

Name _____

Course/Section _____

Date _____

Professor/TA _____



Activity 40.1 How does an organism's structure help it maintain homeostasis?

1. To remain alive, an organism must be able to maintain homeostasis of its internal environment relative to the external environment. What structure(s) or system(s) are of primary importance in maintaining homeostasis in the following situations in amoeba versus mammal?

Situation	Amoeba	Mammal
a. Change in environmental: pH temperature		
b. Reception of stimuli, for example: light touch		
c. Response to stimuli		

2. Cells must be bathed continuously in an aqueous medium to take in oxygen and nutrients and get rid of waste products via diffusion. Diffusion is efficient over only short distances. In fact, diffusion is efficient only for a distance of about three cell diameters maximum (approx. 200 to 300 μm). Note the following times required to diffuse specific distances:

Diffusion distance (μm)	Time required for diffusion
1	0.5 msec
10	50 msec
100	5 sec
1,000 (1 mm)	8.3 min
10,000 (1 cm)	14 hr

- a. From the table calculate the mathematical relationship between the increase in distance and the corresponding increase in time required to diffuse that distance?
- b. How much time would be required for oxygen to diffuse 5 μm ? 200 μm ?

3. What happens to the surface area-to-volume (SA/V) ratio of a three-dimensional object (such as a cell) as its linear dimension increases? For example, how does the SA/V ratio of a sphere or cube change as the linear dimensions increase? (Formulas for a sphere: surface area = $4r^2$; volume = $\frac{4}{3}r^3$.) (Also see Activity 7.1.)

4. What effect(s) do the physical properties of diffusion have on the design of mammalian epithelia and epithelial cells and digestive and circulatory systems? In your answer consider also how SA/V ratios change as organisms become larger and the effect(s) this change can have on the design of organisms.