

SOLUTIONS TO THE MODULE #5 STUDY GUIDE

1. a. Hydrosphere – The sum of all water on a planet
 - b. Hydrologic cycle – The process by which water is continuously exchanged between earth's various water sources
 - c. Transpiration – Evaporation of water from plants
 - d. Condensation – The process by which a gas turns into a liquid
 - e. Precipitation – Water falling from the atmosphere as rain, snow, sleet, or hail
 - f. Distillation – Evaporation and condensation of a mixture to separate out the mixture's individual components
 - g. Residence time – The average time a given particle will stay in a given system
 - h. Salinity – A measure of the mass of dissolved salt in a given mass of water
 - i. Firn – A dense, icy pack of old snow
 - j. Water table – The line between the water-saturated soil and the soil that is not saturated with water
 - k. Percolation – The process by which water moves downward in the soil, toward the water table
 - l. Adiabatic cooling – The cooling of a gas that happens when the gas expands with no way of getting more energy
 - m. Cloud condensation nuclei – Small airborne particles upon which water vapor condenses to form clouds
2. The vast majority of water on the earth is saltwater, since more than 97% of earth's water supply is in the oceans.
 3. The largest source of freshwater is the glaciers and icebergs on the planet.
 4. The largest source of liquid freshwater is groundwater.
 5. Water can enter the atmosphere through evaporation and transpiration.
 6. If the raindrop never really soaks into the soil, it can end up in a river via surface runoff. It could also soak into the groundwater and get to the river via groundwater flow. Alternatively, it could go into the soil, be absorbed by a plant, transpired into the atmosphere, condensed into a cloud, and precipitated into the river. It could also be evaporated before it soaks into the ground, condensed into a cloud, and precipitated into the river. That's four answers, but you only need three of them.

7. Transpiration takes water from the soil and puts it in the atmosphere, because plants absorb the soil moisture and then put it into the atmosphere via transpiration.
8. The residence time in the river is shorter. The residence time will be shorter wherever water is quickly exchanged with other sources.
9. A lake must have a way to get rid of water other than just evaporation. This usually is accomplished when the lake feeds a river or stream. If evaporation is the only way of getting rid of water, the salts that the lake receives will become concentrated, making saltwater.
10. The oceans are not salty enough for the earth to be billions of years old. Since salt accumulates in the oceans, the older the earth is, the saltier the oceans will be. Calculations indicate that even assuming the oceans had no salt to begin with, it would take, at most, 62 million years (*not billions of years!*) to make the oceans as salty as they are now.
11. Melted sea ice would taste like saltwater, because salt is incorporated into sea ice when it freezes.
12. Icebergs come from glaciers. If a glacier moves to the sea, it can break apart and float away as icebergs.
13. Glaciers start on mountains as the result of snow that never completely melts in the summer. If enough snow piles up, the weight causes it to slide down the mountain as a glacier.
14. When a piece of a glacier breaks up and falls into the ocean, we called it calving.
15. The captain is worried because 90% of the glacier is underwater and therefore not visible. The captain steered clear of the visible part, but the underside of the boat could still hit the part that is underwater.
16. The water table will be deeper in the area with lots of trees. Since there are no trees to take away soil moisture in the one area, and since they each have the same kind of grass, the area with the trees depletes soil moisture faster than the other one. As a result, there will be more unsaturated soil in the region with trees, and the water table will therefore be deeper.
17. The air will cool as it expands. That's what adiabatic cooling is all about.
18. Like the cloud in Experiment 5.3, the fog will be thicker in the smoky area.
19. Like the cloud in Experiment 5.3, adiabatic cooling accounts for most cloud formation.
20. A refrigerator compresses a gas, which heats the gas up, and then it allows the gas to expand and any liquid to evaporate, which cools the gas. The only reason the inside of the refrigerator is cold is that the pipes carrying the expanded gas are exposed to the inside of the refrigerator. If you simply reversed the design so that the pipes carrying the gas after compression are on the inside of the refrigerator, the inside would heat up.
21. Groundwater pollution is hard to track back because there is no easy way to tell where the polluted groundwater came from.