

## **Plus Hour #4: Radiometric Dating and the Fossil Record**

*Biological Sciences 102 – Animal Biology*

**NAME:** \_\_\_\_\_

**SCORE:** \_\_\_\_\_

**This assignment is worth 10 points and accounts for the fourth plus hour assignment.**

**Using your textbook or a reliable Internet reference, answer the following questions. You may wish to review several websites or sources to verify your answers. You may wish to refer to the brief description of radiometric dating on the next page.**

### ***Submission Directions***

You may print out this assignment and type and print out the answers on another sheet(s) of paper or you may copy and paste the questions into an MS Word document (or other word processing software), type out your answers between the questions and submit them in printed form.

1. By definition, what is a fossil? What is meant by the fossil record?
2. Can invertebrates ever be fossilized? If so, provide an example of a specific invertebrate species found in the fossil record.
3. What is radiometric dating? Does this always involve carbon? If not, what other isotopes can be used?
4. Specifically, how does radiometric dating allow for the aging of the rock strata in which various fossils are found? As part of your answer define the half-life of a radioactive isotope.
5. By definition, what is a mass extinction? Based on evidence from the fossil record, list three different mass extinction events that are generally recognized by paleontologists/biologists. How long ago did each mass extinction event occur?
6. What event or more likely series of events lead to the extinction of the dinosaurs? How long ago did this occur? Be specific (do not provide a generalized answer). From an ecological perspective, what effect did the extinction of dinosaurs have on the evolution of mammals? Be specific (do not provide a generalized answer).
7. Other than radiometric dating, are there other ways to “age rocks and fossils”?

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### ➤ **RADIOMETRIC DATING**

**ISOTOPE** = an element with a different number of neutrons as compared to the parent element

**RADIOACTIVE ISOTOPE** = an isotope that gives off energy and decays into another isotope

#### **Basic Principles**

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1. Naturally occurring radioactive materials breakdown into other materials at known rates. This is known as radioactive decay.
2. Radioactive parent elements decay to stable daughter elements.
3. Radioactivity was discovered in 1896 by Henri Becquerel. In 1905, Rutherford and Boltwood used the principle of radioactive decay to measure the age of rocks and minerals (using Uranium decaying to produce Helium). The invention of the mass spectrometer after World War I led to the discovery of more than 200 isotopes.
4. Many radioactive elements can be used as geologic clocks. Each radioactive element decays at its own nearly constant rate (the half-life). Once this rate is known, geologists can estimate the length of time over which decay has been occurring by measuring the amount of radioactive parent element and the amount of stable daughter elements.

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#### **CARBON-14 DATING**

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1. Cosmic rays from the sun strike Nitrogen 14 atoms in the atmosphere and convert them into radioactive Carbon 14, which combines with oxygen to form radioactive carbon dioxide.
2. Living things are in equilibrium with the atmosphere, and the radioactive carbon dioxide is absorbed and used by plants via photosynthesis. Thus, the radioactive carbon dioxide gets into the food chain and the carbon cycle.
3. All living things contain a constant ratio of Carbon 14 to Carbon 12 (about 1 in a trillion).
4. At death, Carbon 14 exchange ceases and any Carbon 14 in the tissues of the organisms begins to decay to Nitrogen 14, and is not replenished by new C-14.

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5. The change in the Carbon 14 to Carbon 12 ratio is the basis for dating.
6. The half-life is so short (5730 years) that this method can only be used on materials less than 70,000 years old. Archeological (physical anthropology) dating uses this method. This method is also useful for dating the Pleistocene Epoch (Ice Ages).
7. The method assumes the rate of Carbon 14 production (and hence amount of cosmic ray striking Earth) has been constant (through the past 70,000 years).