**Clam Beds Hike**

**Field Trip Program**

*Revised December, 2014*

**Petrified Forest Focus:** Geology and Paleontology

**School Subjects:** Science & Math

**Grade Levels: 3rd – 8th**

**Duration:** 60 -90 minutes

**AZ Science Standards**

* **SC03-S1C2-01, SC04-S1C2-01, SC05-S1C2-01, SC06-S1C1-0, SC07-S1C1-01**: Demonstrate safe behavior and appropriate procedures.
* **SC03-S1C4, SC04-S1C4, SC05-S1C4**: Communication; communicate results of investigations
* **SC03-S2C1-02, SC04-S2C1-02**: Identify science related career opportunities
* **SC03-S2C1-02, SC04-S1C1, SC05-S1C1**: Observations, Questions, and Hypotheses: Observe, ask questions, and make predictions.
* **SC03-S2C2, SC04-S2C2, SC05-S2C2, SC06-S2C2, SC07-S2C2, SC08-S2C2**: Nature of scientific knowledge; Understand how science is a process for generating knowledge.
* **SC03-S1C4-03, SC04-S1C4-03, SC05-S1C4-03**: Communicate with other groups or individuals to compare the results of a common investigation.
* **SC03-S5C1, SC04-S5C1:** Properties of objects and Materials: Classify objects and materials by their observable properties.
* **SC03-S6C1-02:** Describe the different kinds of rocks and how they are formed: metamorphic, igneous and sedimentary
* **SC03-S6C1-03:** Classify rocks based on the following physical properties: color, texture
* **SC03-S6C1-04**: Describe fossils as a record of past life forms
* **SC03-S6C1-05:** Describe how fossils are formed
* **SC04-S4C3-02:** Differentiate renewable resources from nonrenewable resources.
* **SC04-S4C3-04:** Identify/describe ways to conserve natural resources (eg. Reduce, reuse, recycle, find alternatives.)
* **SC04-S6C2-01:** Identify the earth processes that cause erosion**.**
* **SC04-S6C2-02:** Describe how currents and wind cause erosion and land changes.
* **SC04-S6C2-03**: Describe the role that water plays in the following processes that alter the Earth’s surface features: erosion, deposition; weathering
* **SC04-S6C2-06**: Analyze evidence that indicates life and environmental conditions have changed. (e.g. tree rings, fish fossils in desert regions, ice cores.)
* **SC06-S1C1-02, SC07-S1C1-01, SC08-S1C1-01**: Formulate questions based on observations that lead to the development of a hypothesis.
* **SC07-S1C1-03**: Explain the role of a hypothesis in a scientific inquiry.
* **SC07-S6C1-01**: Classify rocks and minerals by the following observable properties: Grain; color; texture; hardness
* **SC07-S6C1-03:** Explain the following processes involved in the formation of the Earth’s structure: Erosion; deposition; plate tectonics; volcanism
* **SC07-S6C1-04:** Describe how the rock and fossil record show that environmental conditions have changed over geologic and recent time.
* **SC07-S6C2-01:** Explain the rock cycle.
* **SC07-S6C2-02:** Distinguish the components and characteristics of the rock cycle for the following types of rocks: Igneous, metamorphic, and sedimentary.

**AZCCR Standards**

* (3.MP.7) Look for and make use of pattern.
* For Informational 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.

**Lesson Overview**

Students will participate in a guided 1 mile off-trail hike with a ranger within the park. They will use observation and deductive reasoning skills to create hypotheses about the Late Triassic environment, simulating the work that geologists and paleontologists have done, and continue to do at Petrified Forest. This hike involves a small amount of uphill walking in potentially muddy conditions. Group size is limited to 25 students.

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

Petrified Forest National Park is an excellent place for studying paleontology and geology of the late Triassic. The information gained in these studies has enabled scientists to create a picture of what the environment and landscape was like over 200 million years ago. 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 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 of 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 be the sedimentary rock limestone.)

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, and flow pattern 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 now 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.

The area where this hike is conducted is within the Rainbow Forest/Jasper Forest beds of geology at the southern side of the park which are approximately 217 million years old. This layer contains a large concentration of color petrified wood as well as large amounts of invertebrate fossils of fresh water mussels (a common name for a type of freshwater clam) and snails. These fossil remains are large clues for scientists, indicating that large amounts of water once existed. The type of rocks that these fossils are contained in, including fine grained and conglomerate sandstone, are clues to the dynamic nature of the river system during the Triassic.

**Lesson Goals**

* develop an understanding of the sciences of paleontology and geology by learning the skills and concepts involved
* be introduced to geological time periods represented within Petrified Forest NP
* explore the basic goals of paleontology and geology through participation in a guided off-trail hike with a ranger
* Use observation and deductive reasoning skills to determine how clues from rocks and fossils can provide insight into past environments.
* become aware of the importance of preservation of natural and scientific resources
* understand the role of the National Park Service in the preservation and protection of natural, cultural, and scientific resources.

**Learning Objectives**

* describe paleontology as the study of ancient life on earth through fossils
* describe geology as the study of the earth and its rocks
* list geological time periods represented at the park
* explain why choices have consequences
* use observation skills to create hypotheses about the natural world
* 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
* **Conglomerate** - a coarse-grained sedimentary rock composed of rounded fragments (> 2 mm) within a matrix of finer grained material.
* **Context** - the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed. In geology and paleontology context can refer to the entirety of knowledge available at one time that scientists can use to create hypotheses or theories about the past.
* **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
* **Hypothesis** - a supposition or proposed explanation made on the basis of limited evidence as a starting point for further investigation.
* **Limestone** - type of sedimentary rock composed of calcium carbonate, usually formed in shallow marine or freshwater environments and often containing invertebrate fossil evidence.
* **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** – none needed other than proper hiking attire and water. Students are encouraged to bring binoculars or magnifying glasses if they have them.

**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. 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?
5. What kinds of fossils and types of rocks indicate that water once existed in a particular area within Petrified Forest?
6. National parks were created to protect natural and cultural resources for future generations. Can you explain why this is important?