

Activity: Make a mid-Cretaceous Paleogeographic Map

This activity is a **worksheet/educational** part of the **COLORADO PLATEAU DINOSAUR PROGRAM FOR EDUCATIONAL GROUP TOURS**

Activity owner: (the person who designed the activity and/or is responsible for its maintenance):
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Date: This activity was developed November 2010. Contents in this document were approved by Dr. David D. Gillette, Colbert Curator of Vertebrate Paleontology, MNA.

Key messages of the activity:

- Children will learn the following information from this program:
 - Many dinosaurs lived on the Colorado Plateau
 - We find evidence of dinosaurs in various types of rocks
 - Review the information on “Suggestions for Teachers” sheet located in the Paleo map box.
 - Paleontologists study forms of life existing in prehistoric or geologic times, as represented by the fossils of plants, animals, and other organisms.
www.mypursuit.com/careers-99-0059.00/Paleontologist.html
 - A geologist studies land formations/rocks
 - Fossils are not only dinosaur bones but can be shells, plants, insects, teeth and bones of other animals. www.fossilsforkids.com/Website_Directory.html
 - How fossils are formed. <http://www.scienceclarified.com/Ex-Ga/Fossil-and-Fossilization.html>

Intended audiences: (list age ranges)

- Age 9 or fourth grade is the youngest. This activity can be used with older students.
- Ideal group size is 10-15 children

Props or articles needed: (complete list of all things needed to do this activity)

- One Paleogeographic Map of the Southwestern United States Mid-Cretaceous Period per student
- Identical sets of four-colored pencils per student
- Rock samples

Where props are located in the museum: (list which closets and/or benches, etc articles are kept in)

- Paleogeographic maps and rock samples are kept in a box in the docent closet near Branigar Chase
- Colored pencils and a pencil sharpener are in Ethnology docent closet.

Set up instructions: (list complete instructions in detail, so that a docent new to this activity understands how to prepare)

- This is best done on tables set up in a U-shape. Children can work in pairs, but should each color their own sheet.

Set up time: (approximate minutes to complete the set up as per instructions above)

- Allow 20 minutes

Minimum number of docents: (state the number of docents needed; this may be based on age group, number of parents or adults accompanying children, type of group, amount of time the group will spend at the museum)

- One docent for every 10-15 children (two docents would be better)
- Utilize parent/chaperones when possible

Best places within the museum to hold the activity: (are there certain galleries that lend themselves better to this activity?)

- This activity can take place in Branigar Chase or outside on the picnic tables.
- Tables can be set up in Ethnology as an alternative.

Activity time: 25 minutes

Activity details: (This is an outline of how to facilitate the activity; it should be complete enough to allow any docent to execute it. Provide hints, alternative ways of doing the activity, how to alter the activity for different age groups. The activity should be repeatable and trainable and not dependent on certain docents to run it.)

- Introduce yourself and any docents who are assisting
- If this has not already been done, ask a few questions to determine what they know about dinosaurs
- Ask questions about what they learned during the tour they took in the museum or from any other activity done in tandem with this activity
- Explain to them they are experienced geologists who have been traveling and researching throughout the Southwestern United States
- Have them put their name on their paper.
- Focus their attention on the following features: the four corner intersection on the map, the location of Flagstaff, and the legend
- Choose one color of pencil and identify the rock type, animal and the land form in which these would be found and have them color in the legend. Pass the rock type around.
- Repeat this activity for each region, using a different colored pencil for each.
- **Note: there are further directions on the back of the map**
- Circulate among the tables to see if anyone needs assistance
- It takes about 25 minutes for them to complete this activity
- Discuss their results and what they learned from this activity

Short cuts: (state what areas can be eliminated or shortened & still keep the key message if the docent is pressed for time)

- Completing the legend is the important part. They can color in the map back in the classroom

Cultural sensitivities to consider:

- None

Clean up of props, etc.: (Provide precise instructions for how to dismantle displays, how to clean and store materials)

dgillette 10/18/10 1:30 PM

Comment: I assume this paper is an uncolored map of the mid-Cretaceous of the Southwest, showing the Western Interior Seaway. Do students of this age know the map of the modern Southwest, and understand that this area today is all above sea level and consists of mountains, plateaus, valleys, and canyons? Is that something they could do in school, before coming to MNA?

As a courtesy to other docents, please put all props and articles exactly where you found them.

- Return any extra sheets and the rocks to the closet near Branigar Chase
- Return the colored pencils and pencil sharpener to Ethnology closet

Estimated time to clean up:

- 10 minutes

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Suggestions For Teachers

Getting Pupils Started

There are several ways for students to get started on the map. The simplest is for the students to discuss and determine which symbols are the most typical of each province (e.g., sandstone & cycads (palm trees) for coastal plains, shale or oysters for shallow sea, limestone for deep sea, and metamorphics or conglomerates for uplands). The students can then color each of those symbols in their appropriate chosen legend colors, and fill in between them afterwards.

Older students may be able to start by drawing lines between the key symbols (i.e., draw the shoreline, the mountain front, etc.) and then fill in the colors later.

Further Discussion Points

- Can you locate (or mark) Arizona on the map? The city of Flagstaff? Phoenix? Other states and cities?
- Discuss what the area around Flagstaff looked like in the Mid-Cretaceous Period. What about the area around Phoenix? Denver?
- What difference do you see between the western sea and the eastern (continental) sea? (Note difference in slope). Why do you think there is this difference? (Note: at this time, the continent, with its entire center covered by a shallow sea, was moving west into the ancestral Pacific Ocean and colliding with island arcs there).
- Discuss possible causes for the shallow sea covering the center of the continent (e.g., sinking of the continent, displacement of ocean water by uplift there, volume of available water, etc.).
- Where do you think would be the best area to search for fossil remains – the uplands or the coastal plain – and why? What about the marine environment?
- Discuss how plant and animal remains might be trapped in each of the environments.
- There were coastal plain deposits laid down in the Flagstaff area in the Mid-Cretaceous: probably river, swamp and beach deposits, as well as volcanic ash from mountains to the west. (The San Francisco Peaks did not yet exist). Today the youngest sedimentary rocks in the area are older than Cretaceous – the red-brown Triassic Moenkopi sandstones and shales seen along the north side of US 66 east of downtown. What happened to the rocks laid down during the Cretaceous? Discuss the effects of uplift and erosion.



Museum of Northern Arizona

Activity: Make A Mid-Cretaceous Paleogeographic Map

You are a geologist who has the task of making a paleogeographic ("ancient geography") map of the Southwestern United States. After several years of researching and traveling around the area, you have compiled the attached data map of rocks and fossils from the Mid-Cretaceous time period. Each symbol on the map represents either a certain rock type (sandstone & siltstone, shale & mudstone, limestone, conglomerate or metamorphics & volcanics), or the fossil remains of a land animal (various dinosaurs) or a marine animal (elasmosaur, plesiosaur, shark, cephalopod or bivalve) of the period. The symbols are plotted on the map in the geographic position in which they were found.

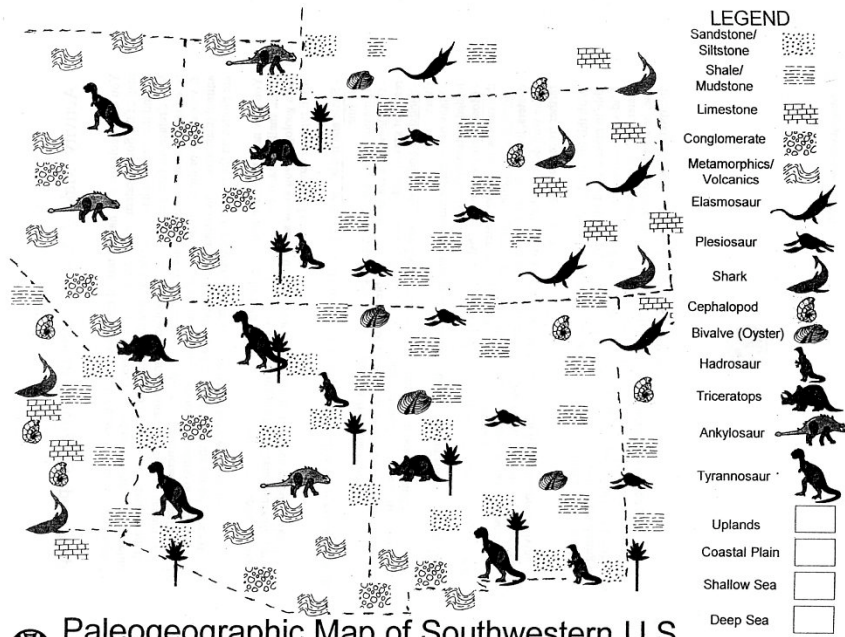
You now need to outline and color the four major geographic provinces (uplands, coastal plain, shallow sea, deep sea) existing in this area during the Mid-Cretaceous time period. As a geologist, you know some things about the conditions in which certain rocks and fossil types are found. To review:

- Shale and mudstone are frequently formed in swamps and shallow water below the high tide line
- Limestone is usually found in deeper calmer water, far from the shoreline
- Conglomerates are created by the breakup of larger chunks of rock, with deposition as a result of gravity slides aided by water; they are usually deposited close to their source
- Sandstone and siltstone are found in desert environments, in beaches and in or near rivers
- Many of the major mountain chains are created either by vulcanism or by the uplift of folded metamorphic rocks
- Most marine vertebrates (fish and reptiles) live in the upper 100 feet of the ocean, but this may be in shallow water or in the upper part of the deep sea
- Some marine shelled animals, especially those with strong shells such as clams and oysters, live on the sea bottom near the shore in shallow or tidal waters; others, especially those with delicate shells such as cephalopods, float or swim freely and prefer living farther from the rough shore environment *cuttle fish, squid, octopus, nautilus*

With this knowledge, the attached data map, and a few colored pencils, you should be able to make a good approximation of the geography in the southwestern US during the Mid-Cretaceous. (Usually, a dark blue color is used for deep water, light blue for shallow water, yellow or tan for coastal plain, and brown for the uplands. Whatever colors you use, be sure to indicate them on the map legend). And don't forget to sign your interpretation with your name. Good luck, geologist!



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 **Paleogeographic Map of Southwestern U.S.**
Mid-Cretaceous Period

GEOLOGIST: