

Name: _____ Period: _____ Date: _____

Open [peededu.com](https://www.peededu.com) and navigate to **Cell Diffusion Explorer**. Click the **Start Experimenting!** button to begin. Read the introduction popup, which describes diffusion, the surface area-to-volume (SA/V) ratio, and why cell shape matters for efficient material exchange.

Free Response Questions

Question 1 – Conceptual Analysis

Simulation Task: Drag the **Star shape** (SA: 355.9) and the **Crescent shape** (SA: 162.1) into the beaker. Calculate the SA/V ratio for each shape (both have $V = 100$). Click **Start / Resume All** and observe which shape completes diffusion first. Note the difference in how quickly each shape fills with color.

(A) (1 pt) **Describe** the condition that must exist across a cell's membrane for passive transport of a substance to occur.

(B) (1 pt) **Explain** why the star-shaped cell completes diffusion before the crescent-shaped cell, given that both cells have the same volume but different surface areas.

(C) (1 pt) **Predict** how the rate of nutrient uptake by passive transport would change for an intestinal epithelial cell if a mutation caused it to lose its microvilli, reducing its surface area while its volume remained unchanged.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

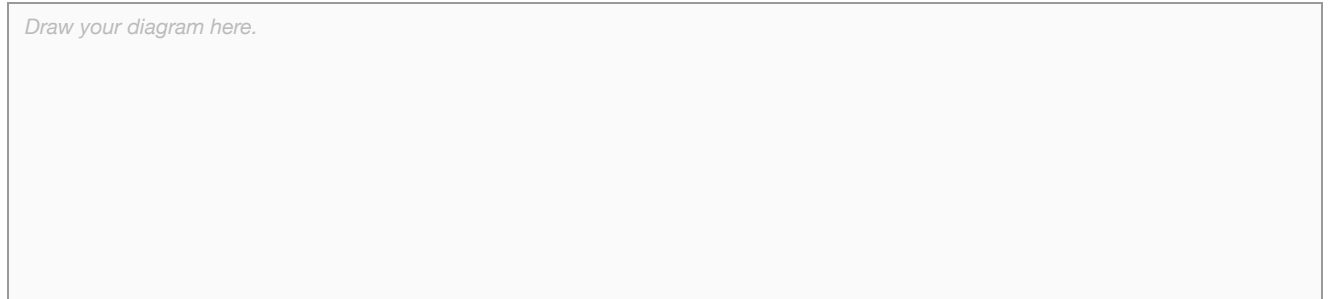
Simulation Task: Drag the **Circle** shape (SA: 251.4), the **Tall Rectangle** shape (SA: 200.0), and the **Amoeba** shape (SA: 251.2) into the beaker. Note that the Circle and Amoeba have nearly identical surface areas despite very different shapes. Click **Start / Resume All** and observe the diffusion rates for all three shapes.

(A) (1 pt) **Describe** how facilitated diffusion differs from simple diffusion in terms of the membrane structures involved, while both share the same requirement regarding energy input.

(B) (1 pt) **Explain** why two cells with the same volume but different shapes reach equal internal and external concentrations at different times during passive transport.

(C) (1 pt) **Represent** how cell shape affects diffusion efficiency by drawing two cells with the same volume -- one compact and spherical, one elongated with membrane projections -- using arrows to show the relative rate of diffusion across each cell's membrane and labeling the surface area-to-volume ratio for each.

Draw your diagram here.



(D) (1 pt) **Explain** how natural variation in the surface-area-to-volume ratio of cells among individuals in a population could lead to differences in survival when nutrient availability is limited.

2.5.A.2, EK 2.6.A.2