

# 2011 AP<sup>®</sup> BIOLOGY FREE-RESPONSE QUESTIONS

## BIOLOGY

### SECTION II

Time—1 hour and 30 minutes

**Directions:** Answer all questions.

Answers must be in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write. Write all your answers on the pages following the questions in the pink booklet.

1. During an investigation of a freshwater lake, an AP Biology student discovers a previously unknown microscopic organism. Further study shows that the unicellular organism is eukaryotic.
  - (a) **Identify** FOUR organelles that should be present in the eukaryotic organism and **describe** the function of each organelle.
  - (b) Prokaryotic cells lack membrane-bound organelles found in eukaryotes. However, prokaryotes must perform many of the same functions as eukaryotes. For **THREE** of the organelles identified in part (a), **explain** how prokaryotic cells carry out the associated functions.
  - (c) According to the endosymbiotic theory, some organelles are believed to have evolved through a symbiotic relationship between eukaryotic and prokaryotic cells. **Describe** **THREE** observations that support the endosymbiotic theory.
2. 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.
3. Reproduction can be either asexual or sexual.
  - (a) Using a specific example, **describe** how organisms can reproduce asexually. **Discuss** **TWO** evolutionary advantages of asexual reproduction.
  - (b) **Identify** **THREE** ways that sexual reproduction increases genetic variability. For each, **explain** how it increases genetic diversity among the offspring.
  - (c) **Discuss** **TWO** prezygotic isolating mechanisms that prevent hybridization between two species. Include in your discussion an example of each mechanism.

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### Question 1

During an investigation of a freshwater lake, an AP Biology student discovers a previously unknown microscopic organism. Further study shows that the unicellular organism is eukaryotic.

- (a) **Identify** FOUR organelles that should be present in the eukaryotic organism and **describe** the function of each organelle.  
(5 points maximum)

Identify organelle (1 point for listing FOUR)	Describe corresponding function (1 point for each function)
Nucleus	Contains hereditary information/DNA/chromosomes or is the site of RNA synthesis.
Ribosomes	Site of protein synthesis.
ER (endoplasmic reticulum)	Internal transport or compartmentalization.
Rough ER	Protein synthesis/packaging/transport.
Smooth ER	Lipid synthesis or detoxification or transport.
Mitochondria	ATP synthesis or aerobic/cellular respiration.
Chloroplasts, plastids	Light absorption/photosynthesis/carbohydrate synthesis.
Vacuole, vesicles	Storage or transport.
Cilia/flagella	Motility.
Basal bodies	Support cilia/flagella.
Centrioles	Assist chromosome movement in mitosis.
Golgi bodies	Protein modification/packaging/transport.
Lysosomes	Enzymatic hydrolysis of wastes/metabolites/pathogens.
Peroxisomes	Catalase/peroxidase function or detoxification.

- (b) Prokaryotic cells lack membrane-bound organelles found in eukaryotes. However, prokaryotes must perform many of the same functions as eukaryotes. For THREE of the organelles identified in part (a), **explain** how prokaryotic cells carry out the associated functions.  
(3 points maximum)

Eukaryotic organelle	Explain how prokaryote carries out function (1 point each)
Nucleus	Hereditary information/DNA/chromosomes or RNA synthesis in cytosol.
Ribosomes	Site of protein synthesis.
ER (endoplasmic reticulum)	Diffusion of molecules in cytosol.
Rough ER	Protein synthesis/transport in cytosol; may be linked to transcription.
Smooth ER	Lipid synthesis or detoxification occurs in cytosol.
Mitochondria	Other membranes or cytosolic molecules function in ATP synthesis.
Chloroplasts	Other membranes or cytosolic molecules function in light absorption/photosynthesis/carbohydrate synthesis.
Plastids	Pigments are distributed throughout cytosol or are associated with membranes.
Vacuole, vesicles	Inclusion bodies/granules/large molecules in cytosol.
Cilia or flagella	Motility via bacterial flagella.

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**Question 1 (continued)**

Basal bodies	Other structures support flagella.
Centrioles	Enzyme-mediated chromosome movement.
Golgi bodies	Protein modification/packaging/transport in cytosol.
Lysosomes	Secreted enzymes hydrolyze wastes/metabolites/pathogens.
Peroxisomes	Production/secretion of catalase or detoxification.

- (c) According to the endosymbiotic theory, some organelles are believed to have evolved through a symbiotic relationship between eukaryotic and prokaryotic cells. **Describe** THREE observations that support the endosymbiotic theory.

*(4 points maximum)*

**Describe three observations (1 point each)**

- Mitochondria contain their own DNA.
- Chloroplasts contain their own DNA.
- Mitochondria can self-replicate.
- Chloroplasts can self-replicate.
- Mitochondrial chromosomes are circular.
- Chloroplast chromosomes are circular.
- Mitochondrial chromosomes lack histones.
- Chloroplast chromosomes lack histones.
- Mitochondria contain ribosomes that are similar to bacterial ribosomes.
- Chloroplasts contain ribosomes that are similar to bacterial ribosomes.
- Inner membrane of mitochondria is similar the membrane of prokaryotes.
- Inner membrane of chloroplasts is similar the membrane of prokaryotes.
- Mitochondria can perform transcription and translation.
- Chloroplasts can perform transcription and translation.
- First amino acid in the polypeptides in mitochondria is fMet (N-formylmethionine).
- First amino acid in the polypeptides in chloroplasts is fMet (N-formylmethionine).
- Mitochondria are approximately the size of bacteria.
- Chloroplasts are approximately the size of bacteria.
- Mitochondria use many prokaryote-like enzymes.
- Chloroplasts use many prokaryote-like enzymes.
- Many antibiotics (e.g., rifampicin) interfere specifically with mitochondrial protein synthesis.

**General description of endosymbiotic theory (1 point)**

- Prokaryotic cells have been engulfed by and are living within ancestral/precursor eukaryotes.