IB Biology B2.3 Cell Specialization

Worksheet 4 - Types of Stem Cells and Stem Cell Ethics

Name:	Class:	Date:
_____	_____	_____

Focus: B2.3.4 and TOK links: totipotent, pluripotent, multipotent, unipotent, therapy and ethics

Instructions: Answer all questions. This worksheet includes evaluation and ethics questions; give balanced biological arguments where appropriate.

Section A - Multiple choice

1. Totipotent stem cells can

A. form only one cell type
B. form any tissue and may form a complete organism
C. form only blood cells
D. only produce surfactant

2. Pluripotent stem cells differ from totipotent cells because pluripotent cells

A. cannot produce a complete organism
B. cannot differentiate
C. exist only in adult bone marrow
D. are red blood cells

3. Bone marrow stem cells that form different blood cells are

A. totipotent
B. pluripotent
C. multipotent
D. non-stem cells

4. A stem cell that forms only one cell type but can self-renew is

A. unipotent
B. totipotent
C. pluripotent
D. zygote

5. Stem cells cannot usually be distinguished by

A. their behaviour
B. how they divide
C. what they differentiate into
D. appearance alone

6. A common ethical concern about pluripotent embryonic stem cells is that

A. they contain no DNA
B. obtaining them can involve destruction of an embryo
C. they are found only in red blood cells
D. they cannot divide

Section B - Short answer

1. Compare totipotent and pluripotent stem cells. [3 marks]

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2. Explain why adult bone marrow stem cells are described as multipotent rather than pluripotent. [2 marks]

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3. State two possible medical uses of stem cell research. [2 marks]

4. Outline one scientific limitation and one ethical limitation of stem cell therapy. [4 marks]

Section C - Data response / case study

Case study: three unknown stem cell samples

Three samples were tested for differentiation potential in culture.

Sample	Observed potential
A	Formed muscle, nerve, pancreatic and blood cells, but did not form extra-embryonic tissues
B	Formed several types of blood cell only
C	Formed all embryonic and extra-embryonic tissues in an experimental model

1. Identify the likely stem cell type in samples A, B and C. [3 marks]

2. Give one reason why sample A could be useful in medical research. [2 marks]

3. Explain why sample C would normally be rare in an organism. [2 marks]

Section D - Extended response

Extended response: Evaluate the potential benefits and ethical concerns of using stem cells to treat disease. [8 marks]

Answer key and marking guidance - Worksheet 4 - Types of Stem Cells and Stem Cell Ethics

Use this section for teacher marking or student self-assessment. Award credit for equivalent wording if the biological idea is accurate and clearly expressed.

- MCQ: 1 B; 2 A; 3 C; 4 A; 5 D; 6 B.

- Totipotent vs pluripotent: both can divide and produce many cell types (1); totipotent can form all tissues and potentially a complete organism (1); pluripotent can form almost all body cell types but not a complete organism/extra-embryonic tissues (1).

- Bone marrow multipotent: produces a limited range of blood-cell types (1); cannot form almost all body cell types or a complete organism (1).

- Medical uses: disease modelling/development studies, drug safety testing, cell-based therapies, replacement of damaged cells in conditions such as diabetes, Parkinson's, spinal cord injury, burns, heart disease, stroke. Award 1 each, max 2.

- Limitations: scientific - control of differentiation, rejection, tumour risk, low success, mostly experimental (1-2); ethical - embryo destruction, consent, cultural/religious objections, regulation (1-2). Max 4.

- Data: A pluripotent (1); B multipotent (1); C totipotent (1).

- Sample A use: can generate many specialized cell types for testing or replacement (1); useful for studying differentiation/development or disease (1).

- Sample C rare: only exists in very early embryo (1); cells soon specialize/become pluripotent (1).

- Extended response marking: explains therapeutic replacement of damaged cells (1); gives disease/trauma examples (1); mentions research/drug testing/development knowledge (1); explains differentiation/self-renewal potential (1); ethical concern about embryo source/destruction (1); notes cultural/religious/legal restrictions or consent (1); includes scientific risks/limitations such as tumour, rejection or control (1); balanced conclusion (1).

General IB-style marking notes

- Do not award marks for vague statements without a clear biological link.

- For structure-function questions, award credit only when the structure is linked to the correct function.

- For data questions, accept rounded numerical answers if the working is correct.

- For extended responses, prioritize accurate terminology, logical sequence and use of relevant examples.