Name:_____

GEOL 104 Dinosaurs: A Natural History
Smithsonian Assignment

DUE ONLINE: November 11

"Every man is a valuable member of society who by his observations, researches, and experiments procures knowledge for men."

-James Smithson (1765-1829), a British natural historian whose legacy of over $500,000 was given to the government of the United States of America for the creation of "an Establishment for the increase and diffusion of knowledge": the Smithsonian Institution.

The Smithsonian Institution's National Museum of Natural History (NMNH) has one of the largest collections of dinosaur and other fossils in the world. 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/Penn Quarter: 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 anatomy sheets available on ELMS. You may work in teams and discuss your answers; however, **ALL WORK YOU TURN IN MUST BE YOUR OWN**. (I have caught and reported a number of students in the past you have cheated by copying each other's work: please don't make me do that again…). To comply with University Senate regulations, this assignment is covered by the University's Honor Code: I pledge on my honor that I have not given or received any unauthorized assistance on this assignment

NOTE: Use your OWN OBSERVATIONS in order to answer the questions.

ALSO NOTE: This assignment requires knowledge from the course as well as from the exhibits. Not all the answers are indicated on museum signs or the like; you have to use your knowledge from GEOL104 to answer them.

The assignment itself is basically a long extended ELMS quiz: you will eventually go onto ELMS and select your answers or type them in, just as you would in a quiz. You can print out this pdf or have it on your smartphone/tablet or whatever as you go along. Either take notes of the answers and enter them later, or (if you have a good enough connection) you can input the answers directly into ELMS.

The entire East Wing First Floor of the National Museum of Natural History was dedicated to fossil life, the brand-new (opened in June 2019) David H. Koch Hall of Fossils – Deep Time. This project takes you there eventually, but you will start on the 2nd Floor, looking at the Osteology ("Hall of Bones") hall. Then you'll move

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down to the 1st floor to look at fossils from the Sant Ocean Hall on the First Floor. From there, you will be guided to the "real" beginning of the Deep Time hall (which is NOT the entrance from the museum Rotunda!)

PART I – OSTEOLOGY

For this exercise, you will probably find the anatomy sheets available on ELMS and the website a useful guide in identifying the homologous bones in these different animals.

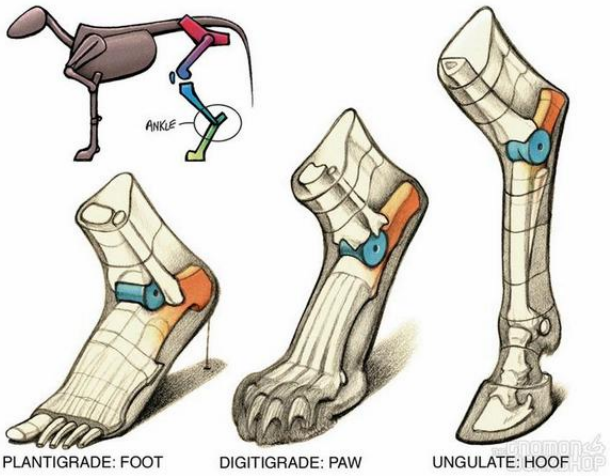
In order to better understand the dinosaurs, we first have to understand the anatomy, behavior, and ecology of modern vertebrates. The Smithsonian's Osteology ("Bones") Hall gives us an excellent opportunity for comparison. We do know a lot more about modern animals (their complete anatomy, including soft tissue; their behavior; their physiology; etc.) than we do about extinct creatures, so that way we can better tell when a particular skeletal structure matches a particular behavior or function. We can then take this information and apply it to extinct creatures, like the dinosaurs of the Mesozoic.

Go to the second floor of the museum and enter into the hall labeled "Bones/Reptiles/Insect Zoo". This is one of the older halls, but it contains a lot of useful specimens and information. This packet works best if you enter the hall from the Rotunda end.

Biologists use the following terms to describe the foot posture of different vertebrates:

- **Plantigrade**: The animal stands and walks with the unguals, other digits, and metacarpals and metatarsals all touching the ground ("flat-footed")
- **Digitigrade**: The animal stands and walks with the unguals and other digits touching the ground, but the metacarpals and metatarsals held up
- **Unguligrade**: The animal stands and walks only on the unguals ("tip-toes"), and the other digits and metacarpals and metatarsals are held up

Here is a graphic showing these foot postures, showing (from left to right) plantigrade, digitigrade, and unguligrade:



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Opposite the entrance is a set of skeletons of apes and a human. Take a look at the human foot.

1) Humans have a(n) [plantigrade | digitigrade | unguligrade] pes.

We'll compare our foot to other mammals when we get into the main room.

Move along and find the panel about bats. Find the skeleton of *Pteropus samoensis* (the Samoan flying fox).

2) How many digits does *Pteropus samoensis* have in its **manus**? [0 | 1 | 2 | 3 | 4 | 5 | 6 | 7]

A little further along (and above your heads) is the skeleton of the La Plata dolphin (*Pontoporia blainvillei*).

3) Which of the following best describes the teeth of *Pontoporia blainvillei*?

a. Undifferentiated (essentially the same shape from the front of the jaws to the back, although maybe different in size)
b. Differentiated (teeth of very different shapes in different parts of the jaw)

Walk into the main mammal room and look around a bit. See some of the wonderful diversity of living (and a very recently extinct) members of Mammalia. Now find the primates exhibit, and specifically the proboscis monkey (*Nasalis larvatus*).

4) Which of the following best describes the teeth of *Nasalis larvatus*?

a. Undifferentiated (essentially the same shape from the front of the jaws to the back, although maybe different in size)
b. Differentiated (teeth of very different shapes in different parts of the jaw)

Now find the skeleton of the pronghorn (*Antilocapra americana*).

5) How many teeth are there in each **premaxilla** (identify it by using the suture lines in the skull) in *Antilocapra americana*? [0 | 1 | 2 | 3 | 4 | 5 | 6 | 7]

6) Which of the best describes the **lower jaw** of *Antilocapra americana?*

a. Continuous teeth from the front to back
b. Teeth only present in the front
c. Teeth only present in the back
d. Nipping teeth present in the front, a diastema (a space without teeth), and then grinding teeth in back

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Find the skeleton of the bison (*Bison bison*)

7) Can you see the horns in this particular skeleton? [Yes | No]

8) Like most of the bigger mammals in this exhibit (those a quarter your size or larger), the femur of *Bison* is oriented [parasagittally | sprawling out to the side].

Find the skeleton of the Indian rhino *Rhinoceros unicornis*.

9) How many **cervical** (neck) vertebrae does *Rhinoceros* have (**note**: cervicals do not have ribs)?

[3 | 4 | 5 | 6 | 7 | 8 | 9 | 10]

Now go opposite side of the passage and find the skeleton of the giraffe *Giraffa camelopardalis*.

10) How many **cervical** (neck) vertebrae does *Giraffa* have?

[3 | 4 | 5 | 6 | 7 | 8 | 9 | 10]

11—Extra Credit) List a feature that would allow *Giraffa* to feed higher in the trees than *Rhinoceros*:

Different animals have different locomotory (moving) habits. Some are fast running specialists (**cursorial**), some are slow plodders (**graviportal**), and many are intermediate. The common zebra (*Equus burchelli*) is a cursor, while its close relative the tapir (*Tapirus bairdi*) is slower, even though both animals are about as long from the back of the neck to the end of the hips (i.e., the butt).

Compare *Equus* to *Tapirus*.

12) The **limbs** of cursors (*Equus*) are [proportionately longer | proportionately shorter] than their less cursorial relatives (*Tapirus*).

13) The **pes** (all the metatarsals plus the toes) of *Equus* is [more slender | much broader] than its less cursorial relative *Tapirus*.

14) Review the different types of foot posture, and indicate if the following mammals are **plantigrade**, **digitigrade**, or **unguligrade**. We will only look at the **pes** and ignore the manus for this. [6 pts total]

Coatimundi (*Nasua nasua*)	[plantigrade | digitigrade | unguligrade]
Mandrill (*Mandrillus sphinx*)	[plantigrade | digitigrade | unguligrade]
Bison (*Bison bison*)	[plantigrade | digitigrade | unguligrade]
Tiger (*Panthera tigris*)	[plantigrade | digitigrade | unguligrade]
Indian rhinoceros (*Rhinoceros unicornis*)	[plantigrade | digitigrade | unguligrade]
Bighorn sheep (*Ovis canadensis*)	[plantigrade | digitigrade | unguligrade]

Pass through the circular chamber that discusses the biology of bone into the bird hall.

Name:_____

Find the section on "Running Birds", and the skeleton of the rhea (*Rhea americana*).

15) The **unguals** are

a. slender and highly curved, like hooks
b. flat on the bottom and straight, like a wedge

16) The **penultimate phalanx** (that is, the one immediate proximal to the ungual) is:

a. as long or longer the other, even more proximal phalanges
b. shorter than the other, even more proximal phalanges

Find the section on "Arboreal Birds", and the skeleton of the pileated woodpecker (*Dryocopus pileatus*).

17) The **unguals** are

c. slender and highly curved, like hooks
d. flat on the bottom and straight, like a wedge

18) The **penultimate phalanx** (that is, the one immediate proximal to the ungual) is:

c. as long or longer the other, even more proximal phalanges
d. shorter than the other, even more proximal phalanges

Find the section on "Aquatic Birds" (right next to the giant leatherback sea turtle *Dermochelys coriacea coriacea*. Find the African penguin (also called the black-footed or jackass penguin) species *Spheniscus demersus* and the common loon *Gavia immer*. The **sclerotic ring** is a series of small platy bones that wrap around the eyeball: this gives you a darn good idea of which opening is the orbit! The naris (nostril opening) is the long slit-like opening on the beak.

19) *Gavia* and *Spheniscus* [do | do not] have an **antorbital fenestra** (an opening on each side of the face between the orbit and the naris).

Both loons and penguins are excellent swimmers, but they swim in different fashions. Use the anatomy of these two species to identify which is a **wing-propelled diver** (that pushes the water along with its wings) and which is a **foot-propelled diver** (that gets most of its propulsion from kicking with its feet).

20) Wing-propelled diver: shorter but strong wing bones; relatively short hindlimbs; feet not necessarily broad:

[*Gavia* | *Spheniscus*]

21) Foot-propelled diver: relatively long hindlimbs; toes long to spread out to form a broad paddling surface:

[*Gavia* | *Spheniscus*]

Name:_____

Move on into the Reptile & Amphibian room. Compare the manus of the leatherback turtle (*Dermochelys coriacea coriacea*) and the Galápagos tortoise (*Geochelone elephantopus*).

22) Which has **long phalanges forming a broad flat surface**? [*Dermochelys* | *Geochelone*]
23) Which has **short stubby phalanges forming compact foot**? [*Dermochelys* | *Geochelone*]

Find the section on snakes, and specifically the Eastern diamondback rattlesnake (*Crotalus adamanteus*). People sometimes think that snakes either don't have tails, or are basically all tails. In animals with legs this isn't a problem, but some people get confused by the legless modern snakes. But there is a distinction between the torso (with dorsal and sacral vertebrae) and the tail (with caudal vertebrae). In life you can look for soft tissues (including the anus, at the point where the tail begins) to distinguish the sections, but you can do so with bones, too. For instance, dorsal and sacral vertebrae have true ribs, but caudals do not. Also, there are often distinction in the shape and size between the (normally larger) torso vertebrae and the (normally smaller) caudal ones.

24) Look at the *Crotalus* skeleton. Which of the following is true?

a. The body is mostly torso, with a much shorter tail.
b. The body is mostly tail, with much shorter torso.
c. The body is about equal parts torso and tail.

Find the crocodilian skeletons. In particular, find the gavial (*Gavialis gangeticus*), and the black caiman (*Melanosuchus niger*).

Compare the skulls of *Melanosuchus* and *Gavialis*.
25) Which genus has a **slender narrow snout and needle-like teeth** (and thus is specialized for catching relatively small fish)? [*Melanosuchus* | *Gavialis*]

26) Which genus has a **broader snout and stouter conical teeth** (and thus is specialized for catching fish of all sizes, and land vertebrates as well)? [*Melanosuchus* | *Gavialis*]

27) Nearly all modern lizards and crocodilians share the same foot posture. Take a look at the **pes** of *Gavialis*. Which posture does it show? [plantigrade | digitigrade | unguligrade]

28) Which best describes the **resting stance of the hindlimb** shown in the crocodilians?

a. Parasagittal (upright)
b. Sprawling

Name:_____

From this point you should head back to the 1st floor and enter the Sant Ocean Hall.

PART II – PALEONTOLOGY IN THE SANT OCEAN HALL

The Sant Ocean Hall 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. But first, let's take a look at the history of fossil apex predators, in the exhibit "Who's On Top?" Use the data provided by this exhibit to answer the next set of questions.

29) Match the letter of the group of apex predator to the time period in which they were dominant. [5 pts total]

100-65 Ma	_____	A. Anomalocariidids
299-251 Ma	_____	B. Eurypterids
416-359 Ma	_____	C. Helicoprionids
444-416 Ma	_____	D. Mosasauroids
542-488 Ma	_____	E. Placoderms

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**.

30) Which mode of growth does *Titanosarcolites* sp. show? [upright | recliner]

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

32) The average **size** of foraminiferans just **after the extinction** were [smaller | the same size | larger] than those before.

Name:_____

33) The **number of species** of foraminferans just **after the extinction** was [fewer | the same | greater] than those before the extinction.

34) Find the section labeled "Who Lives? Who Dies?" Indicate which of the species listed below was a "Victim" or a "Survivor". [4 pts total]

Lahilla larseni	[Victim | Survivor]	*Belemnites densus*	[Victim | Survivor]
Baculites corrugatus	[Victim | Survivor]	*Seriola prisca*	[Victim | Survivor]

Turn around and find the section labeled "The Evolution of the Whale". Whales are placental mammals; in fact, they are the aquatic descendants of terrestrial mammals related to the modern hippopotamus. Look up to find the skeletons of *Maiacetus inuus*, *Dorudon 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, *Dorudon* is the intermediate, and *Basilosaurus* is the closest to modern whales (although it is still far more primitive than any living whale).

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

36) Over their early history, the **size of the hindlimb** of whales

[decreased | remained the same size | increased].

37—Extra Credit) In which of these genera is the **pelvic girdle still attached** to the vertebral column?

[*Maiacetus* | *Dorudon* | *Basilosaurus*]

Now head to the far end of the Sant Ocean Hall, and take a right. Head towards and through the African Voices hall: if you are interested in cultures and history of Africa, make sure you come back to look at it in detail. But for now, head to the Fossil Lab of the Deep Time hall.

PART III – DEEP TIME HALL

This is the newest major hall of the National Museum of Natural History. The main part of the hall is a walk through geologic time, looking at the diversity of life on Earth at these times. But the beginning of the hall (at least from the direction you'll come at it) is the "Fossil Lab". This includes both a glassed-in room in which fossil preparators are working at removing specimens from the matrix and cleaning them up for storage, as well as a number of exhibits about the nature of paleontology and how it works.

We'll start by taking a look at the preparation room. Depending on their (and your) schedule, some preparators may be at work when you visit. Whether they are or not, they should have little signs up that explain what it is they are working on.

Name:_____

38 – Extra Credit) List an example of a fossil which is being prepared in the preparation lab. (It doesn't have to be a dinosaur).

Opposite from the preparation lab is a dinosaur fossil mounted for display. This is actually the type specimen of that species!

39) What **species** is on display?

Sometimes fossils are mounted in **life position**: the skeletons are shown as if the animal was still alive, but somehow had lost all of its flesh, organs, etc. Others are mounted in **death position**: the fossil is shown without restoring the bones to their orientation as in a living creature, but rather as the bones were found in the rock.

40) This specimen is shown in [life | death] position.

Move on, and past the preparation lab take a right into the "Fossil Basecamp" alcove. This section has exhibits on taphonomy, biochemistry, and evolution, among other things. Find the exhibit labeled "How do we find fossils?".

41) The example discussed here is a newly discovered dinosaur from the Late Cretaceous Bissekty Formation of Uzbekistan. The particular genus in question is:

a. The tyrannosaur *Timurlengia*
b. The ankylosaur *Bissektipelta*
c. The ceratopsian *Turanoceratops*
d. The ornithopod *Levnesovia*

Head out towards the main path. There is no way we can look at all the exhibits for the project: for one thing, the Deep Time hall covers all of Life's history, not just dinosaurs! Pass through the section with ocean life, past the metal tree stump, and find the Early Permian exhibit. You can find it with the label "An Eat-and-be-Eaten World".

There are two skeletal mounts on this side of the exhibit: *Edaphosaurus* and *Eryops*.

42) Which **posture** do these Early Permian animals show? [plantigrade | digitigrade | unguligrade]

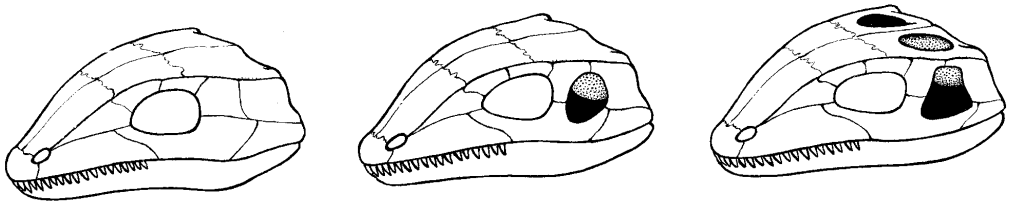
Name:_____

43) Which best describes the **resting stance of the hindlimb** shown in these Early Permian animals?

a. Parasagittal (upright)
b. Sprawling

44) Which of these two likely ate mostly fish? [*Edaphosaurus* | *Eryops*]

Recall the basic skull patterns for tetrapods:



Anapsid (no temporal fenestrae) Synapsid (infratemporal only) Diapsid (both infra- and supratemporal)

45) Which of these two Early Permian animals show a synapsid skull pattern? [*Edaphosaurus* | *Eryops*]

Look at the panel labeled "Light, Energy & Life".

46) These Early Permian communities had:

a. More herbivores than carnivores
b. Equal percentages of carnivores and hebivores
c. More carnivores than herbivores

Now move to the other side of this glass case. On this side you'll find mounted skeletons of *Dimetrodon*, *Ophiacodon*, *Xenacanthus*, and *Diplocaulus*.

46) *Dimetrodon* has which **skull pattern**? [Anapsid | Synapsid | Diapsid]

47) Which of these four seems to be the **apex predator on land**?

[*Dimetrodon* | *Ophiacodon* | *Xenacanthus* | *Diplocaulus*]

48) Which of these four seems to be the **apex predator in the water**?

[*Dimetrodon* | *Ophiacodon* | *Xenacanthus* | *Diplocaulus*]

Now move to the Late Permian, labeled by "Rise of the Herbivores".

Name:_____

49) According to the display, these Late Permian communities had:

a. More herbivores than carnivores
b. Equal percentages of carnivores and hebivores
c. More carnivores than herbivores

50) Which of the following Late Permian animals shown on display is **NOT a synapsid**?

[*Bradysaurus* | *Diictodon* | *Oudenodon* | *Cynosaurus* | *Aulacocephalodon*]

51) Which of the following best describes the teeth of *Cynosaurus*?

a. Undifferentiated (essentially the same shape from the front of the jaws to the back, although maybe different in size)
b. Differentiated (teeth of very different shapes in different parts of the jaw)

Now move on to the Mesozoic, and find "A Riot of Evolution" and its discussion of Triassic amniotes.

52) Match the fossil genus to its proper description.

Smilosuchus	_____	a. A gliding reptile
Icarosaurus	_____	b. A large quadrupedal herbivorous reptile
Vancleavea	_____	c. Gigantic crocodile-like reptile
Haramiyavia	_____	d. Early turtle
Proterochersis	_____	e. Aquatic reptile covered by armored scales
Trilophosaurus	_____	f. Early mammal

53) Which **posture** does *Trilophosaurus* show?

[plantigrade | digitigrade | unguligrade]

54) Which best describes the **resting stance of the hindlimb** shown in the Late Triassic animals listed above for those in which you can see the limbs)?

a. Parasagittal (upright)
b. Sprawling

Okay, so how about a freaking dinosaur in this packet??

Among these Late Triassic animals is *Eoraptor*, one of the oldest and most primitive dinosaurs.

55) *Eoraptor* is [bigger | the same size | smaller] than *Trilophosaurus*.

56) Which **posture** does *Eoraptor* show? [plantigrade | digitigrade | unguligrade]

Name:_____

57) Which best describes the **resting stance of the hindlimb** in *Eoraptor*?

a. Parasagittal (upright)
b. Sprawling

58) *Eoraptor* is a(n) [obligate biped | facultative biped | obligate quadruped].

59) *Eoraptor* has which **skull pattern**? [Anapsid | Synapsid | Diapsid]

Move to the left, past the head of *Smilosuchus*, and come around the far side of the Triassic exhibit. You should be facing the Jurassic "island", and specifically the section labeled "Spikes and Claws". Head over to it and check out *Stegosaurus* and *Ceratosaurus*.

60) Which of these two seems to be winning in the fight? [*Stegosaurus* | *Ceratosaurus*]

61) Which of these two has **gastralia**? [*Stegosaurus* | *Ceratosaurus*]

62) Which best describes the condition of the **teeth** in *Ceratosaurus*?

a. Undifferentiated (essentially the same shape from the front of the jaws to the back, although maybe different in size)
b. Differentiated (teeth of very different shapes in different parts of the jaw)

63) Which of the body parts seems to have been the primary weapon in *Ceratosaurus*?
[the manual claws | the teeth and jaws]

64) In *Stegosaurus*, which **leg bone** is longer? [femur | tibia]

Move to the right past the tails of *Ceratosaurus* and *Stegosaurus*, and follow along the edge of the Jurassic "island". The next pair of dinosaurs is a juvenile and subadult of the iguanodontian ornithopod *Camptosaurus*. (By the way, very few of the dinosaurs on display here are represented by fully-grown adults!)

65) Which growth stage of *Camptosaurus* has a highly curved **ischium and pubis**? [juvenile | subadult]

66 – Extra Credit) Based on the snout shape, *Camptosaurus* was likely a [choosy | less choosy] feeder.

Keep moving to the right. The next dinosaur you encounter is the carnosaurian theropod *Allosaurus*.

Name:_____

67) The *Allosaurus* specimen is shown engaged in what **behavior**?

a. Stalking *Camptosaurus*
b. Defending against *Diplodocus*
c. Feeding on *Dryosaurus*
d. Protecting its own eggs

68 – Extra Credit) In *Allosaurus* **metatarsal III** is

[the same width at the top as II and IV | pinched in between II and IV].

69) In *Allosaurus* which is longer? [The largest tooth | The largest manual ungual]

Take a look at the skull of *Allosaurus*.

70) Which of the following best describes the **proportions of the skull** of *Allosaurus*?

a. About as wide or wider mediolaterally at the posterior end than it is tall dorsoventrally.
b. Much narrower mediolaterally at the posterior end than it is tall dorsoventrally.

Allosaurus has triangular crests on the dorsal (top) surface of its **lacrimals**.

71) These lacrimal crests are [anterior to | directly dorsal to | posterior to] the orbits.

To the right of the *Allosaurus*, out where you can touch it, is the single largest bone in this entire hall.

72) Which **bone** (body part) is this?

73 – Extra Credit) What **genus** is this giant bone from?

Looming over this part of the island is the skeleton of a subadult *Diplodocus*. (Yes, this specimen is "merely" 27.2 m [that is, 90'] long; a fully-adult specimen is 33.5 m [110'] long and about twice as massive.)

74) Look at the **metacarpus** of *Diplodocus*. It is:

a. Wider mediolaterally than tall proximodistally
b. About equally wide as tall
c. Taller proximodistally than wide mediolaterally

75) The number of **cervicals** in *Diplodocus* is [fewer than | the same number as | more than] the number in *Giraffa* (see back at page 4).

Name:_____

Keep going to the right and find a pair of skulls of sauropods: the diplodocid *Diplodocus* and the macronarian *Camarasaurus*.

76) Which of these has **stout spatulate teeth**? [*Camarasaurus* | *Diplodocus*]

77) Which of these has **peg-like teeth** all at the front of the snout? [*Camarasaurus* | *Diplodocus*]

Before we leave the Jurassic "island", take a look at the mounted skeleton of a subadult *Camarasaurus*.

78) As mounted, this specimen is doing what?

a. On the ground, in death position.
b. Partially rearing up.
c. Watching the fighting *Stegosaurus* and *Ceratosaurus*.
d. Feeding on low vegetation.

Turn around and head over to the Cretaceous "island". Head towards the side on the left (the one facing the wall rather than the center of the hall) and find the section "Dinosaurs Take to the Air".

There are skeletons of four different genera of theropods displayed.

79) Match the genus with its proper description.

Sinosauropteryx	_____	a. One of the oldest toothless birds
Caudipteryx	_____	b. A flightless maniraptoran with broad feathers
Archaeopteryx	_____	c. A compsognathid
Confuciusornis	_____	d. A Jurassic bird with teeth and a long bony tail

80 – Extra Credit) Which of these genera occurs oldest in time?

[*Sinosauropteryx* | *Caudipteryx* | *Archaeopteryx* | *Confuciusornis*]

Move along to the left and find the exhibit "Dinosaur Diversity Peaks". This discusses the Late Cretaceous Epoch around 75 million years ago.

81) Match the following dinosaurs to their proper description:

Prosaurolophus	_____	a. Tyrannosaurid
Centrosaurus	_____	b. Pachycephalosaur
Gorgosaurus	_____	c. Ankylosaurid
Euoplocephalus	_____	d. Hadrosaurid
Stegoceras	_____	e. Dromaeosaurid
Saurornitholestes	_____	f. Ceratopsid

Name:_____

82) Take a look at the skull of *Prosaurolophus*. Which of the following best describes its **jaws**?

a. Teeth are present throughout the length of the jaws.
b. Teeth are absent in the front half of the jaw, and closely packed in the back of the jaw

83) Take a look at the **tail** of *Euoplocephalus*. Which of the following best describes it?

a. A thagomizer: two pairs of spikes
b. Flexible all the way to the tip
c. Rigid in its posterior half, ending with a tail club

84) Which of the following large herbivores is most likely to have a choosier diet?

[*Prosaurolophus* | *Centrosaurus* | *Euoplocephalus*]

85) In *Centrosaurus* the **nasal horn** is [larger than | equal in length to | smaller than] the postorbital horns.

Turn around and find the Cretaceous marine bird *Hesperornis*.

86) Based on the information from page 5, *Hesperornis* was a [wing-propelled | foot-propelled] diver.

Turn back to the Cretaceous island and move right: past the "Dinosaur Diversity Peaks" and "Dinosaurs Take to the Air", and along to "Dinosaurs in a Flowering World". Look for the display "Life Flourishes at the Water's Edge".

87) Match these non-dinosaurian organisms to their proper description.

Didelphodon	_____	a. Water plant related to the modern lotus
Stangerochampsa	_____	b. Freshwater clam
Plethobasus	_____	c. Turtle
Eubaena	_____	d. Marsupial mammal
Nelumbago	_____	e. Alligator

Now move around and find the specimen of *Tyrannosaurus* feeding on *Triceratops*. Hail to the King!

88) Look at the dorsal view of the *Tyrannosaurus* skull. Its **nasals** are
[separate from each other throughout their length | fused together for most of their length].

89) Which of the following best describes the **proportions of the skull** of *Tyrannosaurus*?

a. About as wide or wider mediolaterally at the posterior end than it is tall dorsoventrally.
b. Much narrower mediolaterally at the posterior end than it is tall dorsoventrally.

Name:_____

90) In *Tyrannosaurus* which is longer? [The largest tooth | The largest manual ungual]

91 – Extra Credit) In *Tyrannosaurus* **metatarsal III** is
[the same width at the top as II and IV | pinched in between II and IV].

Now examine the *Triceratops* specimen

92) In *Triceratops* the **nasal horn** is [larger than | equal in length to | smaller than] the postorbital horns.

93) The **metatarsus** in *Triceratops* is [shorter than | the same length as | longer than] the metatarsus of *Tyrannosaurus.*

Compare the pelvic region of *Tyrannosaurus* and *Triceratops*. (You'll have to walk around to get different views of these).
94) Which dinosaur is **wider at the hips**? [*Tyrannosaurus* | *Triceratops*]

Move to the right of *Tyrannosaurus* and *Triceratops* to find two more latest Cretaceous dinosaurs: *Edmontosaurus* and *Thescelosaurus*.
95) Which of these dinosaurs is an **obligate biped**? [*Edmontosaurus* | *Thescelosaurus*]

96) Which of these dinosaurs could feed higher in the trees? [*Edmontosaurus* | *Thescelosaurus*]

97) In which of these two dinosaurs are the **ossified epaxial tendons** (tendons along the neural spines which have turned to bone)? [*Edmontosaurus* | *Thescelosaurus* | both | neither]

Go the right past these two dinosaurs; around the corner is a discussion of the Cretaceous-Paleogene mass extinction 66 million years ago.
98) Based on the information presented here, match the different environmental effects of this catastrophe with the time scale on which they occurred.

Ferns flourish	_____	a. Days
Global cooling	_____	b. Weeks
Global warming	_____	c. Months
Wildfire	_____	d. Years
Ecosystem collapse	_____	e. Centuries

Thus passes the glory of the world…

Name:_____

However, that isn't the end of the project! With such a wealth of Cenozoic fossils it would be a shame to not have you take a look at some of them.

So here is a Cenozoic scavenger hunt. Listed are a series of fossil organisms in the remaining part of the exhibit, with some indication of the display case they are in.

99) Match the fossil taxon to its proper description.

Uintatherium ("Dense Forests Open Up") _____

Stenomylus ("Browsing, Grazing, Moving in Herds") _____

Moropus ("The Not-So-Distant Past") _____

Smilodon (near the Rotunda entrance) _____

Eremotherium (across from one of the Rotund entrances) _____

Mammut (facing the center of the hall) _____

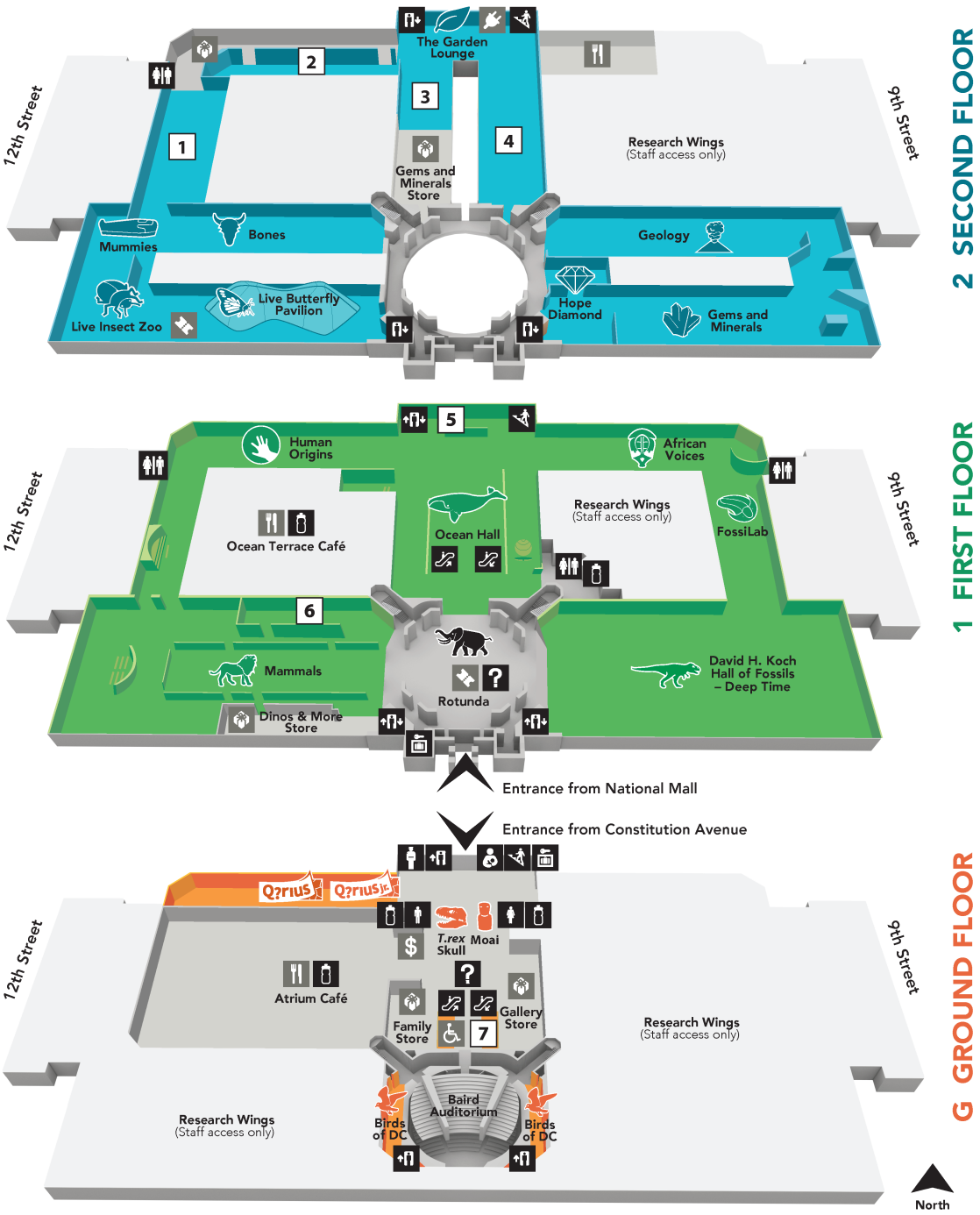
a. Clawed-footed herbivorous "hoofed" mammal
b. Slender running camel
c. Giant ground sloth
d. Mastodon
e. Sabre-toothed cat
f. Sabre-toothed knob-headed quadrupedal herbivore

100 – Extra Credit) Find any Cenozoic fossil not listed in question 99, name it, and correctly describe the type of organism it is and the time period and location it is from.

That is it. Feel free to enjoy the rest of the Deep Time hall, and the rest of the museum.

Remember that this assignment is "turned in" by answering the questions (the same as in this packet) on ELMS.

Name:_____



AMENITIES

Stores · ATM · Outlets · Free Wi-Fi: si-visitor
Tickets · Dining · Wheelchairs

FACILITIES

Special Exhibitions · Escalator · Information Desk · Security Office · Stairs
Elevator · Lactation Room · Locker Storage · Restrooms · Water Bottle Refill Station