

Solutions

2.1

- $3/2.5 = 1.2 \mu m^{-1}$ – four times the hepatocyte's service ✓.

2.2

- $20/0.025 = 800$ ✓.

2.3

- $SA/V = 3/r$ falls as cells grow; folding membrane raises effective surface without raising volume.

3.1

- Hepatocyte $3/10 = 0.3$; reticulocyte $3/2.5 = 1.2$ – the small cell has $4\times$ the membrane service ✓.
- Demand (protein synthesis, pumping) scales with volume; the electron-transport chain lives on inner membrane, so mitochondria multiply to supply area.
- Consequence: secretory cells fold membrane (ER) and/or stay small or flat.

3.2

- Substrate cannot be dismantled at pH 4.8 → accumulates → lysosome swells → cell dies of failed recycling.
- Storage disease: the undigested substrate is stored in swollen lysosomes.
- pH ≈ 4.8 ; proton pumps keep it acidic so hydrolases are active only inside, protecting the cytosol (pH ~ 7.2).