How Dinosaurs Tell Time in Grand Staircase Escalante National Monument

Teacher Guide

BLM

Grand Staircase-Escalante National Monument

How Dinosaurs Tell Time in Grand Staircase-Escalante National Monument

Grade Level

9-12 and 6-8 (with adaptations)

Duration

90 minutes – Individual student activity
45 minutes – Group activity

Description

Students interpret the geologic history of Grand Staircase-Escalante National Monument using the Geologic Time Line and online research about dinosaurs excavated in, or near, its boundaries.

Goals

- Correlate the Geologic Time Line with the fossil record in GSENM
- Analyze data collected online to characterize the ancient environment and inhabitants of GSENM.

Academic Content Standards

The following standards are drawn from *Content Knowledge*[1].

Earth/Space Science Standard 2
Understands Earth's composition and structure

Level IV (Grades 9-12)

Benchmark 5
Knows methods used to estimate geologic time (e.g., observing rock sequences and using fossils to correlate the sequences at various locations; using the known decay rates of radioactive isotopes present in rock to measure the time since the rock was formed)

Level III (Grades 6-8)

Benchmark 7
Knows how successive layers of sedimentary rock and the fossils contained within them can be used to confirm the age, history, and changing life forms of the Earth, and how this evidence is affected by the folding, breaking, and uplifting of layers.

Benchmark 8
Knows that fossils provide important evidence of how environmental conditions have changed on the Earth over time (e.g., changes in atmospheric composition, movement of lithospheric plates, impact of an asteroid or comet)

[1] *Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education: 4th Edition,* Mid-Continent Research for Education and Learning in Aurora, Colorado. http://www.mcrel.org/standards-benchmarks/

Life Science Standard 7
Understands biological evolution and the diversity of life.
Level III (Grade 6-8)
Benchmark 2
Knows that the fossil record, through geologic evidence, documents the appearance, diversification, and extinction of many life forms.
Benchmark 3
Understands the concept of extinction and its importance in biological evolution (e.g., when the environment changes adaptive characteristics of some species are insufficient to allow survival; extinction is common; most species that have lived on the Earth no longer exist.)

Nature of Science Standard 11
Understands the nature of scientific knowledge.
Level IV (Grades 9-12)
Benchmark 3
Understands how scientific knowledge changes and accumulates over time (e.g., all scientific knowledge is subject to change as new evidence becomes available; some scientific ideas are incomplete and opportunity exists in these areas for new advances; theories are continually tested, revised, and occasionally discarded)
Benchmark 4
Knows that from time to time, major shifts occur in the scientific view of how the world works, but usually the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.

Materials

- *How Dinosaurs Tell Time in Grand Staircase-Escalante National Monument – Student Activity*
- Computer with internet access.
- Video or DVD *Traces in Time*, produced by GSENM

Objectives

1. Evaluate geologic time and the fossil record, with emphasis on dinosaurs found in Grand Staircase-Escalante National Monument.
2. Use the internet to collect data about dinosaurs identified in Grand Staircase-Escalante National Monument.
3. Analyze dinosaur data to characterize the ancient environment and inhabitants of Grand Staircase-Escalante National Monument.

Procedures

This activity can be completed in either 45 or 90 minutes, depending on whether students work in groups or individually. The video or DVD *Traces in Time* is a great way to introduce students to the Grand Staircase-Escalante National Monument.

1. Step 1 – In *How Dinosaurs Tell Time in GSENM*, read the introduction, *Geologic Timeline,* and *Dinosaurs of GSENM* (pages 1-4). Students should read the information and, if time allows, follow website links to learn more about geologic time and mass extinctions.

2. Step 2 – *Step 1. Research and Record* (page 5 and 6), requires students to go online and collect data about dinosaurs from GSENM. Data collections can be done quickly if students divide the dinosaurs between themselves and share data post-collection.

3. Step 3 – *Step 2. Organize your data* (page 5 and 7) and *Step 3. Assessment* (pages 8-9), analysis of collected data to answer questions about the ancient environment and inhabitants of GSENM, can be done individually or in small groups. Analyses should be shared with the class.

4. Classroom discussion following Step 3 should include the observation that collected data does not provide enough evidence to definitively answer the questions posed. Scientists would use this data as a beginning for the process of inquiry and further analysis.

Adaptations

This activity was written for grades 9-12 but it is easily adaptable by omitting pages 6-7 and having students create Dinosaur Data Cards for the dinosaurs of GSENM (sample cards are provided at the end of this teacher guide. As many copies as needed may be made, or students can design their own data cards). Students can be divided into groups and assigned different dinosaurs to be used to complete the data cards.

After each group is finished with their dinosaurs, combine data cards and go over them in class. You might even have students add a drawing of their dinosaur to their data cards. It is not required that students find information on only the nineteen dinosaurs mentioned in the student activity – if they would prefer to find their own dinosaurs, that's fine too. This activity is left open for the teacher to decide what will work best for individual classes.

Extensions

There are several excellent interactive activities online that students can use to learn more about dinosaurs. Highly recommended sites include:

BBC's Walking With Dinosaurs – An interactive game requiring knowledge and skill
http://www.bbc.co.uk/sn/prehistoric_life/games/big_al/

Discovery Channel's Dinosaur Viewer
http://dsc.discovery.com/convergence/dinosaurplanet/interactive/interactive.html

Discovery Channel's Beasts in Your Back Yard
http://dsc.discovery.com/convergence/dinos/lookup.html

Discovery Channel's Go Back in Time
http://dsc.discovery.com/convergence/dinos/timetravel.html

References

Websites

Natural History Museum of London
http://www.nhm.ac.uk/

Jurassic Park Institute
http://yahooligans.yahoo.com/content/science/dinosaurs/start.html

Dinosauria.com
http://www.dinosauria.com/dml/dmlf.htm

Northern Arizona University's Global Paleogeographic Views of Earth History
http://jan.ucc.nau.edu/~rcb7/globaltext.html

National Geographic News - August 23, 2005
http://news.nationalgeographic.com/news/2005/08/0823_050823_dinolava.html

University of California Berkeley
http://www.ucmp.berkeley.edu/diapsids/extinction.html

Geo Times
http://www.agiweb.org/geotimes/feb05/feature_25years.html

BBC's Walking With Dinosaurs – An interactive game requiring knowledge and skill
http://www.bbc.co.uk/sn/prehistoric_life/games/big_al/

Discovery Channel's Dinosaur Viewer
http://dsc.discovery.com/convergence/dinosaurplanet/interactive/interactive.html

Discovery Channel's Beasts in Your Back Yard
http://dsc.discovery.com/convergence/dinos/lookup.html

Discovery Channel's Go Back in Time
http://dsc.discovery.com/convergence/dinos/timetravel.html

Assessment

- Grades 9-12: The last question in Objective 3, *the next step they would take as investigating scientists*, should lead students to the understanding that science is ongoing and that the data obtained in this activity is only a starting point for future investigations.
- Grades 6-8: Students will end this activity with Dinosaur Data Cards. Using these references students should be able to make some observations about the ancient environment and inhabitants of GSENM.

Ouestion 1

Data Table for GSENM Dinosaurs

Genus	Geologic Period	Time Span (mya)	Diet	Size
Brachiosaurus	Late Jurassic	155-140 mya	Herbivorous	30 M long
Brachylophosaurus	Late Cretaceous	89-88 mya	Herbivorous	7 M long
Camarasaurus	Late Jurassic	150-140 mya	Herbivorous	23 M long
Daspletosaurus	Late Cretaceous	76-74 mya	Carnivorous	9 M long
Dilophosaurus	Early Jurassic	190 mya	Carnivorous	6 M long
Dromaeosaurus	Late Cretaceous	76-74 mya	Carnivorous	1.8 M long
Edmontonia	Late Cretaceous	76-74 mya	Herbivorous	4 M long
Euoplociphalus	Late Cretaceous	76-70 mya	Herbivorous	7 M long
Gryposaurus	Early Cretaceous	84 mya	Herbivorous	10 M long
Hagryphus *	Late Cretaceous	75 mya	Omnivorous	3 M long
Nothronychus	Early Cretaceous	90 mya	Herbivorous	6 M long 3 M high
Parasaurolophus	Late Cretaceous	76-74 mya	Herbivorous	11 M long
Saurornitholestes	Early Cretaceous	76 mya	Carnivorous	2 M long 0.7 M high
Stegoceras	Late Cretaceous	76-74 mya	Herbivorous	2.4 M long
Struthiomimus	Late Cretaceous	76-74 mya	Omnivorous	4 M long
Thescelosaurus	Late Cretaceous	76-67 mya	Herbivorous	3.5 M long
Troodon	Late Cretaceous	74-65 mya	Carnivorous	2 M long
Utahceratops **	Late Cretaceous	75 mya	Herbivorous	7 M long
Zuniceratops	Early Cretaceous	90 mya	Herbivorous	3 M long 1.3 M high

* Hagryphus is an oviraptor and, as of March 2006, holds the world record for largest oviraptor and the only oviraptor known south of the Black Hills. The genera Oviraptor and Chirostenotes are closely related. Hagryphus became official in December 2005.

** Utahceratops is a horned dinosaur. Closest other named genera are Pentaceratops and Chasmosaurus. Utahceratops had not been officially recognized as of March 2006.

Question 2

Geologic Period	Time Span	Diet	Size	Genus
Early Jurassic	190 mya	Carnivore	6 meters long	Dilphosaurus
Late Jurassic	155 – 140 mya	Herbivore	30 m long	Brachiosaurus
	150 – 140 mya	Herbivore	23 m long	Camarasaurus
Early Cretaceous	90 mya	Herbivore	3 m long 1.3 m high	Zuniceratops
			6 m long 3 m high	Nothronychus
	84 mya	Herbivore	10 m long	Gryposaurus
	76 mya	Carnivore	2 m long .7 m high	Saurornitholestes
Late Cretaceous	89 – 88 mya	Herbivore	7 m long	Brachylophosaurus
	76 – 74 mya	Herbivore	2.4 m long	Stegoceras
			4 m long	Edmontonia
			11 m long	Parasaurolophus
		Carnivore	1.8 m long	Dromaeosaurus
			4 m long	Struthiomimus
			9 m long	Daspletosaurus
	76 – 70 mya	Herbivore	7 m long	Euopolcephalus
	76 – 67 mya	Herbivore	3.5 m long	Thescelosaurus
	75 mya	Herbivore	7 m long	Utahceratops
		Carnivore	3 m long	Hagryphus
	74 - 65	Carnivore	2 m long	Troodon

Question 3

Which Period had the greatest diversity of dinosaurs in GSENM? (Identify the period by Early, Middle, or Late.) How many, and what are their names?

Late Cretaceous – 12 species
Brachylophosaurus, Daspletosaurus, Cromaeosaurus, Edmontonia, Euoplocephalus, Hagryphus, Parasaurolophus, Stegoceras, Struthiomimus, Thescelosaurus, Troodon, and Utahceratops

Question 4

What was the ratio of carnivorous to herbivorous dinosaurs in the following Periods?

a) Early Jurassic
1:0

b) Late Jurassic
0:2

c) Early Creataceous
1:3

d) Late Creataceous
5:7

Question 5

During which Period(s) do you think there was an abundance of vegetation? Why?

Late Cretaceous – seven Herbivores, dinosaurs that only eat vegetation.

Question 6

Can you determine which dinosaur was the top predator (carnivore) in the Late Cretaceous? Explain how you reached your conclusion.

From the data one can only surmise the answer to this question. By size, Daspletosaurus was the largest carnivore, but size alone cannot tell us who was the top predator. Others, such as Hygraphus, may have been more successful or voracious.

Question 7

If you were a scientist, what would your next step be in researching the ancient environment and inhabitants of GSENM?

Answers will vary, but a good next step would be to research the other fossils found in the same rock strata as the dinosaurs to learn more about vegetation and therefore the environment. More research into what is known about each of the dinosaurs would also yield better information on how they ate. Science is ongoing. This is only a starting point for future investigations.

Vocabulary

Carnivore	An animal that eats other animals
Era	A division of geologic time composed of Periods
Geologic Time Line	Time line developed by geologists and other scientists to describe the timing and relationships between events that have occurred during the history of the Earth
Herbivore	An animal that feeds on plants
Omnivore	An animal that feeds on both plants and animals
Period	A division of a geologic Era
Terrestrial	Land based, as opposed to aquatic or atmospheric

Dinosaur Data Cards

Genus: Geologic Period: Time span (mya): Diet: Size:	Genus: Geologic Period: Time span (mya): Diet: Size:
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