

Exercise walk-through

14.1

Specialized cells: structure linked to function

International Baccalaureate · IB Diploma · Biology · HL

14.1 Specialized cells: structure linked to function

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS differentiation • gene expression

Objective

Specialized cells: structure linked to function. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

1 Key knowledge and worked examples

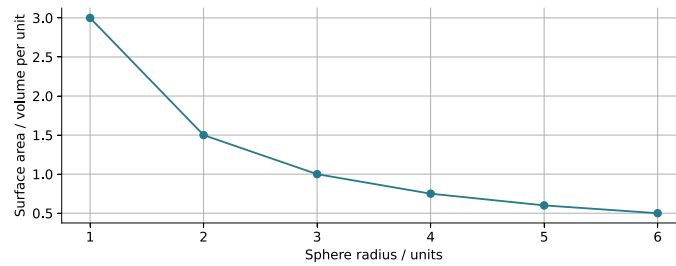
■ What would explain this observation?

- 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 expres-

sion: 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.

Exercises 2.1·2.3

2.1 What best explains many differences between specialized cells? Choose one answer.

- **A** They express different sets of genes
- **B** Every cell has a different genetic code
- **C** They have no shared ancestry

[1]

2.2 For a sphere, surface area/volume = $3/r$. Find this ratio when $r = 6$ units. Show the relation, substitution and units. [2]

2.3 Decide whether this claim is true and justify: All mature animal cells lack a nucleus. [2]

Exercises 2.1·2.3

2.1 What best explains many differences between specialized cells? Choose one answer.

- **A** They express different sets of genes
- **B** Every cell has a different genetic code
- **C** They have no shared ancestry [1]

2.1 A 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.

2.2 For a sphere, surface area/volume = $3/r$. Find this ratio when $r = 6$ units. Show the relation, substitution and units. [2]

2.2 $SA/V = 3/r = 3/6 = 0.5$ per unit length.

2.3 Decide whether this claim is true and justify: All mature animal cells lack a nucleus. [2]

2.3 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.

Exercises 2.4·3.1

2.4 Development of specialized cell structure and function: write the technical term. [1]

3 Exam-style questions

3.1 A spherical cell doubles radius. Compare area, volume and SA/V factors; explain why total area increasing does not remove exchange constraints. [4]

Exercises 2.4·3.1

2.4 Development of specialized cell structure and function: write the technical term. [1]

3 Exam-style questions

2.4 differentiation. differentiation means Development of specialized cell structure and function.

3.1 A spherical cell doubles radius. Compare area, volume and SA/V factors; explain why total area increasing does not remove exchange constraints. [4]

3.1 Area $\times 4$, volume $\times 8$, SA/V $\times 1/2$. Exchange capacity per volume falls in the geometric model; actual cell specialization also involves shape, transport and demand.