

CHAPTER 2

Properties of Water and the Hydrosphere

1. Water has a high surface tension. With a little searching on the internet, explain what surface tension is. How does the molecular structure of water contribute to its high surface tension?

Answer: Surface tension makes liquid water behave as though its surface were covered with a membrane that prevents it from wetting material that it contacts. The surface tension of water is largely due to its hydrogen bonding capacity.

2. Describe ways in which measures taken to alleviate water supply and flooding problems might actually aggravate such problems.

Answer: Construction of levees and dikes prevents water from spreading out around rivers and dams are used to make impoundments for water. When these structures are overwhelmed by extreme precipitation events the resultant flooding is much worse than it otherwise would have been without these measures.

3. The study of water is known as _____, _____, is the branch of the science dealing with the characteristics of fresh water, and the science that deals with about 97% of all Earth's water is called _____.

Answer: Hydrology, limnology, oceanography.

4. Consider the hydrologic cycle in Figure 2.2. List or discuss the kinds or classes of environmental chemistry that might apply to each major part of this cycle.

Answer: As examples, atmospheric chemistry can lower the pH of rainwater by oxidation of acid-forming gases, geochemical interactions of groundwater with mineral strata add solutes such as alkalinity and calcium to water, and the high dissolved sodium chloride content of ocean water makes the chemistry of this water relatively unique.

5. Consider the unique and important properties of water. What molecular or bonding characteristics of the water molecules are largely responsible for these properties? List or describe one of each of the following unique properties of water related to (a) thermal characteristics, (b) transmission of light, (c) surface tension, (d) solvent properties.

Answer: The polar nature of the water molecule and its ability to form hydrogen bonds are very important in determining water's unique properties. These two characteristics of the water molecule are largely responsible for water's thermal characteristics, surface tension, and solvent properties. The lack of chromophores (color absorbing functional groups) on the water molecule enable it to transmit light (water is transparent).

6. Discuss how thermal stratification of a body of water may affect its chemistry.

Answer: The major effect is the formation of an anoxic layer in the bottom of a body of water results in chemically reducing conditions in this region whereas exposure to atmospheric oxygen in the upper layer favors chemically oxidizing conditions.

7. Relate aquatic life to aquatic chemistry. In so doing, consider the following: autotrophic organisms, producers, heterotrophic organisms, decomposers, eutrophication, dissolved oxygen, biochemical oxygen demand.

Answer: Autotrophic organisms convert simple organic compounds to biomass, producers use photosynthesis to generate biomass, decomposers are organisms that break down biomass

to carbon dioxide and other simple inorganic compounds, eutrophication occurs when excessive biomass is generated then decays, algae performing photosynthesis add oxygen to water, biodegradation consumes dissolved oxygen, and the presence of biodegradable organic matter is responsible for biochemical oxygen demand.

8. Summer fallowing is practiced in more arid agricultural areas to build up soil moisture for the following year's crops. Typically, it involves leaving crop residues in place on the soil surface and avoiding the growth of plants or grass. Why is it best to avoid such growth in order for summer fallowing to be successful?

Answer: A growth of plants would result in loss of soil moisture by transpiration

9. Western areas of the state of Oregon have a generally wet climate and the eastern sections are dryer with regions of desert. With a little research on the geography and topography of Oregon, suggest the reasons for these conditions.

Answer: The Cascade mountain range runs north and south somewhat inland from the Pacific coast. Moist air blowing inland from the Pacific forced upward over the mountains is cooled and releases rain. The air that descends on the east side of the mountains is dry and produces little rain resulting in arid conditions.

10. Suggest ways in which development and urbanization may adversely affect watersheds and groundwater recharge.

Answer: Buildings, paved roads, and paved parking lots prevent infiltration of surface water into groundwater aquifers. These same things plus drainage structures result in rapid runoff of water from the watershed.

11. Explain the action of streams in the sorting of sedimentary materials by size.

Answer: As the water flow in streams carrying suspended material may become slower so that the suspended matter settles. The coarser material settles first resulting in sorting.

12. On the internet, find some pictures of stone structures, such as cathedrals, in central Mexico City dating from Spanish colonial times. Relate any structural anomalies of these structures to groundwater.

Answer: Some pictures will show buildings from the early Spanish colonial era that have obviously settled and become distorted. Mexico City was built on a lake bed and pumping of underground water has caused the ground to subside resulting in structural damage to buildings.

13. What is water productivity? Suggest ways in which productivity may be a self-limiting process.

Answer: Water productivity refers to its ability to produce biomass by algae. It may be limited when the nutrients are exhausted or, if too much biomass is produced, eutrophication may result that chokes off further production of biomass.

14. Look up recent studies of the conditions of shells in marine shellfish and suggest how the observations may relate to atmospheric carbon dioxide levels.

Answer: Current research shows thinning of shells due to the action of acid from increased carbon dioxide levels in the water.