Size and shape

Year 11 Biology · ordinary

Card F · Shape, size and units

For a cube with edge a, surface area = $6a^2$ and volume = a^3. Surface-area-to-volume ratio = 6/a. Keep area and volume units: dividing μm^2 by μm^3 gives μm^{-1}. A ratio can be written as a surface area : volume pair, but “6 : 1” without dimensions can conceal a size change. A centre is a/2 from the nearest face.

Model cube	Edge	Surface area	Volume	SA/V	Face-to-centre distance
P	10 µm	600 μm^2	1,000 μm^3	0.60 μm^{-1}	5 µm
Q	20 µm	2,400 μm^2	8,000 μm^3	0.30 μm^{-1}	10 µm
R	40 µm	9,600 μm^2	64,000 μm^3	0.15 μm^{-1}	20 µm

Larger similar shapes have more total surface but less surface per unit volume and a longer route to the centre. These features can constrain exchange relative to demand and help explain cell-size limits. They do not alone prove an exact maximum size for all cells: permeability, shape, internal transport and metabolic demand also matter. Folds can add exchange surface; a thin shape can shorten diffusion distance. This table is geometry, not a measured biological experiment.

Slot 16 · Keep the units

Use Card F's rules. A new cube S has edge 30 µm. Calculate its surface area, volume, SA/V and face-to-centre distance. Compare it with P's 10 µm edge: does S have more total surface? More surface per unit volume? Explain both answers.

Your explanation · words, directed marks or a sketch

Surface area
Volume
SA/V / units
Centre distance / comparison

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Slot 17 · Same volume, different shape

A cube is 2 × 2 × 2 units. A rectangular model is 1 × 2 × 4 units. For a rectangular box, area = 2(lw + lh + wh), volume = lwh. Calculate each area, volume and area/volume. Find each shortest centre-to-face distance. Explain how the thinner model might help exchange and name one reason geometry alone cannot predict an actual cell's exchange rate.

Your explanation · words, directed marks or a sketch

Model 1 · not to scale



Model 2 · not to scale



Label dimensions, units and the question each measure answers.