Day 1: Introduction.

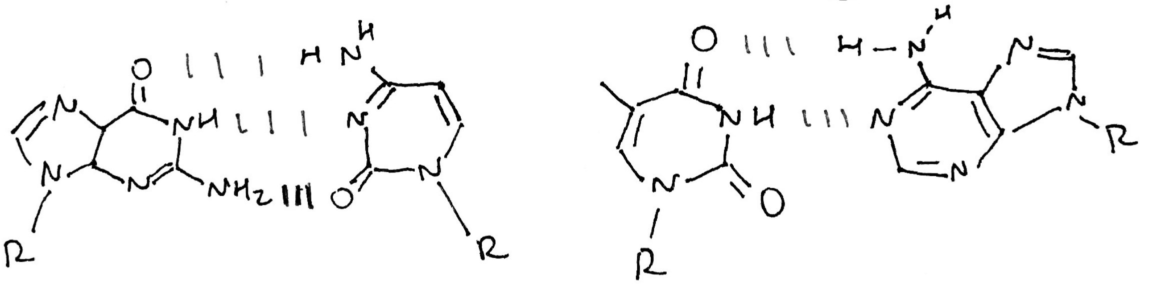
1. E. coli surface area: $\pi \cdot L \cdot \omega = \pi \cdot 3\mu m \cdot 1\mu m = 9.42 \mu m^2$

Water surface area: $\pi r^2 = \pi (1.5 \times 10^{-4} \mu m)^2 = 7.06 \times 10^{-8} \mu m^2$

Number of water molecules: $\frac{9.42 \mu m^2}{7.06 \times 10^{-8} \mu m^2} = 1.33 \times 10^8$ water molecules

2. Because of the density of ice (less than that of liquid water), lakes freeze from top to bottom, allowing fish to survive in the liquid part.

3. d) We see that the molecule is amphiphatic (it has two alcohols and a long hydrocarbon chain) so using soap is a must. On top of that, baking soda (basic pH) will help make this compound more polar (as it will lose a hydrogen) due to its pKa being 8.

4. 

5. Hemoglobin is necessary as the carrier for O_2, so if CO is displacing it (due to its higher affinity) it would feel like being asphyxiated.

~~$K_a = \frac{[R\text{-}NH_2][H^+]}{[R\text{-}NH_3^+]}$~~ fraction of glycine $R\text{-}NH_3^+ / R\text{-}NH_2$

a) $pH = pKa - \log \frac{[HA]}{[A^-]}$ ($[HA] = R\text{-}NH_3^+$, $[A^-] = R\text{-}NH_2$)

$pH - pKa = -\log [frac]$

$10^{-(pH-pKa)} = [frac] = 10^{-(9-9.6)} = \underline{3.98\%}$

b) $10^{-(10-9.6)} = 0.398\%$

~~1L~~ $1L \cdot \frac{0.1 \text{ mol Gly}}{L} \cdot 3.98\% = 3.98 \times 10^{-3} \text{ mol } R\text{-}NH_3^{\oplus}$

$0.398\% = 3.98 \times 10^{-4} \text{ mol } R\text{-}NH_3^{\oplus}$

$3.98 \times 10^{-3} - 3.98 \times 10^{-4} = 3.582 \times 10^{-3}$ mol KOH

$\cdot 56.1 \text{ g/mol} = \underline{0.2 \text{ g KOH}}$

c) $10^{-(pH-pKa)} = 99\%$

$-(pH-pKa) = \log(99\%)$

$pH - pKa = -\log(99\%) = \underline{4.365 \times 10^{-3}}$