

Name: \_\_\_\_\_

GEOL 104 Dinosaurs: A Natural History

Smithsonian Assignment II: Mesozoic Marine Life and the Cenozoic Era

**DUE: December 4**

The Smithsonian Institution's National Museum of Natural History (NMNH) has one of the largest collections of dinosaur and other fossils in the world. This exercise will concentrate on the wonderful dinosaur fossils on exhibit.

The Smithsonian museums are free; hours for the NMNH are 10 am to 5:30 pm 7 days a week. You can take the Metro from the College Park Station to any of a number of stations near the Museum. The quickest route is the Green Line from the UMD-College Park Station to Archives/Navy Memorial: you don't have to change trains, and the NMNH is just on the other side of the Archives Building.

For this exercise you may wish to bring along the dinosaur cladograms handed out in class. You may work in teams and discuss your answers; however **ALL WORK YOU TURN IN MUST BE YOUR OWN**. To comply with University Senate regulations, please sign the following so that you may receive credit for this assignment.

I pledge on my honor that I have not given or received any unauthorized assistance on this assignment

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Signature

UID

Date

This package works as sort of a self-guided tour. It will start you at the Mesozoic section of the Life in the Ancient Seas Hall, and then take you into the Hall of Fossil Mammals and Hall of Ice Age Mammals to get a glimpse at life after the Age of the Dinosaurs.

Some things to keep in mind:

- Remember proper handwritten taxonomic grammar:
  - **Genera** have one-word, capitalized, and underlined names:
    - Examples: Giganotosaurus Brachiosaurus
  - **Species** have two-word, underlined names; the first part of the name (which is the same as the genus name) is capitalized, but the second part of the name is not:
    - Examples: Giganotosaurus carolinii Brachiosaurus altithorax
- When given a choice of items in bracket, **circle** the appropriate answer.

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## PART I – SANT OCEAN HALL

The newest major hall at the Smithsonian is the Sant Ocean Hall. It is directly opposite the main entrance to the museum—beyond the elephant—on the first floor. The Ocean Hall has a big central concourse that concentrates on ocean life, a right hand path that focuses on environments and human interactions, and a left hand path about fossil marine life. Head over to that left hand path, and we'll explore some issues about Mesozoic and Cenozoic marine life and the Cretaceous/Paleogene extinction event.

Down the middle of the fossil marine life section are a set of free-standing displays. Find the one of these labeled “A Reef Built by Clams”. This exhibit concentrates on rudists, a group of extinct clams that were the major reef-builders in the Cretaceous seas. There are two major groups of rudists described, characterized by the different way they grow: **uprights** and **recliners**.

- 1) Which mode of growth does *Titanosarcolites* sp. show? [ upright | recliner ]
- 2) Which mode of growth does *Parastroma sanchezi* show? [ upright | recliner ]

The long wall of the fossil section, labeled “Global Vanishing Acts”, discusses two great mass extinctions: the Permo-Triassic extinction and the Cretaceous-Paleogene extinction. We will focus on the Cretaceous-Paleogene extinction: find the section labeled “The Sky is Falling!”, and specifically the part that says “How Do We Know?” On display are models of two deep sea cores that sample sediments from before, during, and after the Cretaceous-Paleogene extinction.

- 3) Where was the ODP Site 1049 core drilled? \_\_\_\_\_
- 4) Where was the ODP Site 1259 core drilled? \_\_\_\_\_

The exhibit describes the changes in the foraminiferans (armored amoeba-like single-celled organisms) over the event.

- 5) The average size of foraminiferans just after the extinction were [ smaller | the same size | larger ] than those before.
- 6) The number of species of foraminiferans just after the extinction was [ fewer | the same | greater ] than those before the extinction.

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The core also contains non-fossil geological materials that record the impact of the asteroid in the Yucatán. Two types of materials are present in these cores (one is found in both cores, on only shown in ODP 1049).

7) List one of these non-fossil geologic records of the impact:

Extra Credit) List the other of these non-fossil geologic records of the impact:

Find the section labeled “Survivors”.

8) What ecological types (that is, ways of life) does it say were among the better survivors in the sea?

Turn around and find the section labeled “The Evolution of the Whale”. Look up to find the skeletons of *Maiacetus inuus*, *Dorodon atrox*, and *Basilosaurus cetoides*: primitive whales from the early part of the Cenozoic Era. Of these three, *Maiacetus* is the oldest and the most primitive, *Dorodon* is the intermediate, and *Basilosaurus* is the closest to modern whales (although it is still far more primitive than any living whale).

9) Over their early history, whales [ decreased | remained the same size | increased ] in size.

10) Over their early history, the size of the hindlimb of whales [ decreased | remained the same size | increased ].

11) In which of these genera is the pelvic girdle still attached to the vertebral column?

## PART II – MESOZOIC MARINE LIFE

Go back out to the central rotunda of the museum (with the elephant), and go into the Hall of Ancient Life in the Seas. This hall as a whole documents marine vertebrate, invertebrate, and plant life throughout the last 542 million years with fossils, a great mural, and some life restoration models hanging about. Go through the Paleozoic Era section and make your way to the Mesozoic fossils (that is, go underneath the sign labeled “Act Two – The Mesozoic Era”). The particular section you are in contains exhibits on the marine life of the Age of Dinosaurs.

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Find the Mesozoic marine reptiles. These are mounted in front of or directly below the mural (and a few are in glass cases along the rail). Match the letter of the description to the species of marine reptile on display that it best describes.

- |  |       |   |
|--|-------|---|
| 12) <i>Protostega gigas</i>            | _____ | A. Long tail and snake-like body, huge skull with conical teeth     |
| 13) <i>Stenopterygius quadrissicus</i> | _____ | B. Toothed beak, reduced forelimbs, powerful hindlimbs              |
| 14) <i>Dolichorhynchops osborni</i>    | _____ | C. Leathery shell, toothless beak, paddle-shaped limbs              |
| 15) <i>Tylosaurus proriger</i>         | _____ | D. Huge eyes, front paddles much larger than hind                   |
| 16) <i>Hesperornis regalis</i>         | _____ | E. Long skull with conical teeth, paddle-shaped limbs all same size |

Extra Credit) Which of these is technically a member of Dinosauria?

The seas of the Mesozoic, like those of today, had diverse types of “shellfish” (invertebrates). Many examples are on display: some along the wall with the main mural, others in the center “island”, and still others on their own display labeled “Taking Cover” on the wall opposite from the main mural.

In the center island, facing the marine reptiles, is an exhibit about ammonites (extinct relatives of the modern octopi, squids, and nautili.) Some ammonites have **straight** shells, many have shells coiled in a **disc** (like a Frisbee or donut), still others have more **complex coiled** patterns (i.e., not simply circular or along a single plane).

17) *Sphenodiscus lenticularis* had a [ straight | disc-shaped | complex coiled ] shell.

18) *Baculites compressus* had a [ straight | disc-shaped | complex coiled ] shell.

19) *Cirroceraus stevensoni* had a [ straight | disc-shaped | complex coiled ] shell.

Find the display labeled “Taking Cover”. On the top of this section are many excellent fossils, such as several enormous ammonites and a specimen of the scallop-relative *Inoceramus*.

20) The *Inoceramus* shown here is approximately the size of [ a quarter | a dinner plate | a welcome mat ].

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### PART III – LIFE AFTER THE AGE OF DINOSAURS

Now you'll be heading to the fossil mammal halls. Move down the Hall of Ancient Life in the Seas into the next section ("Act Three – The Cenozoic Era"), and take a right up the steps labeled "Reptiles: Masters of the Land". Go left under the "Fossil Lab" sign. Turn right (the only option), and then turn left again. You should be facing the entrance to the Hall of Fossil Mammals, with a sign labeled "Mammals in the Limelight".

Find the wonderful mounted skeleton of *Hyracotherium vasacciensis*.

21) *Hyracotherium vasacciensis* is a member of what modern family of mammals?

Now head over to the start of the hall, past the "Plants in the Age of Mammals" display, to a glass case display of Mesozoic mammals. In general, as you follow the Hall of Fossil Mammals along you proceed upwards in time, tracing the history of North American mammals, other animals, and their environments through the Cenozoic Era. Each exhibit is organized by Epochs. Cenozoic Epoch names are different from those in the rest of geologic time: instead of being in the form "Late Jurassic Epoch" or "Early Permian Epoch", each is given a unique name. From oldest to youngest, they are the Paleocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene, and Holocene (or Recent). The last two Epochs are part of the Quaternary Period, and have a hall of their own (the Hall of Ice Age Mammals). The rest are the old "Tertiary Period," (now broken into the Paleogene and Neogene Periods) and represent the exhibits in the main Hall of Fossil Mammals.

Compare the actual fossils (not the enlarged white models) of Mesozoic mammals with those of the Paleocene mammals.

22) Compared to Mesozoic mammals, the largest Paleocene ones [ decreased | remained the same size | increased ] in size.

23) What part of the body is most represented in the Paleocene mammals on display here?

The rest of the Tertiary is organized with a series of paintings in the back and the actual fossils and casts of fossils arrayed in front. Start with the Eocene exhibit.

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In the glass cases are many specimens from the Green River Shale, a famous fossil locality. Many types of organisms have been recovered from these rocks. Indicate the group of organism represented Green River Shale fossils listed below:

24) *Primobucco mcgrewi* [ plant | fish | bird ]

25) *Mioplasmus labracoides* [ plant | fish | bird ]

26) *Platanus wyomingensis* [ plant | fish | bird ]

27) From the types of fossils and the descriptions provided, how was the **non-living** environment of Eocene Wyoming different from the current environment of the “Cowboy State”?

28) The biggest animal in the main Eocene display is *Uintatherium anceps*, a horned quadrupedal herbivorous mammal. What feature of the dentition (teeth) of *Uintatherium* appears to be unusual for a typical plant-eater?

29) Does it appear that *Uintatherium* could feed relatively high in trees (the way that sauropods and hadrosaurids could)? Why or why not?

Continue along the Eocene display. Rank the following animals in size (by “Largest”, “Medium”, and “Smallest”):

30) *Diatryma* (a bird) [ largest | medium | smallest ]

31) *Smilodectes* (a primate) [ largest | medium | smallest ]

32) *Hyrachyus* (a rhinoceros-relative) [ largest | medium | smallest ]

Move on to the “Oligocene” Epoch exhibits (which are actually mostly latest Eocene Epoch animals, by more recent geologic time studies).

33) *Brontotherium hatcheri* is the largest animal on display here. It was a

[ bipedal carnivore | quadrupedal carnivore | bipedal herbivore | quadrupedal herbivore ].

Name: \_\_\_\_\_

Find the following “Oligocene” species and indicate the group to which it belongs. The options include:

**dog**    **cat**    **rhino**    **horse**    **tortoise**       **lizard**    **bird**    **oreodont** (extinct herbivorous mammal)

34) *Merycoiodon culbertsoni* \_\_\_\_\_

35) *Hesperocyon gregarius* \_\_\_\_\_

36) *Trigoniis osborni* \_\_\_\_\_

Turn around, and find the vertical burrow with the skeleton at the end. The burrower is the rodent *Paleocastor fossor*.

37) To what group of rodents does *Paleocastor fossor* belong? \_\_\_\_\_

Head on over to the Miocene Epoch exhibit. Find the following “Oligocene” species and indicate the group to which it belongs. The options include:

**rhino**    **horse**    **camel**    **chalicothere** (extinct herbivorous mammal)    **oreodont** (extinct herbivorous mammal)

38) *Moropus elatus* \_\_\_\_\_

39) *Parahippus tyleri* \_\_\_\_\_

40) *Promerycochoerus superbis* \_\_\_\_\_

41) *Stenomylus hitchcocki* \_\_\_\_\_

Turn around and find out about the evolution of the horse at the exhibit “Evolution: Browsers to Grazers”.

(Incidentally, the Smithsonian has an excellent collection of fossil horses). Over the history of equids (horses) many aspects of their anatomy change. They represent one of our best records of **correlated progression**. Indicate how each of the following attributes of horses changed over time.

42) Overall size                            [ increased | remained the same | decreased ]

43) Number of toes                        [ increased | remained the same | decreased ]

44) Relative length of leg                [ increased | remained the same | decreased ]

45) Depth of jaw                            [ increased | remained the same | decreased ]

46) Height of teeth                         [ increased | remained the same | decreased ]

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Look at the Late Miocene-Early Pliocene Epoch display. The largest mammal here is *Stegomastodon mirificus*.

47) To what **living** animal group is *Stegomastodon* most closely related?

[ rhinos | horses | elephants | humans | hippos ]

48) What evidence can you see that the rhinocerotoid *Teleoceras fossiger* was not a fast running animal?

Move into the Hall of Ice Age Mammals. As you enter, there is an exhibit of some odd mammals off to your left.

Find the pair of skeletons of the giant ground sloth *Eremotherium rusconii*.

49) Could this animal have browsed from tree branches as well as from the ground? If so, how?

Just as the dinosaurs produced the ankylosaurs, the mammals produced their own heavily armored forms: the glyptodonts. On display is the glyptodont *Glyptotherium arizonae*. Like the ankylosaurs, glyptodonts were herbivores.

50) Why might heavily armored animals like ankylosaurs and glyptodonts not make effective predators?

51) Could the shell of *Glyptotherium* and other glyptodonts fold up into a ball the way a modern armadillo's shell (also on display) can? If so, how can you tell? If not, why not?

Turn around, and look at the fossils from Rancho La Brea (the famous La Brea Tar Pits) in the exhibit "Fossils and Tar Pits". There are two species of carnivorous mammal here, threatening the ground sloth *Paramylodon harlani*.

Give the **species name** for the carnivorous mammals on display:

52) Dire wolf:

53) Sabre-toothed cat:



Name: \_\_\_\_\_

54) These Ice Age predators are [ much smaller | about the same size as | much larger than ] *Tyrannosaurus rex*.

55) The large bird *Teratornis merriami* was a(n) [ herbivore | carnivore ].

56) According to the display, carnivores make up about \_\_\_\_\_% of the large mammals in the La Brea Tar Pits.

57) According to the display, what is the likely explanation that so many carnivorous animals are found in the tar pits?

Further down in the Ice Age Mammal Hall are fossils of northern mammals. The largest of these is *Mammuthus primigenius* (the woolly mammoth).

58) Where was this particular composite skeleton of *Mammuthus primigenius* found?

Go to the skeleton of *Mammut americanum* (the mastodon). In front of it are the teeth of *Mammut* and *Mammuthus* that you can touch.

59) The teeth of [ the mastodon *Mammut* | the mammoth *Mammuthus* ] were better adapted for chewing, while the other one was better adapted for grazing and grinding.

Find the “mummy” of the extinct bison *Bison crassicornus* on display.

60) In dinosaur “mummies” the actual skin is not preserved, only the impression of the skin. In the case of this bison, however, actually soft tissue was freeze-dried. What sort of particular tissues were found that are not normally preserved in typical fossils?

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Consider that the animals in the main section of this hall were living in North America when humans first entered the continent 13,000 years ago (in some cases, they actually arrived at the same time). Just a short time ago (geologically speaking), America's wildlife was at least as spectacular as that of the modern Serengeti Plain.

There are some non-American fossil animals on display in this room, in a rotunda. Find these, and indicate what genus represents each of the following groups

61) Bird: \_\_\_\_\_

62) Marsupial: \_\_\_\_\_

63) Deer: \_\_\_\_\_

Extra Credit) Which of those three was a dinosaur?

That's it for this trip! While you are in the museum, use your time to examine some of the other exhibits.