1.

In most aquatic environments, primary production is affected by the light available to the community of organisms.

Using measurements of dissolved oxygen concentration to determine primary productivity, design a controlled experiment to test the hypothesis that primary productivity is affected by either the intensity **or** the wavelength of light. In your answer, be sure to include the following.

- A statement of the specific hypothesis that you are testing
- A description of your experimental design (Be sure to include a description of what data you would collect and how you would present and analyze the data using a graph.)
- A description of results that would support your hypothesis

2.

The movement of water through vascular plants is important to their survival.

(a) **Explain** the mechanism of water movement through vascular plants during transpiration. Include a discussion of how the anatomy of vascular plants and the properties of water contribute to this process.

(b) **Explain** how gas exchange affects transpiration.

(c) **Describe** TWO adaptations that affect the rate of transpiration in desert plants.

3.

In many ways, all organisms in a food web can be said to be solar-powered. The producer level of the food web is responsible for the transformation of the solar energy into a form that can be used by other living organisms.

(a) Discuss the role of green plants in transforming the Sun's energy into a form that can ultimately be used by heterotrophs.

(b) Discuss the flow of energy from producers through top carnivores in a food web in terms of the laws of thermodynamics.

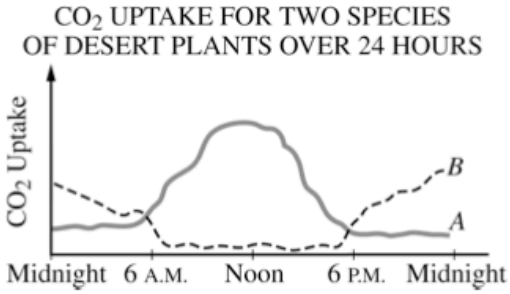
4.

Compared with other terrestrial biomes, deserts have extremely low productivity.

(a) **Discuss** how temperature, soil composition, and annual precipitation limit productivity in deserts.

(b) **Describe** a four-organism food chain that might characterize a desert community, and **identify** the trophic level of each organism.

(c) **Describe** the results depicted in the graph. **Explain** one anatomical difference and one physiological difference between species *A* and *B* that account for the CO_2 uptake patterns shown. **Discuss** the evolutionary significance of each difference.



5.

The physical structure of a protein often reflects and affects its function.

(a) **Describe** THREE types of chemical bonds/interactions found in proteins. For each type, **describe** its role in determining protein structure.

(b) **Discuss** how the structure of a protein affects the function of TWO of the following.

- Muscle contraction
- Regulation of enzyme activity
- Cell signaling

(c) Abnormal hemoglobin is the identifying characteristic of sickle cell anemia. **Explain** the genetic basis of the abnormal hemoglobin. **Explain** why the sickle cell allele is selected for in certain areas of the world.

6.

Many biological structures are composed of smaller units assembled into more complex structures having functions based on their structural organization.

For THREE of the following complex structures, describe the smaller units, their assembly into the larger structures, and one major function of these larger, organized structures.

(a) A eukaryotic chromosome

(b) A mature angiosperm root

(c) A colony of bees

(d) An inner membrane of a mitochondrion

(e) An enzyme

7.

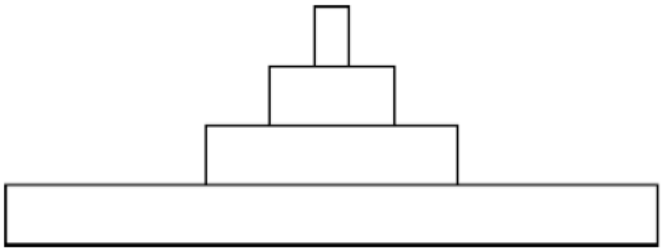
ATP and GTP are primary sources of energy for biochemical reactions.

(a) **Describe** the structure of the ATP or the GTP molecule.

(b) **Explain** how chemiosmosis produces ATP.

(c) **Describe** TWO specific cell processes that require ATP and explain how ATP is used in each process.

(d) An energy pyramid for a marine ecosystem is shown below. **Label** each trophic level of the pyramid and provide an example of a marine organism found at each level of this pyramid. **Explain** why the energy available at the top layer of the pyramid is a small percentage of the energy present at the bottom of the pyramid.



8.

Organisms utilize a diversity of methods to obtain proper nutrition.

(a) Some organisms digest food intracellularly, while others digest food extracellularly.

- **Identify** ONE nonvertebrate organism that digests food intracellularly and **describe** the process.
- **Identify** ONE nonvertebrate organism that digests food extracellularly and **describe** the process.

(b) **Describe** TWO structural features of the human stomach and/or small intestine. For each, **explain** how the structure relates to the function.

(c) Plants have a variety of mechanisms for obtaining nutrients. **Describe** TWO plant structures and **explain** how each structure is utilized in nutrient uptake.