AP® BIOLOGY
2011 SCORING GUIDELINES

Question 2

Organisms utilize a diversity of methods to obtain proper nutrition.

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

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

	Organisms include, but are not limited to (1 point each)	**Identify process (1 point each)**
Intracellular	Protozoa, sponges, flatworms, Cnidaria	Breakdown/hydrolysis of food inside the cell.
Extracellular	Fungi, bacteria, invertebrates with a gut, Cnidaria, carnivorous plants, flatworms	Breakdown/hydrolysis of food in the gastrovascular cavity, gut, or outside of the organism.

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

	Structural feature	**Description (1 point each)**	**Explanation of structure/function relationship (1 point each)**
Stomach	Lining	Mucus layer	Protection from acid damage.
	Wall	Muscular	Mechanical digestion/churning/movement.
	Shape	Saclike	Food reservoir/storage.
		Rugae	Expansion/increase of surface area and secretions.
	Sphincter	Muscular ring	One-way movement through the system.
Small intestine	Villi	Fingerlike or hairlike	Increases surface area to increase absorption.
	Microvilli	Fingerlike or hairlike	Increases surface area to increase absorption.
	Duodenum	Tubular passageway	Enzyme-mediated digestion or nutrient absorption.
	Length/size	Long or folded	More area and time for absorption.

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Question 2 (continued)

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

	Description of plant structure (1 point each)	**Explanation of mechanism (1 point each)**
Root	Branched or fibrous	Increases surface area for absorption.
	Taproot	Increases soil penetration to reach deep nutrients.
	Nodules	Nitrogen uptake.
Root hairs	Hairs, thin extensions	More surface area for water/mineral absorption.
Leaf	Stomata/pores/openings in leaf	Carbon dioxide uptake, transpiration drives water/mineral uptake.
Trap	Chamber for catching/digesting prey	Breakdown of prey into nutrients absorbed through chamber wall.

2. Organisms utilize a diversity of methods to obtain proper nutrition.

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

a) A nonvertebrate organism that digests intracellularly is an amoeba. This organism digests food by physically engulfing it by creating a vacuole, or vesicle, from the outer membrane and then secreting digestive enzymes to breakup the food into smaller particles and nutrients that can be used by the amoeba.

A nonvertebrate organism that digests food extracellularly is a hydra. This organism has two cell layers and there is a tube that goes through the organism that is continuous with the surrounding environment. Food takes in by the hydra through the opening that serves as a mouth passes into the digestive tract (the tube) and is broken down into smaller particles that the hydra can use. The wastes are then sent through the rest of the tube and through the anus and are excreted. The wastes from the

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digestive processes of the amoeba are disposed of in two ways. Some wastes are expelled from the cell through the semi-permeable outer membrane. Some wastes are broken down by digestive enzymes within the amoeba. These enzymes are secreted by the lysosome into vacuoles or vesicles that contain the waste products of the digestive process.

(b) The human stomach has chief cells that secrete mucus to protect the lining of the stomach from very acidic digestive enzymes, such as hydrochloric acid, that help to digest food and help the body to receive the nutrients it requires to carry out the normal, daily functions. Having a mucus layer helps the stomach to maintain a very acidic environment that is effective in digesting food without damaging cells lining the stomach wall.

The small intestine has finger-like projections called villi. On these

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villi are ~~the~~ many thin, hair-like projections called micro-villi. The many folds in the small intestine ~~that~~ containing the villi help to increase the surface area of the small intestine. By increasing the surface area of the small intestine, ~~they~~ there is a greater available area to reabsorb nutrients and minerals. By absorbing more nutrients, the body is available to prevent spending time and energy to manufacture these essential nutrients.

c.) Root hairs are thin projections from roots that project into the soil. By having a ~~to~~ lot of root hairs, ~~and the~~ the plant has a greater surface area in the soil. By having this greater surface area, plants are able to rapidly take up water and nutrients ~~from~~ Nutrients diffuse through membranes ~~to~~ and into the roots; the ~~large~~ high surface area enables this diffusion to happen rapidly, allowing the plant to regulate the amount of nutrients present

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quickly, and is able to respond rapidly to the changes in the plant's needs.

The vascular tissue in the plant, namely xylem and phloem, is used to ~~[illegible]~~ transport nutrients and water and other materials throughout the plant. By having an elaborate vascular system that spreads throughout the plant, the plant can have nutrients come to all areas of the plant. The many metabolic processes in the plant can occur much ~~[illegible]~~ more readily with this adequate supply of materials

2.B1

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(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.

(a) Hydra is a nonvertebrate organism that digests food intracellularly. Food comes in through it's one opening & the interior layer of cells (only two layers) secrete digesting enzymes into the cavity. The food is slowly broken down, nutrients extracted, then waste expelled through same opening it entered in.

Mycorrhizae, a fungus (symbiotic w/ plants) digests its nutrients extracellularly by secreting digestive enzymes into the surrounding dirt. The enzymes then break down the substances for the fungus to "eat"/absorb.

(b) The microvilli of the stomach allows for increased surface area & therefore increased absorption of nutrients. The little appendages attached to sides of cells (on interior side) are like hairs; the nutrients are able to be absorbed more efficiently with more surface area.

~~The endothelial cells of the stomach are specialized~~ The small intestine contains many tissue folds on its interior also increasing it's uptake of nutrients by increasing surface area. The folds allow nutrients to flow over more tissue giving more opportunities for absorption.

(c) Root hairs on a plant extend from the roots of plants. They interact with the soil around them as well as the symbiotic fungi, mycorrhizae (sp.?) Again, these small appendages increase the surface area of the epidermis & allow for more absorption of water (by osmosis) & mineral nutrients found in the soil. The stomata on the leaves are openings that allow the uptake of nutrients from the surrounding air/atmosphere - chiefly CO_2. The stoma

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are gated w/ guard cells & are recessed openings (~concave) located on the bottom of leaves. ~~Stomata~~ The guard cells can "close" or "open" the stomata to balance the transpiration v. uptake of CO_2 ratio, in a cost-benefit balancing act. When open, comb-like structures just inside the stomata allow for the diffusion of CO_2 from the atmosphere into the plant to be used for the Calvin cycle.

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2C1

2. Organisms utilize a diversity of methods to obtain proper nutrition.

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- **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.

a) An earthworm is an example of a nonvertebrate organism that digests food intracellularly. It does this by absorbing the soil through its skin, which is then entered into each stomach of its segmented body where it is processed and filtered and excreted through from each individual statement. One nonvertebrate organism that digests food extracellularly is a sponge. It does not have a digestive system, but if filters the water through its body to absorb the nutrients needed to maintain itself.

b) One feature of the human stomach is its mucous membrane that coats the inner lining of the stomach. This is used to protect the tissues of the stomach from the high acidity of its contents which are used to digest molecules by denaturing them. One feature of the human small intestine is the easily diffusible membrane of the intestine. The function of this membrane serves to allow any useful nutrients to be absorbed before the contents of the intestine are converted to waste and excreted from the body.

c) One plant structure that has a mechanism for obtaining nutrients is the root hair, which further consists of villi and microvilli. These hairs exponentially increase the roots total surface area, allowing for more absorbancy of nutrients and water through the soil by chemiosmosis and diffusion. The

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plant leaves also help with nutrient uptake because they are covered in stomata, which when open allow the plant to do gas exchange, ~~which provides~~ providing the plant with CO_2, ~~which~~ which then allows the plant to meet its requirements for and to conduct ~~photosynthesis~~, where it makes its own ~~energy~~. The leaves also consist of chloroplasts, which consist of thylakoids where the electron transport chain and oxidative ~~phosphorylation~~ occur, ~~which provides~~ also helping the plant [redacted] its own energy.
Produce

AP® BIOLOGY
2011 SCORING COMMENTARY

Question 2

Overview

Question 2 focused on nutrition. In part (a) the distinctions between intracellular and extracellular digestion, along with one example of an invertebrate organism that utilizes each type of digestion, were requested. In part (b) the focus changed to human digestion by requesting a description of structural features of the stomach and small intestine, along with an explanation of structure and function. In part (c) the focus shifted to plants, with a request for the description of two plant structures used for obtaining nutrients, again with an explanation of structure and function.

Sample: 2A
Score: 10

The response earned the maximum of 4 points in part (a). One point was earned for identifying the amoeba as an organism that digests intracellularly; another point was earned for describing intracellular digestion by stating that the amoeba physically engulfs the food and secretes "digestive enzymes to breakup the food." The hydra is identified as an organism that digests extracellularly. Because the hydra (a cnidarian) uses both forms of digestion, the identification point was not earned until a correct description of extracellular digestion is given: the hydra passes food "into the digestive tract" where it "is broken down into smaller particles that the hydra can use." With that statement, 2 points were earned, 1 for the description of the process and 1 for the correct identification.

The response earned the maximum of 4 points in part (b). One point was earned for describing the mucus lining as a structural feature of the stomach, and 1 point was earned for stating that the function of the lining is "to protect … the stomach from … digestive enzymes" and "hydrochloric acid." A second structural feature point was earned for describing villi as "finger-like projections," and a second function point was earned for stating that the villi "increase the surface area of the small intestine."

In part (c) 1 point was earned for describing the root hair as a plant structure that is utilized for nutrient uptake, and 1 point was earned for explaining that root hairs create "a greater surface area in the soil" so "plants are able to rapidly take up water and nutrients." No points were earned for naming vascular tissue as another plant structure for nutrient uptake.

Sample: 2B
Score: 8

In part (a) 1 point was earned for identifying fungus as an organism that uses extracellular digestion. One point was earned for the description of the process, which involves "secreting digestive enzymes into the" surroundings, then breaking down "the substances for the fungus to … absorb." Using the hydra as an example of intracellular digestion did not earn any points, because the student describes extracellular digestion.

In part (b) 1 point was earned for describing the "tissue folds" as a structural feature of the small intestine, and 1 point was earned for explaining that the folds increase "uptake of nutrients by increasing surface area." No points were earned for the discussion of microvilli, because they are incorrectly described as a structural feature of the stomach.

Question 2 (continued)

The response earned the maximum of 4 points in part (c). One point was earned for the description of root hairs that "extend from the roots" as a plant structure used in nutrient uptake. One point was earned for explaining that root hairs "increase the surface area of the epidermis & allow for more absorption of water … & mineral nutrients." A second plant structure point was earned for describing stomata as "openings" on a leaf, and 1 point was earned for explaining that stomata allow uptake of carbon dioxide "from the surrounding air/atmosphere."

Sample: 2C
Score: 6

No points were earned in part (a).

In part (b) 1 point was earned for describing the mucus membrane lining as a structural feature of the stomach, and 1 point was earned for explaining that the function of the lining is "to protect the tissues of the stomach from the high acidity of its contents."

The response earned the maximum of 4 points in part (c). One point was earned for a description of the root hair as a structure for nutrient uptake, and 1 point was earned for explaining that root hairs "increase the root's total surface area, allowing for more absorbency of nutrients." A second plant feature point was earned for describing "stomata, which … open," and 1 more point was earned for explaining that stomata "allow the plant to do gas exchange, providing the plant with CO_2."