

My name is: _____

WORD PROBLEMS ON FLUXES

Consider a uniform, steady flow that contains deep North Atlantic concentrations of nutrients, namely NO_3^- at a concentration of $14 \mu\text{M}$. After deep winter mixing, this concentration is flowing horizontally in a surface coastal current at 25 cm s^{-1} . Assume a molecular diffusion coefficient of $1.5 \times 10^{-5} \text{ cm}^2 \text{ s}^{-1}$. (1) What is the horizontal advective flux of NO_3^- ? A $1\text{-}\mu\text{m}$ diam *Chlorococcus* sp. is taking up NO_3^- very effectively so that its cell-surface concentration of NO_3^- is zero. (2) What is its uptake rate (per cell)? Later, in summer, a stably stratified nutricline sets up, with transfer during calm days through the nutricline being controlled exclusively by molecular diffusion. Over a 2-cm thick central piece of this nutricline, nitrate changes in concentration from 8 to $6 \mu\text{M}$ in concentration, with the $6 \mu\text{M}$ concentration found closer to the water surface. (3) What is the net flux, and what is its direction? Please note that I am intentionally reporting the diffusion coefficient and concentration in non-SI units. Please report your answers in SI units, however. The SI unit for concentration is mol m^{-3} , and $1 \text{ mol m}^{-3} = 1 \text{ mM}$.

Due in my mailbox (physical or electronic) by 0900 hours Monday, 1 November.