

Name _____

Ecology & Evolutionary Biology 2245/2245W
Exam 1
18 February 2014

READ THE EXAM OVER CAREFULLY BEFORE YOU BEGIN. IT CONSISTS OF A TOTAL OF 15 QUESTIONS; YOU MUST ANSWER ALL PARTS OF EACH QUESTION.

1. Use the following list of fossil taxa to answer parts a through f below. You may use each taxon only ONCE. (7 pts)

“seed fern”	<i>Archaeopteryx</i>	<i>Dimetrodon</i>	lycopsids
ostracoderm	gymnosperms	<i>Haikuichthyes</i>	placoderms
<i>Pikaia</i>	<i>Opabinia</i>	synapsids	<i>Smilodon</i>
<i>Gigantopithecus</i>	<i>Equus</i>	<i>Miohippus</i>	<i>Glyptodon</i>
<i>Merychippus</i>	<i>Cooksonia</i>	pterosaur	<i>Anomalocaris</i>

- first flighted diapsids _____
- first potentially flighted saurischians _____
- first 3-toed taxon of horses _____
- Cambrian predatory arthropod _____
- With vascular tissue and seeds, but not found until Carboniferous _____
- Nasty “cats” of the Miocene clearly exhibiting heterodonty _____
- Large extinct hominoid known from late Miocene China _____

2. a. Identify and describe the function of 3 of the 4 main components of the amniotic egg. (6 pts)

Name	Function
(i) _____	_____
(ii) _____	_____
(iii) _____	_____

- Why is the amniotic egg considered to represent such an important evolutionary breakthrough? (2 pts)

3. Identify whether each of the following statements about the evolution of primates is TRUE or FALSE in the blank provided. In each case feel free to justify your answer. (7 pts)
- Australopithecus afarensis* is the smallest hominoid ever known. _____.
 - The cranial capacity of *Homo neanderthalensis* was generally larger than that of any other extinct or extant species of *Homo*. _____.
 - A round, rather than oval, birth canal is a feature of *Australopithecus* species. _____.
 - Whereas the first anthropoid fossils are known from the Pliocene Period, those of the first hominoids are known from the Eocene Period. _____.
 - Homo habilis* is often referred to as “the handy man” because stone tools have been found in association with fossils of this hominid. _____.
 - Among extant and extinct anthropoids, bipedal posture was thought to have occurred only in species of *Homo*. _____.
 - Fossils of *Homo erectus* are known only from the continent of Africa. _____.
4. Answer the following 3 questions with respect to the endosymbiotic theory:
- What does it explain? (2 pts)
 - Identify one piece of evidence in support of the idea. (1 pt)
 - Are purple bacteria or cyanobacteria considered to be associated with secondary events of endosymbiosis? (1 pt.)

5. You have just opened a new paleontology lab which, among other services, has the capacity to carbon-date and to extract DNA from appropriate fossils. However, when your first set of samples arrives you realize you will need to refine the description of the services you provide because several will be impossible for you to process. For each of the following 6 fossils indicate whether it will be possible for you to (1) date using C14/N14 and/or (2) extract DNA. In each case enter YES or NO in the blank provided. Feel free to provide an explanation for the answer you have chosen. (10 pts)

Fossil sample	Date using C14/N14 (YES/NO)	Explanation? (optional)	Extract DNA (YES/NO)	Explanation? (optional)
a. dragonfly in amber from Pliocene				
b. carbonized flowers from end Pleistocene				
c. mummified body of <i>Homo floridensis</i>				
d. brachiopod cast from Devonian				
e. Doushantuo formation petrified embryo				

6. From the three evolutionary scenarios described below, circle the letter of the one that exemplified Cope's Rule. (1 pt)
- During the Great American Exchange the placental mammals of North America displaced the marsupial mammals of South America as a result of the Panama Isthmus allowing dispersal via land between the two continents.
 - Over the course of the Mesozoic Era, dinosaurs of both lineages tended to increase in body size.
 - The evolution of flight in pterosaurs lead to their adaptive radiation and expansion into a diversity of niches.

7. For each of the following pairs of taxa, geological intervals, or features circle the one that is generally considered to be OLDEST. (14 pts)
- a. life on land vs. life in the air
 - b. Proterozoic vs. Archean
 - c. seed vs. amniotic egg
 - d. “anapsid” skull vs. diapsid amniote skull
 - e. flowers vs. synapsids
 - f. Pangaea vs. Laurasia
 - g. chloroplast vs. cyanobacteria
 - h. Rodinia vs. Gondwana
 - i. *Homo* vs. *Australopithecus*
 - j. prokaryotes vs. eukaryotes
 - k. *Proconsul* vs. *Homo*
 - l. rangeomorphs vs. prokaryotes
 - m. vascular plants vs. *Ichthyostega*
 - n. snowball earth vs. anoxic atmosphere

8. You have been charged with developing an exhibit featuring the Cambrian Period. Assuming you are striving for accuracy, answer the following questions about your exhibit (9 pts):
- a. Should it include a craniate? If so, provide an example.

 - b. Should it include life on land? If so, provide an example.

 - c. Should it include more than 30 phyla of invertebrates?

 - d. Should it include extinct phyla? If so, provide an example.

 - e. Should it include extant phyla? If so, provide an example.

 - f. Should it include a vascular plant? If so, provide an example.

9. Dr. Annin travels to a museum in British Columbia to assist with sorting an extensive collection of fossils taken from a local fossil bed. The fossils consist of molds and casts of an incredibly wide diversity of seafloor dwelling invertebrates. The data associated with the collection, indicate that the fossils were taken from a deposit of sedimentary rock sandwiched between two layers of igneous rock and that the igneous rock below and above the fossil deposit had been dated using absolute dating methods to approx. 530 and 510 million years ago, respectively.
- Would you expect the organisms represented by these fossils to have developed from embryos? Explain your answer. (2 pts)
 - Would K40 and its daughter isotope Ar40 be appropriate for radiometric dating of the sedimentary rocks in which the fossils were found? Explain your answer. (2 pts)
 - Would you expect the fossils to represent terrestrial or marine organisms? (1 pt)
10. You are faced with identifying a large fossil taxon sent to you by a colleague in Montana. It was collected from sedimentary rocks which, based on the principle of superposition, are estimated to be approximately Cretaceous in age. Although the teeth are missing, the skull of the specimen exhibits both upper and lower temporal fossae, and the pubis and ischium are oriented parallel to one another.
- Identify a genus this fossil is likely to represent. (2 pts)
 - What is the *minimum* age (± 10 my) of this fossil? (1 pt)
 - Although the teeth of the skull have been lost, would you expect this animal to have been an herbivore or a carnivore? (2 pts)

11. For each of the following taxa or features, identify the *oldest* PERIOD of Phanerozoic time in which the first fossil evidence is considered to occur. (10 pts)

- a. flowering plants _____
- b. amniotes _____
- c. gymnosperms _____
- d. trilobites _____
- e. dinosaurs _____
- f. *Archaeopteryx* _____
- g. ostracoderms _____
- h. predators _____
- i. seeds _____
- j. vascular plant tissue _____

12. Identify one of the key innovations that occurred in either the Paleozoic Era or Mesozoic Era and describe the impact it had on the organisms involved. (2 pts)

13. Dr. Oito has created a time machine and is able to travel back in time for brief, but informative visits. Answer the following questions with respect to 3 of his trips back in time.

Trip 1: Dr. Oito sets the time dial to 470 million years ago and arrives on land but, except for a few liverworts, there is almost NOTHING there! No vascular plants, no animals. Fortunately, he has brought his snorkeling gear with him, so can investigate the types of organisms found under water.

- a. Since he is hoping to observe a diversity of life forms, would his time be more well spent exploring freshwater or marine habitats? (1 pt)

- b. While he recognizes that he is unlikely to encounter large predatory dinosaurs or mammals at this time (or place), describe an extinct group of predators that he may encounter and about which he should have some concern. (2 pts)

Trip 2: Dr. Oito sets the time dial to 2.8 billion years ago.

- a. When he arrives would he expect to see acritarchs? (1 pt)

- b. He recognizes that he may need to be particularly prepared for this trip and has room in his time capsule, given what you know about life on earth 2.8 billion years ago, identify one item/piece of equipment that he **MUST** bring with him if he is to survive for even a few minutes when he arrives. Justify your suggestion. (2 pts)

Trip 3: Dr. Oito wishes to observe the “Age of flowering plants”.

- a. What **Era** of geological time would be most appropriate for him to visit? (1 pt)

- b. What other major group of organisms would he expect to find radiating and diversifying throughout this **Era** of time? (1 pt)

- c. If he were to attempt to arrive at the **beginning** of the **second Period** of this era, to what time should he set the dial on his machine? (± 5 mya). (1pt)

14. Identify whether each of the following statements about the Mesozoic Era is True or False in the blank provided. In each case, feel free to justify your answer. (5 pts)

- a. The end of the Jurassic Period was marked by a major extinction event associated with the impact of an asteroid in the Yucatan Peninsula in Mexico.
_____.
- b. The beginning of the Mesozoic Era is marked the first evidence of plant life on land.
_____.
- c. By the beginning of the Cretaceous Period the continents had finally converged into the single supercontinent Pangaea. _____.
- d. The Mesozoic Era began 251 million years ago and terminated approximately 185 (\pm 10) million *years later*. _____.
- e. The Mesozoic Era was dominated by diapsids, although synapsids were also present at the time. _____.

15. Circle ALL of the intervals of geological time from the list below that BEGAN immediately after a mass extinction event. (4 pts)

Silurian	Triassic	Tertiary
Jurassic	Cretaceous	Mesozoic
Devonian	Cambrian	

BONUS QUESTION: Which of the 5 famous Evolutionary Biologists who have visited class to date this semester did you find to be the most interesting (last name only is fine)? Justify your answer. (1 point total)