

Cell specialization · supported focus

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

Supported HL focus. First assessment 2025; current subject brief acquired; full Biology guide not acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

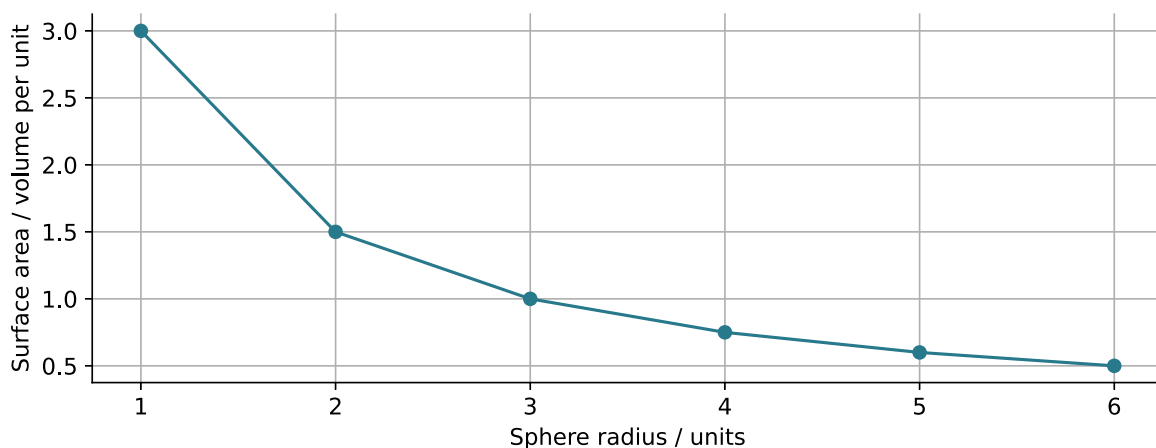
Specialized cells: structure linked to function

■ What would explain this observation?

- A root-hair cell and a red blood cell have different shapes because their functions impose different demands.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Differentiation** produces specialized cells through different patterns of **gene expression**. A root-hair extension increases exchange area. A mammalian red blood cell lacks a nucleus at maturity and contains haemoglobin; this is a specific adaptation, not a rule for all animal cells.
- differentiation: Development of specialized cell structure and function; gene expression: Use of genetic information to produce a functional product.



■ Choose evidence that can test it

- Link a named feature to a mechanism and then to the function. Increased area can support exchange, but membrane proteins, gradients and metabolic demand also matter. Stem cells retain different degrees of developmental potential.
- Compare scaled drawings of named cells. Label the structure, state the function and explain the causal link. Use tissue-specific examples rather than saying every specialized cell has every adaptation.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a spherical model cell has radius 2 units. Surface area/volume = $3/r$ = 1.5 per unit. A radius of 4 gives 0.75 per unit. Doubling radius halves this ratio, even though total area increases.

Example:

For a sphere, surface area/volume = $3/r$. Find this ratio when $r = 6$ units. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- Specialization does not usually require a cell to lose most of its genes. The spherical calculation models geometry; it does not describe every actual cell shape.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

All mature animal cells lack a nucleus. This claim is false: Specialization does not usually require a cell to lose most of its genes. The spherical calculation models geometry; it does not describe every actual cell shape.

Key:

Specialized cells: structure linked to function: Link a named feature to a mechanism and then to the function. Increased area can support exchange, but membrane proteins, gradients and metabolic demand also matter. Stem cells retain different degrees of developmental potential.