ANSWER KEY.

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Surface Area to Volume Ratio

Biology | ANSWER KEY

Answer in complete sentences. Show your work for calculations.

1. Model three cells as cubes. Complete the table.

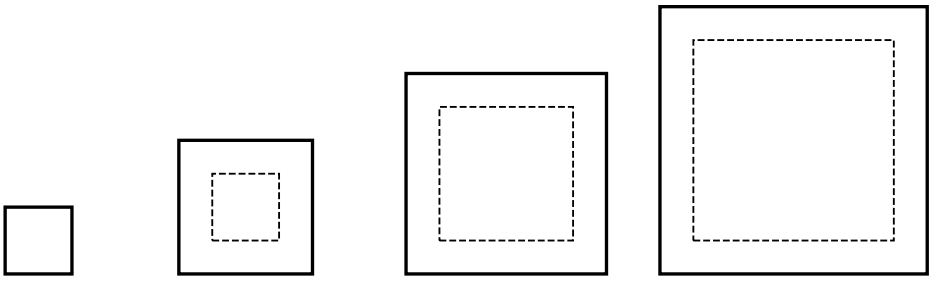
Side of cube (μm)	SA = 6 s^2 (μm²)	V = s^3 (μm³)	SA : V
2	**24**	**8**	**3 : 1**
5	**150**	**125**	**1.2 : 1**
10	**600**	**1000**	**0.6 : 1**

2. Look at your table. What happens to the SA : V ratio as the cube gets larger?

The SA : V ratio gets smaller. Volume increases faster than surface area.

3. Agar cubes of different sizes were soaked in dye. The dye reached 0.5 cm in from every face. The drawings show a slice of each cube (sample data).

Slice through agar cubes after the dye reaches 0.5 cm in from every face



1 cm cube	2 cm cube	3 cm cube	4 cm cube
100% colored	87.5% colored	70.4% colored	57.8% colored

Write a claim, evidence, and reasoning about how cube size affects the part of the cube the dye reaches.

Claim: the larger the cube, the smaller the percent of it the dye reached. **Evidence:** the dye reached 100% of the 1 cm cube, 87.5% of the 2 cm cube, 70.4% of the 3 cm cube, and 57.8% of the 4 cm cube. **Reasoning:** a larger cube has a smaller SA : V ratio, so less of its volume is close to its surface, and diffusion from the surface reaches a smaller share of it.

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4. A cube-shaped cell grows from a side of 10 µm to a side of 20 µm.

(a) By what factor does its surface area increase?

(b) By what factor does its volume increase?

(c) Does its SA : V ratio increase or decrease? Explain.

(a) SA: 6 x 20^2 = 2,400 μm^2 compared with 6 x 10^2 = 600 μm^2, so **4 times**.

(b) V: 20^3 = 8,000 μm^3 compared with 10^3 = 1,000 μm^3, so **8 times**.

(c) **It decreases (from 0.6 : 1 to 0.3 : 1).** The volume increases by a larger factor (8) than the surface area (4), so there is less surface for each unit of volume.

5. Explain how microvilli help an intestinal cell absorb nutrients more quickly.

Microvilli increase the cell's surface area without adding much volume, so there is more membrane through which nutrients can enter.

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