

Exercise walk-through

2.4

Stem cells, specialisation and phenotype (statements 3.17–3.21)

Pearson Edexcel · International A-Level · Biology

A eukaryotic cell is a set of compartments

Structure	Function
Nucleus	stores DNA behind a double membrane
Rough ER	folds and transports proteins from its ribosomes
Golgi	modifies, packages and exports proteins
Mitochondrion	aerobic respiration and ATP

Mitosis preserves chromosome number

Prophase : chromosomes condense, spindle forms



Metaphase : chromosomes line up on the equator



Anaphase : chromatids pulled to opposite poles



Telophase : nuclear membranes reform

Check yourself

Your turn

A pond sample has counts 60, 20, 15 and 5. What is the index of diversity?

- A. $N(N-1)$ over the sum of $n(n-1)$: 9900 over $4150 = 2.39$
- B. add the species counts first, then divide by four
- C. the largest count over the smallest count
- D. species richness times total individuals

Exercises 2.1·2.3

2.1 State the difference between a totipotent and a pluripotent stem cell. [2]

2.2 Explain why every cell in an organism has the same genes but different proteins. [3]

2.3 Give one example of a human phenotype affected by both genotype and environment. [1]

Exercises 2.1·2.3

2.1 State the difference between a totipotent and a pluripotent stem cell. [2]

2.1 Totipotent cells can differentiate into any cell type including placenta and a whole organism; pluripotent cells can form any tissue of the body but not extra-embryonic tissue.

2.2 Explain why every cell in an organism has the same genes but different proteins. [3]

2.2 All cells inherit the same genome at division; each cell type switches on only a subset of its genes via transcription factors, so different mRNAs and proteins are made.

2.3 Give one example of a human phenotype affected by both genotype and environment. [1]

2.3 Any correct example with both components: height, skin colour, weight.

Exercises 3.1·3.2

3.1 The Dsx gene of fruit flies is transcribed in every cell, but the pre-mRNA is spliced one way in males and another in females. Explain how this produces two different proteins from one gene, and name the level at which this control acts. [4]

3.2 Skin melanin amount is controlled by several genes (polygenic) and increases with sun exposure. Explain why skin colour in a population shows continuous variation rather than distinct categories, and what the environment adds to the genetic range. [5]

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3.1 The same pre-mRNA transcript has its introns removed and exons joined differently in the two sexes, producing mRNA molecules with different exon sequences, which translate into proteins with different amino-acid sequences and functions. The control acts after transcription – at RNA processing/splicing (post-transcriptional).

3.2 Skin melanin amount is controlled by several genes (polygenic) and increases with sun exposure. Explain why skin colour in a population shows continuous variation rather than distinct categories, and what the environment adds to the genetic range. [5]

3.2 Several genes each contribute a small, additive amount of melanin, so combinations of alleles give many slightly different levels – a continuum, not categories. Sun exposure adds environmental darkening on top of the genetic potential, so even identical genotypes differ in phenotype across environments.

Exercise 3.3

3.3 Stem cells from a blastocyst can be used to treat spinal injuries in trials. Describe the property of these cells that makes treatment possible, explain why rejection remains a risk, and give one ethical argument for and one against using embryonic stem cells. [6]

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3.3 Pluripotency – they can differentiate into the lost neuronal cell types. Rejection: the cells carry another individual's surface antigens, which the patient's immune system recognises as foreign. For: treatments can relieve untreatable suffering using embryos that would otherwise be discarded. Against: the embryo is destroyed, which those who grant it moral status cannot accept.