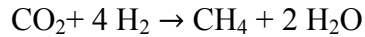


Origins of Life Course – Peer Review Assignment

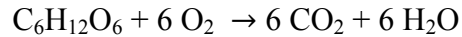
The following assignment aims to encourage a primary goal of the course: to bring new and synthetic thinking to the field of origins of life.

1. *Energetics of metabolism*

Methanogenesis proceeds by the reaction:



and releases -130 kJ of energy per carbon dioxide, as calculated by the standard reduction potential. The aerobic oxidation of glucose occurs through the reaction:



with a standard free energy of -2870 kJ, or -478 kJ per carbon in the sugar.

- a. Based on your knowledge of the history of Earth and natural selection, why is methanogenesis more likely to be an early evolutionary metabolism, while aerobic oxidation was a later development? Provide at least 1 reason. **(2 points)**
- b. If aerobic oxidation is more energetically favorable, why would methanogenesis still exist today? Provide at least 1 reason. **(2 points)**

2. *Life elsewhere*

Congratulations! You have been asked to participate on a mission to locate extraterrestrial life. What geochemical signatures would you want to look for (provide a minimum of 3 with justification) to help you determine if a planet is or has been inhabited in the past, based on the fossil record of the Earth and geochemistries elsewhere in the solar system? **(2 points)**

3. *Phylogenetic tree building* (instructions included in “how to generate phylogenetic trees”)
 - a. Generate a phylogenetic tree based on a single protein (or nucleotide) sequence **(1 point)**
 - b. Generate a phylogenetic tree based on the known taxonomy **(1 point)**
 - c. Compare your protein and taxonomic trees. Do you notice any differences? (Include at least 1 difference, or state that they are identical) **(1 point)**
 - d. What are the challenges with building these trees? (Provide a minimum of 2 challenges) **(2 points)**