Assignment #1 - Correct Answers

1.

a) upwelling: cold water from the deep oceans that reach the surface and bring nutrients for primary production
b) vadose zone: unsaturated zone or zone above the water table in groundwater that is saturated with air.
c) evapotranspiration: the amount of water evaporated and transpired by plants.
d) drainage basin: surface area drained by tributary streams that coalesce into a main channel.

2. Total volume of the aquifer: 900,000 m^3; Surface area of 60,000 m^2. Maxium depth of the aquifer: 900,000 m^3 / 60,000 m^2 = 15 m. The water head cannot lower less than 5 m from the normal level to maintain the aquifer in operation, so the minimum water level can only be 10 m. The porosity of this aquifer is 0.7, which indicates that 70% of the volume of the aquifer consists of water. Therefore the total volume of groundwater available is 0.7 x 900,000 m^3 = 630,000 m^3 and the minimum volume of groundwater that has to remain in the aquifer is: 0.7 x 10 m x 60,000 m^2 = 420,000 m^3.

a) If rainfall is about 3 cm per day along the entire drainage basin during the wet season (3 months), the amount of water recharge during the wet season is: 0.03 m x 60,000 m^2 x 90 days = <u>162,000 m^3</u>.
To maintain the water level of the aquifer to 10 m, the amount of water pumped during the wet season (X) cannot be more than: 630,000 + 162,000 - X = 420,000 => X = 372,000 m^3 or 372,000 / 90 days = <u>4133 m^3/day</u>.

b) A gallon is 3.79×10^{-3} m^3 => 150 gallons = 0.568 m^3. Therefore, the number of people supplied with water from this aquifer during the wet season is: 4133 (m^3/day) / 0.568 (m^3/person) = <u>7276 people per day</u>.

c) Amount of rainfall during the dry season (9 months): 0.005 m x 60,000 m^2 x 270 days = 81,000 m^3. Pumping rate (assuming the aquifer is at full capacity to begin with): 630,000 + 81,000 - X = 420,000 => X = 291,000 m^3 or 291,000 m^3 / 270 days = <u>1078 m^3/day</u>. The number of people supplied with water during the dry season is: 1078 (m^3/day) / 0.568 (m^3/person) = <u>1898 people per day</u>.

d) The average number of consumer the aquifer can supply water each day during the year is: 7276 people/day x 90 days + 1898 people/day x 270 days = 1,167,300 people per year or, in average, <u>3198 people per day</u>.

3. Sea spray contains in average 15 g/l of NaCl. A lake of 1,000,000 m^3 lake that contains 15 mg/l NaCl contains initially: 15×10^{-3} (g/l) x 1×10^{9} (l) = 15×10^{6} g of NaCl.

a) Evaporation mainly removes water from solutions, leaving a seawater with a higher concentration of ions.

b) If precipitation is 1000 m^3/yr (or 10^6 l/yr) of water in the lake, and if this water contains 100 g/l of NaCl, the total mass of NaCl raining in the lake is: 100 (g/l) x 10^6 (l) = 10^8 g. The concentration of NaCl in the lake at the end of the year is therefore: $\frac{10^8 + 15 \cdot 10^6}{10^6 + 10^9} = 0.115 g/l$