

Endings, Spring 2006

Questions for study III

(be prepared to discuss and turn in these questions Tuesday, April 18)

Ward and Brownlee, *The Life and Death of the Planet Earth*

1. (page 26) What is an **atom**? Give at least **five** ways in which an atom of hydrogen differs from an atom of carbon.
2. (pages 27 and 28) What evidence is there for the theory that a large body the size of Mars (but not Mars itself) slammed into the Earth to break off pieces that would become the **moon**?
3. (page 28) What evidence exists that the **Earth's rotation** has slowed ten percent over the last 500 million years?
4. (pages 31 and 32) They keep speaking of "**density**" or "denser" or "less dense", whether they are discussing rocks or the atmospheres of various planets. What is density, and how does it differ from **weight**?
5. (pages 30 and 54) What is **plate tectonics** (yes, we all know it's a theory, but a theory of what?)? How is plate tectonics related to the **second law of thermodynamics**?
6. (page 53) James Lovelock's **Gaia hypothesis** postulates that the Earth itself is a living organism. Ward and Brownlee disagree with this hypothesis. What characteristics define something as "alive"? Are viruses alive? Are computer viruses alive?
7. (page 59) In the diagram, two plates (the gray layers) are shown: one to the left with the volcanoes on top of it, and one to the right that is sinking under the one to the left. Why is the plate to the right sinking under the plate to the left? How do we know this really happens?
8. (page 61) Why is the weathering of the mineral **wollastonite** important to the biogeochemical cycles described in this section?
9. (page 102) The authors perpetuate a common oversimplification: "...[the Sun's] light powers photosynthesis, which converts sunlight into food sugars by plants..." Plants don't make food sugars out of sunlight *only*; what **materials** are necessary for plants to carry out photosynthesis?
10. (page 102) "In fact, our Milky Way galaxy makes dozens of new stars each year." Really? Find a good photo of a so-called "**stellar nursery**" where such stars are born (web page, book or magazine), and give the complete citation.
11. (pages 104 and 105) The authors don't explain this somewhat cryptic statement: "...if all the hydrogen was converted to helium, the Sun would only

have **one-fourth** the number of atoms it started with..." On page 103, the authors state that the first critical step in nuclear fusion is to fuse two protons (hydrogen nuclei) into a single deuterium nucleus. This cuts the number of atoms in half, from two to one. How do the authors arrive at the "one-fourth" figure?

12. (page 106) The graph shows the "age of animals", a period in Earth's history where multicellular life forms flourish. The graph is spoiled a bit by the cryptic y-axis (the vertical axis) with its "1" and "2" and no other labels. Be the editor of this book and supply the correct label for the quantity this axis represents, **including the units**. Hint: note the point representing "now" and the y-value it corresponds to.

13. (page 109) Fill in the reasoning from "the problem of the life span of the biosphere [of Earth]" and "the probability of finding biologically active planets in our galactic neighborhood." In other words, what's the **connection** between how long life exists on this planet with the likelihood of meeting (or even detecting) an ET (extra-terrestrial)?

14. (page 113) What is **reduced carbon**? For that matter, what is **oxidized carbon**? Give an example of a molecule with reduced carbon. Give an example of a molecule with oxidized carbon? Finally, why is reduced carbon necessary for life to exist?

15. (whole chapter) The Gaia hypothesis is an example of a **feedback mechanism**; in other words, when a change in the biosphere occurs, the consequence of that change "feeds back" into the biosphere to either accelerate the change (**positive** feedback) or slow down the change (**negative** feedback). Which type of feedback (**positive** or **negative**) in any system tends to allow the system to continue? Is the **loss of carbon dioxide** from the biosphere an example of positive or negative feedback? In either case, explain your answer.