AP® Biology
2003 Sample Student Responses
Form B

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3. Water is important for all living organisms. The functions of water are directly related to its physical properties.

(a) **Describe** how the properties of water contribute to TWO of the following.

- transpiration adhesion - water
- thermoregulation in endotherms
- plasma membrane structure

(b) Water serves as a reactant and a product in the carbon cycle. **Discuss** the role of water in the carbon cycle.

(c) **Discuss** the impact of one human activity on the water cycle.

a) The property of adhesion of water contributes to transpiration. Adhesion is the ability of the water to be attracted to different molecules. The water is attracted to tracheid cells in plants and this way the upward flow of water is established. Another property is cohesion the sticking together (attraction of water molecules to each other. This also helps transpiration since when one water molecule evaporates from the leaf another molecules is pulled up by cohesion.

In the plasma membrane structure which is made up of a phospholipid bilayer. The waters property of polarity can be observed. polar molecules can dissolve in water and therefore are hydrophilic the phosphate heads of the cell membrane layers face the extracellular matrix and the plasma. Where as the polar, hydrophobic tails of the phosphlipids face inside the membrane. This gives the membrane its selective permeability, small molecules that are dissolved in water can pass through the membrane but large non polar molecules cannot pass.

b) In the carbon cycle O_2 resulting from the break down of CO_2 combine with H^+ in the strona

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3A2

of the chloroplasts and form H_2O this way water is a product of the Carbon cycle.

c) Due to the increase in industrialization and the increased production of gases like methane, CO_2 and CO the atmosphere is getting more polluted as a result of human activity. When water evaporate from water bodies like oceans, lakes and rivers the evaporating gases make up the clouds in the atmosphere. The accumulation of these water molecules return back to earth by rains. When the air is polluted to such extend. The rain water is mixed with the harmful gases in the atmosphere and the rain is called acid rain. This way the harmful chemicals become a part of the water cycle and mix with the water bodies after rains.

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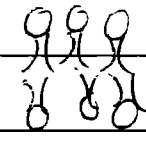
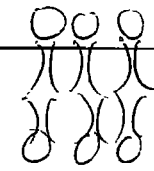
a) the properties of water are essential for transpiration.

The hydrogen bonds between ~~the oxygen & hydrogen~~ water molecules gives water the properties of cohesion & adhesion. Water moves up the xylem of plants b/c of diffusion. It moves from the areas w/ most water to areas of less water concentration. Thus, it diffuses into the air. The water can move up the xylem in a column that does not break thanks to its cohesive properties. Each water molecule pulls the next one up, etc... Adhesion to the sides of the xylem tubes & the capillarity of the tubes also contribute in transpiration.

* Plasma membrane structure

- Water is ~~polar~~ polar. The plasma membrane is composed of a ~~double~~ phospholipid bilayer: →  : A double layer of phospholipids - Phospolipids - a phosphate group w/ 2 attached fatty acid tails are amphiphatic molecules. The fatty acids are hydrophobic ~~while the phosphate heads~~ because they are non-polar. The phosphate head is polar & hydrophilic - Thus - these molecules arrange themselves so that the hydrophilic region (the head) is in touch w/ the water & the lipid tails are away from it. as so: 

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

b.) ~~Water is a polar molecule, which creates~~ Water is part of the carbon cycle in photosynthesis & respiration. In photosynthesis it is used, by plants, as a reactant along w/ CO_2 in order to ~~make~~ produce glucose. It is split by photolysis & its electrons are excited by light in the photosystems. ~~to~~ & used in the e⁻ transport chain. The O_2 released by plants is a byproduct that comes from splitting water.

In cellular respiration, water is a product. It is formed when the O_2, ~~that has accepted~~ pulling down electrons from the e⁻ transport chain combines w/ ~~2~~ hydrogen.

c.) Human activity - by polluting water resources ~~that~~ is responsible for acid rain.

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Water is a polar molecule, that is, it has a δ+ & a δ− end. The oxygen molecule has a greater pull on the shared electrons than does hydrogen because of its more paritive core. Oxygen has more protons than hydrogen does. Water molecules form hydrogen bonds with other water molecules. Hydrogen bonds are weak intermolecular bonds formed between the slightly positively charged hydrogen atoms & slightly negatively charged atoms, in this case oxygen. This attraction between water molecules is called cohesion. Water molecules are also attracted to other polar substances. This attraction is called adhesion. Cohesion & adhesion are two major properties of water that contribute to transpiration. Transpiration is water loss from the leaves of plants to the air. Stomata are small openings in the leaf through which water evaporates/transpires. Water transpiring from the leaf "pulls" on the water molecules behind it (cohesion). Water thus moves up the xylem of a plant to replace the lost water. Adhesion helps the water by attracting the water molecules to the walls of the xylem.

Water's high heat capacity contributes to Thermoregulation in endotherms. Heat capacity is the amount of energy needed to raise the temperature of 1g of substance by 1°C. Thermoregulation is the control of an organism's temperature to maintain homeostasis. An endotherm is an organism that does not rely on the environment to maintain its body temperature. Water is used by endotherms to lower body temperature. Humans are endoderms. When a human's

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body temperature goes above the desireable range, the body responds by sweating. Sweat consists largely of water. The water absorbs heat from the skin's surface & evaporates, removing heat from the skin & cooling the body.

Water as a reactant in the carbon cycle is incorporated into glucose during photosynthesis. Water molecules contribute the electrons that are excited by photons of light during the light-dependent stage of photosynthesis. The [redacted] hydrogen atoms from water are then incorporated into glucose molecules during the light-independent pcess of the Calvin-Benson cycle. The oxygen atoms form oxygen gas & are released into the atmosphere. Water is reproduced during cellular respiration when O_2 acts as an electron acceptor at the end of the electron transport chain & combines with H^+ ions passing through ATP synthase in the mitochondria.

human pollution causing an increase in atmospheric CO_2 & a decrease in ozone has caused [redacted] global warming. This increase in temperature means that more water evaporates & transpires. This has dried up a lot of land, creating more desert. The heat is also melting the polar ice caps causing a rise in sea level. The global warming causing pollution includes activities such as using cars & freon refrigerators.

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