AP® BIOLOGY
2009 SCORING GUIDELINES (Form B)

Question 4

Many organisms require a continuing source of oxygen for respiration. **Discuss** important structural and physiological adaptations for oxygen uptake in THREE of the following:

- a paramecium
- a tree
- a fish
- a mammal

Each structural and physiological adaptation earns 1 point. Student must mention at least one structural and one physiological area to earn 10 points. **Only the first three** organisms mentioned earn points.

- **Paramecium (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Membrane surface area/volume small	Utilizes diffusion
Wet habitat	Cytoplasmic streaming
Membrane permeable to oxygen	Ventilation of surface with cilia

- **Tree (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Stomata/guard cells	Stomatal **regulation**
Large wet internal surface area in mesophyll	Surface for gas exchange
Lenticels	Cohesion, transport
Pneumatophores	Pressure flow/source to sink
Root hairs	
Epidermis permeable to oxygen	
	Photosynthesis production of oxygen

- **Fish (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Gills	Countercurrent exchange
Operculum	Operculum movement/gill slit movement
	Ram ventilation (swimming)
Vascularization/gill capillaries	Increase surface area/diffusion
	Blood flow—heart pumping
Hemoglobin	Iron molecules holding oxygen
Lungfish lungs	

Question 4 (continued)

- **Mammal (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Lungs	Homeostatic adjustments via medulla
Vascularization of alveoli	Capillaries increase surface area/diffusion
Hemoglobin/RBC	Iron molecules holding oxygen
Diaphragm/ventilation (breathing) mechanisms	Ventilation physiology
Four-chambered heart	Separate pulmonary and systemic blood
	Blood flow—heart pumping

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d) Mammal - In the mammal lungs, there are alveoli's - grape-like clusters at the end of bronchioles, which increase the surface area for O_2 uptake for respiration. When Oxygen then diffuses into the capillaries around the alveoli and into the bloodstream attached to hemoglobin in redblood cells - hemoglobin is an iron-containing protein which latches on to oxygen & carries it to cells for respiration. Alveoli's & hemoglobin are important structural and physiological adaptations for O_2 uptake in mammals.

b) trees - In trees the stomata bark contains lenticels - which allow for CO_2 to enter & O_2 to leave - Although the leaves contain stomatas, which are controlled by the guard cells, allow CO_2 to enter & O_2 to leave.... ~~Although, not all the O_2 leave~~ Not all the CO_2 is needed for chloroplasts in order for photosynthesis, the O_2 is made as a by-product Some O_2 escapes through the stomata but some stay and are used in the mitochondria for cellular respiration. The structural adaptation in trees is the lenticles and stomates.

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(c) In fish countercurrent exchange occurs- there countercurrent exchange is the diffusion of two substances in opposite directions, which ~~[illegible]~~ makes the uptake of the substance more efficient, because this mechanism makes diffusion more efficient. Oxygen dissolved in H2O diffuses through the gills of the fish and CO_2 diffuses out at the same time into the H_2O. ~~The gills are~~ Fishes, such as the bony fish, contain operculum, when fish aren't moving swimming, the operculum, contains 4-5 flaps which move H_2O over their ~~gated~~ gills for them; then the counter-current mechanism can occur. The structral adaptations that are the gills and operculum,

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Oxygen is essential for respiration in many organisms. Respiration is the uptake of oxygen which is then circulated throughout a body or plant in order to survive.

• A tree requires oxygen for various reasons. The tree also has certain structures which deal with oxygen. The process of photosynthesis releases oxygen as a byproduct. In photosystem II of photosynthesis, water is hydrolyzed and split so that oxygen is released. The oxygen is released through the stomata of leaves. Stomata are small pores in which the byproducts of photosynthesis are released into the atmosphere. Without plants and trees undergoing photosynthesis, humans would not have a source of oxygen readily available.

• A fish also requires oxygen but has unique physiological structures to obtain it. A fish has gills which open and close letting water flow over them. As the water flows over the gills, oxygen diffuses into the cells and capillaries into the blood. The gills are extremely sensitive and are able to obtain enough oxygen for a fish to survive underwater.

• A mammal has a unique respiratory and circulatory system to oxygenate its blood and body. A mammal has lungs which receive air from the mouth and trachea. The lungs are spongy and act by negative pressure. When a mammal breathes in the diaphragm lowers making the lungs expand and the pressure inside lower than the pressure outside. This makes air rush into the lungs. In the lungs there are many alveoli which oxygen diffuses into. They have alot of surface area to maximize oxygen uptake. The alveoli cells have many capillaries where the oxygen diffuses into the blood. The blood is then carried to the heart through the pulmonary veins.

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NSWERING QUESTION 4

The oxygenated blood enters the left atrium and moves through a valve into the left ventricle. Then, the oxygenated blood is pumped through the aorta and aortic valve to the body. This oxygenates the body's cells and organs. The de oxygenated blood then returns to the heart through the inferior and superior vena cava. The blood enters the right atrium and is pumped to the right ventricle. After that, it then is pumped through the pulmonary artery where it returns to the lungs to become oxygenated once more.

4C1

4. Many organisms require a continuing source of oxygen for respiration. **Discuss** important structural and physiological adaptations for oxygen uptake in THREE of the following:

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Organisms have adapted ways for a continual source of oxygen for respiration. Paramecium have adapted an open circulatary system. A paramecium would push the air into the air tubes the are spread within the body. The cells of the body then directly or indirectly by diffusion exchange oxygen for respiration. After exchanging for oxygen, the air would be then again pushed out by the path in.

Mammals have adopted a closed circulatary system. Mammals have hearts to pump blood throughout the body in the vestles. The cells of mamals obtain oxygen by the red blood cells that carry oxygen in the blood. After the red blood cell had given oxygen to the cells and obtained carbon dioxide, it would go to the lungs to exchange carbon dioxide for oxygen.

Fishes, like mammals, also adopted a closed circulatary system, but except that it is specialized to be used in water.

First, the water goes in the fish by A, the mouth. Then, the water flows past the tubes in part B. This place functions similarly to the lungs of mammals. It exchanges for oxygen at site B with the blood flowing countercurrent to increase the efficiency. The water would then leave the fishe's body at C. A physiological adaptation for fishes would be that its body would always be countercurrent, to save energy and let the water flow through the fish itself.

There is a common adaptation for the previous three. They are all able to continue the source of oxygen for respiration even uncautiously.

Trees have two different sources for oxygen. For the cells who are fortunately close to the cells who have choroplasts or have choroplasts themselves could directly obtain the oxygen as the result product of photosynthesis. For the cells who are less fortunate, could still

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obtain oxygen by the same circulation tubes for nutritions for the tree. By this, the cells who are away from the leaves could also obtain oxygen for respiration.

AP® BIOLOGY
2009 SCORING COMMENTARY (Form B)

Question 4

Sample: 4A
Score: 10

The response earned the maximum of 4 points for its discussion of mammals. It earned 3 points for describing the structures in mammals: lungs, capillaries (vascularization) in the alveoli, and hemoglobin in red blood cells. The response earned the physiology point for mammals by describing how there is an increase in surface area for oxygen uptake.

The response earned 3 points for a description of tree structures and physiological adaptations. Two points were earned for identifying structures called lenticels, which are used to acquire oxygen in trees, and the additional structure point was earned for the leaf structure stomata. A point for physiological adaptation was earned for oxygen production by photosynthesis.

The response earned 3 points for discussion of the structural and physiological adaptation in fish. The first point was earned for citing the physiological adaptation of the countercurrent exchange found in fish. Two points were earned for identifying structural adaptations: gills and the operculum.

Sample: 4B
Score: 8

The response earned 2 points in the tree discussion by addressing the physiological adaptation of photosynthesis, which provides oxygen, and the structural adaptation of the leaf, the stomata.

The response earned only 2 points with the fish discussion by providing two structural adaptations but no physiological adaptations. The first point was earned for citing the structural adaptation of gills, and the second point was earned for the vascularization in gills with the capillaries.

The final points were earned in the discussion of mammals by alternating structural adaptations and physiological adaptations. The first point was earned for identifying the structural adaptation of the lungs. The first physiological adaptation point was earned for the description of ventilation physiology when pressure changes during breathing. The final two points were earned for describing the structural adaptation of vascularization of the alveoli and the physiological adaptation of increasing the surface area for maximum oxygen uptake.

Sample: 4C
Score: 4

The response discussed four organisms when asked to include only three. For such responses, the first three discussions were used in scoring, and the fourth was not considered. In this response the paramecium, the mammal, and the fish are discussed first, and finally the tree. Because the tree is the fourth organism discussed, the information provided on the tree did not contribute to the score.

The response earned no points for its first organism, the paramecium. Three points were earned for the discussion of mammals. The first point was earned for mentioning the physiological adaptation of blood pumping by the heart. Two additional points earned for citing the two structural adaptations, the red blood cells and the lungs.

The response earned 1 point for the discussion of the physiological adaptation of the countercurrent mechanism in fish.