AP® BIOLOGY
2006 SCORING GUIDELINES

Question 1

A major distinction between prokaryotes and eukaryotes is the presence of membrane-bound organelles in eukaryotes.

(a) **Describe** the structure and function of TWO eukaryotic membrane-bound organelles other than the nucleus. **(4 points maximum)**

NOTE: One point is awarded for each bulleted item.

Organelle	Structure—1 point per box, Maximum—2 points	Function—1 point per box, Maximum—2 points
Mitochondria	• Indicate two membranes <u>with either</u>: - infolding of the inner membrane - cristae, or matrix	• cellular or aerobic respiration (Krebs, ETS) • production of ATP • release of chemical energy
Chloroplasts	• Indicate two membranes <u>with either</u>: - flattened sacs (thylakoids). - flattened stacks (grana). - stroma.	• photosynthesis or description of photosynthesis • production of 3-Carbon molecules (sugars, PGAL, glucose).
Endoplasmic Reticulum (ER)	• interconnected membranes, vesicles or sacs • rough ER has attached ribosomes and/or smooth ER without ribosomes	• synthesis of lipids (e.g., steroids) and/or proteins • detoxification of poisons, alcohol • transport • calcium signaling/storage If rough and smooth ER are the two named organelles • synthesis of proteins
Golgi apparatus	• series of flattened sacs	• modification of molecules • packaging molecules • processing molecules • vesicles (sacs) and their contents can be targeted for various locations in the cell and to its exterior
Lysosome	• vesicle (bag, sac) with enzymes	• digestion or breakdown of molecules waste materials and food with digestive enzymes (e.g., nucleases). • cell lysis • recycling organelles
Peroxisome (glyoxysomes)	• vesicle (bag, sac) with enzymes	• breakdown or detoxify free radicals or peroxides
Vacuoles	• vesicle (bag, sac)	• water balance • turgidity • storage water, ions, nutrients, or waste
Contractile vacuole	• vesicle (bag, sac)	• expulsion of water from cell
Vesicles	• sac (bag, sac)	• transporting materials to/from ER, Golgi, or cell membrane
Leucoplast	• Indicate two membranes with starch	• storing starch
Chromoplast	• Indicate two membranes with pigments	• storing pigments

Question 1 (continued)

(b) Prokaryotic and eukaryotic cells have some non-membrane-bound components in common. **Describe** the function of TWO of the following and **discuss** how each differs in prokaryotes and eukaryotes.

- DNA
- Cell wall
- Ribosomes

(4 points maximum)

Component	Function—1 point	Difference between Prokaryotes and Eukaryotes—1 point
DNA	• contains, stores, or transmits genetic information • codes for proteins or traits	• single molecule vs. usually many molecules • circular molecule vs. linear molecule • on avg. smaller number of base pairs (bp) vs. 1,000 times the average number of prokaryote bp • in cell's cytoplasm vs. within nucleus • few/no proteins* vs. histone proteins • no introns * vs. introns *archaebacteria are an exception
Cell wall	• protects • supports • maintains turgidity • maintains shape/ allows adherence	• Peptidoglycans (murein, amino acid, and sugar polymer) vs. Cellulose and/or Chitin
Ribosome	• make protein • site of translation	• smaller vs. larger • free in cytoplasm vs. free and attached • simultaneous transcription/translation vs. non-simultaneous • contain different proteins, or RNAs • different antibiotic sensitivity

(c) **Explain** the endosymbiotic theory of the origin of eukaryotic cells and **discuss** an example of evidence supporting this theory. **(2 points)**

Explain (1 point):
Prokaryotic cell was engulfed by another cell and formed a (symbiotic) relationship.

Evidence (1 point):
- Mitochondria and/or chloroplast contains own DNA.
- Mitochondria and/or chloroplast contains own ribosomes.
- Mitochondria and/or chloroplast contain double membrane.
- Mitochondria and/or chloroplast divides by binary fission.
- Mitochondria and/or chloroplast have a similar size to prokaryotic cells.

BIOLOGY
SECTION II
Time—1 hour and 30 minutes

1A,

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 this booklet.

1. A major distinction between prokaryotes and eukaryotes is the presence of membrane-bound organelles in eukaryotes.
   (a) **Describe** the structure and function of TWO eukaryotic membrane-bound organelles other than the nucleus.
   (b) Prokaryotic and eukaryotic cells have some non-membrane-bound components in common. **Describe** the function of TWO of the following and **discuss** how each differs in prokaryotes and eukaryotes.
      - DNA
      - Cell wall
      - Ribosomes
   (c) **Explain** the endosymbiotic theory of the origin of eukaryotic cells and **discuss** an example of evidence supporting this theory.

Two eukaryotic membrane-bound organelles are the mitochondria and the vacule. The mitochondria is comprised of an outer membrane, intermembrane or christae and a matrix. The mitochondria is where aerobic respiration occurs and ATP is made. The vacule is a large sac like organelle that is used for storage. In plants the vacule is surrounded by a membrane known as the tonoplast. When vacules are filled with water in plants, they help contribute to the turgor of the cell and rigidity of the plant.

DNA and Ribosomes are found in both eukaryotic and Prokaryotic cells. In both DNA is the genetic information and template for protein synthesis. In eukaryotes DNA is found as chromosomes in the ~~nuclear~~

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1A2

ADDITIONAL PAGE FOR ANSWERING QUESTION 1

~~membrane~~. nucleus. The DNA is shaped like a double helix and is wraped around histone proteins. In prokaryotic cells the dNA is "Naked" and is found within the cytosol of the cell because there is no nucleus. Ribosomes in eukaryotic cells can be found on the rough endoplasmic reticulum or "floating" in the cytosol. The ribosomes in prokaryotes are found in the cytosole.

The endosymbiotic theory of the origin of eukaryotic cells basically states that prokaryotic cells worked together one inside another helping eachother. Over time these ~~cells~~ prokaryotes evolved in to ~~Pro~~Eukaryotes. The prokaryotes that were internal became the membrane bound organelles. Evidence of this theory is found in the fossil record.

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BIOLOGY
SECTION II
Time—1 hour and 30 minutes

1 B1

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   - DNA
   - Cell wall
   - Ribosomes

   (c) **Explain** the endosymbiotic theory of the origin of eukaryotic cells and **discuss** an example of evidence supporting this theory.

The mitochondrion is an organelle that functions primarily to generate ATP, or energy, for the cell. The mitochondrion is relatively large and oval-shaped, and is usually found near sites of major activity within the cell. It is the primary provider of energy within the cell.

The chloroplast is found within plant cells, and its primary function is to carry out photosynthesis. Photosynthesis is a process in which food and energy is provided for the plant, using light, water, and carbon dioxide. Plants are autotrophic, as they create food for themselves, and thus, they rely upon the chloroplast to carry out photosynthesis. Within the chloroplast are pigments that absorb the light necessary for photosynthesis. Inside the chloroplast are grana,

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where most of photosynthesis is carried out.

DNA contains the genetic information necessary for actions within the cell to be carried out. DNA also contains the instructions for some proteins to be made. The DNA within eukaryotes is located within a central structure called the nucleus. The nucleus directs most of the activities within the cell. A prokaryotic cell, however, does not have a nucleus and the DNA exists freely as chromosomes. DNA exists as a double helix and is linear within the eukaryotic cell and circular within the prokaryotic cell.

The cell wall's main purpose is to provide protection to the cell. In eukaryotes, the cell wall is found in plant cells, located around the cell membrane. In prokaryotes, the cell wall is found in fungi, and ~~it~~ it covers the outside of the cell. In eukaryotes, the cell wall is made of cellulose, while in prokaryotes, the cell wall is made of chitin.

The endosymbiotic theory of the origin of eukaryotic cells states that eukaryotic cells have branched off from prokaryotic cells. Some cells have evolved from prokaryotic cells, and those are present-day eukaryotic cells.

BIOLOGY
SECTION II
Time—1 hour and 30 minutes

1 C1

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   - ~~DNA~~
   - ~~Cell wall~~
   - Ribosomes

   (c) **Explain** the endosymbiotic theory of the origin of eukaryotic cells and **discuss** an example of evidence supporting this theory.

Eukaryotes have membrane bond organs. Flagella is one of them. They are propellors coming of the outside of the cell. They are used to move the organism around. Another organ is the mitochontria. The mitocondria is the organ where energy is made. It preforms cellular respiration to produce ADP's for the cell. Non bound organs are DNA, Cell wall & Ribosomes. These vary in prokaryotes to eukaryotes. DNA in the Eukar is inclosed in a nucleus. Prokaryotes DNA just floats around the cytoplasm. The difference in the cell wall is that prokaryotes cell wall doesn't hold a certin shape. Eurkaryote cell walls are more structured and stiff. Lastly the ribosomes in a Eukaryote

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1C2

ADDITIONAL PAGE FOR ANSWERING QUESTION 1

are much bigger than the ones in a prokaryotes. They are bigger because ~~[illegible]~~ Eukaryotes need more ~~[illegible]~~ proteins synthase to make enzymes for its other organd. prokaryote are not as complex so their ribosome doesn't need to make as much.

Prokaryotes evolved into eukaryotes. They became more complex to survive in the environment. Fossils show how Eukaryotes survive on earth. Two Prokaryotes combined to make a Eukaryote. ~~[illegible]~~

They started duplicating and out surviving prokaryote. The ~~[illegible]~~ Eukaryote can change is DNA to fit in better in its surroundings.

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AP® BIOLOGY
2006 SCORING COMMENTARY

Question 1

Overview

This question tested students' knowledge of structures in prokaryotic and eukaryotic cells. The three-part question asked students to describe the structure and function of two membrane-bound organelles, to discern structural differences in two out of the three listed nonmembranous components common to prokaryotic and eukaryotic cells, and to explain and discuss the endosymbiotic theory of the origin of eukaryotic cells.

Sample: 1A
Score: 8

In part (a) the response earned the maximum of 4 points for correctly describing the structure and function of mitochondria and vacuoles. Even though the inner mitochondrial membrane was called the "intermembrane," the structure point was earned. The function point was earned not for stating the vacuole "is used for storage" but for the last sentence in the paragraph where the student states the role of the vacuole in contributing to the cell's "turgor." A total of 3 points was earned in part (b). The function of DNA earned a point, but the function of ribosomes is not explained. A point was earned for correctly explaining that ribosomes in eukaryotes are found on the endoplasmic reticulum and free in the cytosol, whereas in prokaryotic organisms ribosomes are found in the cytoplasm. The response earned a point by correctly distinguishing differences between eukaryotic and prokaryotic DNA. In part (c) the minimum explanation of the endosymbiotic theory earned a point. The student does not describe a cell engulfing a prokaryotic cell, but the portrayal of a prokaryotic cell being "inside" another and establishing a relationship shows sufficient knowledge of the concept. No point was earned for the evidence supporting the theory.

Sample: 1B
Score: 5

In part (a) 2 points were earned for identifying the functions of mitochondria and chloroplasts. No structure points were earned since the response does not describe the double membrane nature of these organelles and some distinguishing feature of their internal structure. Describing the function of DNA and the cell wall earned 2 points in part (b), and a third point was earned for correctly describing the linear vs. circular DNA in eukaryotes and prokaryotes. No points were earned in part (c).

Sample: 1C
Score: 2

In part (a) 1 point was earned for stating that mitochondria perform cellular respiration. Information on the flagellum did not earn points since it is not a membrane-bound organelle. In part (b) no function for DNA is given. One point was earned for correctly noting how eukaryotic DNA differs from prokaryotic DNA. No point was earned for the comment about cell walls. A third point could have been earned for distinguishing the size difference in ribosomes, but only the first two components discussed can earn points, as noted on the back cover of the pink exam booklet. In part (c) no points were earned since the statement "Two prokaryotes combined to make a eukaryote" does not adequately describe endosymbiosis.