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. In biological systems, structure and function are related. Choose three of the following components of organ systems.

alveolus	villus
sarcomere	capillary
nephron	neuron

   (a) For each component, **describe** the structure of the component and **explain** how that structure is responsible for the function of that component.

   (b) For the three components that you chose in part a, **explain** how the structure of the component contributes to the functioning of the organ system to which it belongs.

2. Charles Darwin proposed that evolution by natural selection was the basis for the differences that he saw in similar organisms as he traveled and collected specimens in South America and on the Galapagos Islands.

   (a) **Explain** the theory of evolution by natural selection as presented by Darwin.

   (b) Each of the following relates to an aspect of evolution by natural selection. **Explain** three of the following.

      (i) Convergent evolution and the similarities among species (ecological equivalents) in a particular biome (e.g., tundra, taiga, etc.)

      (ii) Natural selection and the formation of insecticide-resistant insects or antibiotic-resistant bacteria

      (iii) Speciation and isolation

      (iv) Natural selection and behavior such as kinesis, fixed-action-pattern, dominance hierarchy, etc.

      (v) Natural selection and heterozygote advantage

GO ON TO THE NEXT PAGE.

AP® BIOLOGY
2001 SCORING GUIDELINES

Question 1

A maximum 4 points for each component.

Elaboration point: 1 point for either **structure** or **function** after the first 2 points have been earned
* = required element to receive elaboration point

1 point **(a)** Describe **structure**	**1 point** **(a) Explain** how structure is responsible for function (**must be linked to structure described**)	**1 point** **(b) Explain** how the structure contributes to the function of the organ system to which it belongs
Sarcomere *** Thin-thick (i.e., actin-myosin or protein) filaments (i.e., myofilaments)** • cross-bridges • troponin-tropomyosin complex/Ca^{++} binding • detailed description of sarcomere (e.g., A-band, Z-line, etc.)	*** Shortening of sarcomere (unit) causes contraction** • sliding of actin filaments during contraction • number of groups of sarcomeres regulate strength of muscle contraction	*** Cause a muscle fiber (muscle) to contract (shorten) in the muscular system (muscle) OR movement in muscle**
Neuron *** Cell with dendrites and axon OR axon and dendrites and cell body OR nerve cell with cytoplasmic extensions** • myelin sheath/Node of Ranvier • plasma membrane (neurilemma) • Na^+/K^+ pump-gated channels • synaptic knobs/dendrite membrane receptors • axon hillock (i.e., neck of cell body)	*** Generate/conduct/transmit impulses (electrical/chemical signals or messages)** • speed of impulse transmission • change in membrane polarity • change in membrane polarity • neurotransmitters • origin of depolarization	*** Conduct impulses (electrical/ chemical signals or messages) in the nervous system**
Nephron *** (Renal) tubules and capillaries (glomerulus) OR** *** Tubular excretory unit of the kidney** • filtering unit • PCT, loop of Henle, DCT, collecting duct • epithelial cells • single layer of epithelial cells	*** Filtration of materials from blood** • (re)absorption of materials (e.g., HCO_3^-, NaCl, H_2O, glucose, amino acids, vitamins, K^+, urea) • tubular secretion of materials (H^+, NH_4^+, K^+, drugs, toxins) • counter-current multiplier	*** Regulates osmolarity/ waste removal/ homeostasis in urinary (excretory) system**

Question 1 (cont.)

Villus *** Finger-like (hair-like) projections in <u>small intestine</u>** • microvilli (brush border) • capillary bed and lacteals • single-cell layer/simple columnar epithelial • tight junction • goblet cells *** Also acceptable: Chorionic villus Finger-like projection in the placenta**	*** Absorption of digested material (nutrients)** • increase surface area • secrete mucus **Maternal-fetal exchange for nutrients, gases, etc**.	*** Increases amount of surface area for absorption of nutrients in digestive system** **Increases surface area for exchange in the reproductive system during fetal development**
Capillary *** Small(est) blood vessel (i.e., tiny tubes carrying blood)** • one-cell layer • simple squamous epithelial (endothelium) • porous (fenestrated) • connects arterioles (arteries,metarterioles) to venules (veins)	*** Movement of material (gases, nutrients, wastes, hormones, etc.) across capillary membrane** • increases surface area • blood cells moving through one at a time • low pressure • slowest velocity of blood • allows passage (conduit) for white blood cells • heat dissipation	*** Increases vessel contact with all body cells for the exchange of substances between body cells and blood in the circulatory system OR** **increases surface area in the circulatory system OR** **a description of a capillary network in the circulatory system**
Alveolus *** Air sac OR** *** Thin (single-celled) layer** • simple, squamous, epithelial cells • moist permeable membrane • surfactant • thin basement membrane	*** Allows gas diffusion (site to site)** • surface area (High SA/V ratio) • close association with capillaries • reduces surface tension, prevents collapse of alveolus • enhance diffusion	*** Increases amount of surface area which allows for the exchange of gases in respiratory system**