

# BEP 210A - Epic of Evolution

## Midterm Exam - March 17, 2000

Name \_\_\_\_\_

This exam is closed book, closed notes. You have 1 hour. Answer 15 of 18 questions in Part I and 4 of 6 in Part II. Write all of your answers on these pages. Good luck!

**Part I. (60 pts.): Answer 15 of the following 18 questions in a few sentences. Please cross out the 3 that you don't do. Each of these questions is worth 4 pts.**

- 1) Which of the following objects make up which other ones: neutrons, atoms, quarks, nuclei, electrons, protons? What force holds each composite object together?
- 2) Put the following three milestones of the Big Bang in chronological order: nucleosynthesis, proton-antiproton (and neutron-antineutron) annihilation, baryogenesis. Once you have ordered the processes, explain how the first process set the stage for the second; and similarly explain how the second process set the stage for the third.
- 3) How do we know that distant galaxies are moving away from us? Give an example of an analogous effect in everyday life (involving sound).
- 4) Tell what happened at the period of electron-positron annihilation (about 1 second after the Big Bang). Explain why it could not have happened earlier.
- 5) What is a quasar and how does it work? Why are all the quasars that astronomers have discovered far away from the earth?
- 6) What was the "T-Tauri event" in the formation of the solar system? What effect did it have on the composition of the planets? Why is a T-Tauri event much faster than the normal energy producing processes that make the sun shine now?
- 7) What factors contributed to the early melting of the Earth?
- 8) Describe how the Moon formed?
- 9) What are rising plumes and sinking slabs?

- 10) Why is the Earth like a pot of soup on the stove?
- 11) Why are there ocean fossils here in St. Louis?
- 12) Why do volcanoes occur at subduction zones, and why are the eruptions explosive?
- 13) Thinking of an RNA molecule as a paper-doll chain:
  - a) Which paper-doll component(s) represent covalent bonds?
  - b) Which are involved in base-pairing?
  - c) How is base-pairing involved in generating RNA shapes?
  - d) How is base-pairing involved in RNA replication?
- 14) In the switch over from an RNA World to present-day life:
  - a) Which class of macromolecule came to carry the instructions?
  - b) Which class of macromolecule came to catalyze biochemical reactions?
  - c) Which class of macromolecule came to be directly involved in translating the genetic code?
  - d) How is base-pairing involved in translating the genetic code?
- 15) Describe why an enzyme changes its shape as the consequence of "pocket occupancy."
- 16)
  - a) During photosynthesis, where are the electrons located that interact with photons?
  - b) During gene regulation, where in the DNA are the nucleotides located that interact with transcription factors?
  - c) During signal transduction cascades, how is ATP used to generate shape changes?
  - d) During embryology, where is the first gradient found?

- 17) Some of the following statements can be used to document that all present-day life is genetically descended from a common ancestor - some do not yield this conclusion. Circle those that can be used.
- a) All modern organisms are aware.
  - b) All modern organisms use the same codons.
  - c) Shapes were generated by RNA molecules in the early "puddles."
  - d) ATP-binding domains are the consequence of bricolage.
- 18) Describe the essential features of the cell cycle.

**Part II: (40 pts.) Answer 4 of the following 6 questions with a paragraph or so. Each is worth 10 points. Please cross out the two that you do not do. Use the other page side if necessary.**

- 1) Explain how a star like the sun shines. Your explanation should include the following:
  - a) a statement of what the "raw materials" and "end products" are. (You do not need to list the individual reactions along the way.)
  - b) the role of each of the four forces.
  - c) the reason why the energy-releasing process only starts when the temperature gets high enough.
- 2) What happened at the period of "decoupling" and why? How is the cosmic microwave background related to decoupling? What significance does decoupling have for the condensation of galaxies and stars?
- 3) Explain the ways in which the Earth cools down, eventually losing its heat to space.
- 4) Explain the difference between the way ocean crust and continental crust is formed.

- 5) Explain (flesh out) what is meant by the following: mutations basically run new protein shapes up a flagpole, and natural selection is equivalent to asking whether anybody salutes.
  
- 6) Explain (flesh out) what is meant by the following: embryology expanded on the unicellular idea of regulating gene expression in time to include regulating gene expression in space.