

Bio390

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Problem: Salamander Gas Exchange

The respiratory physiology of the aquatic salamander, *Siren intermedia*, has been extensively investigated by Ultsch. His 1974 publication is the source of the following data:

- a. body mass: 13.7 grams
- b. rate of oxygen consumption: 452 $\mu\text{l O}_2/\text{hour}$
- c. total surface area of skin: 57.53 cm^2 (assume oxygen uptake from the external environment takes place only through the skin)
- d. partial pressure of oxygen in water: 110 torr
- e. partial pressure of oxygen in blood in the blood vessels located in the skin: 23 mm Hg
- f. skin thickness: 100 μm
- g. temperature: 20°C

Assume the pressure difference in oxygen between water and blood is a steady-state condition.

(1) Estimate the amount of oxygen diffusing through the skin, in units of: $\mu\text{lO}_2(\text{hr cm}^2 \text{ mm torr})^{-1}$.

(2) Estimate Krogh's permeability coefficient for the skin of this animal and compare it to the values for various materials listed below.

MATERIAL	K in $\text{cm}^3 \text{O}_2 \cdot \text{cm} \cdot (\text{min cm}^2 \text{ atm})^{-1}$
water	34×10^{-6}
muscle	14×10^{-6}
connective tissue	11.5×10^{-6}
chitin	1.3×10^{-6}