fossil** - any record of past life found preserved in rock; can be plant materials such as stems, seeds, or cones, and pollen, or animal parts such as bone, shells, or teeth; can be trace impressions, such as tracks, footprints, trails, burrows, leaves, etc.
* **Fossilization** - a process by which plant and animal remains or their impressions are preserved in rock *(evidence of life preserved by a geologic process)*
* **Geology** - a science that concentrates on the origin, history, and structure of the earth including the study of rocks and the forces acting upon the earth
* **Limestone** - type of sedimentary rock composed of calcium carbonate, usually formed in shallow marine or freshwater environments and often containing invertebrate fossil evidence.
* **Magma** - molten rock beneath the Earth’s surface; surface magma is called lava
* **Mineral** - naturally occurring chemical element or compound with specific physical properties, composition, and crystal form
* **Mudstone or shale** - fine grained sedimentary rock composed of silt and clay sized particles
* **Organic material** - dead plant and animal matter in various stages of decomposition or fossilization
* **Pangaea** - a supercontinent in existence during the Mesozoic and Paleozoic Eras that contained all seven continents present on Earth’s surface today in a single land mass
* **Permineralization** - fossilization through in-filling of pore spaces in organic material by minerals; organic material is encased within the mineral (scientific term for petrification)
* **Period** - division of geologic time smaller than an era, based on rock layers and the fossils they contain
* **Relative Dating** - dating of events or substances in comparison with one another, in chronological order; comparing types of fossils is often a relative dating technique
* **Sand** - loose, granular, gritty particles of worn or disintegrated rock, finer than gravel, **c**ommonly composed of silica; particle size is 1/16 - 2 millimeters
* **Sandstone -** type of sedimentary rock composed of cemented sand grains
* **Sediment** - material suspended in water or air that eventually settles out, usually in layers
* **Sedimentary** - rock formed from the deposition, accumulation, and cementation of sediments, usually forming layers, often including fossils
* **Triassic Period** - the first geologic timespan within the Mesozoic Era, dating from 248-206 million years ago; the Late Triassic Period is well represented at Petrified Forest National Park

**Materials** - All materials will be provided by the park

**Student Assessment Questions**

Use the following questions to help your students prepare for their trip and to assess what they learned after visiting the park.

1. Can you think of two facts you know about Petrified Forest or the National Park Service?
2. What is a fossil? Give an example of a fossil found at Petrified Forest National Park.
3. It is important to protect our natural resources. Fossils are an example of resources that are in danger of being destroyed. Can you list two reasons for why fossils are being destroyed?
4. With any job, most people will do a variety of tasks. Think about all the jobs your teacher does. The same is true of paleontologists. List two jobs you think a paleontologist might do.
5. Geologic time is how scientists measure the age of the earth, the age of rocks, and the age of fossils. The Jurassic Period is the geologic time period when dinosaurs ruled the earth. Petrified Forest National Park represents the time before the dinosaurs. Do you know the geologic time period represented at the park?
6. National parks were created to protect natural and cultural resources for future generations. Can you explain why this is important?