Mutation and variation

Student activity • observation and reasoning

YEAR 11 / LESSON 97 / BIOLOGY + SCIENCE (DOUBLE AWARD)

The question

Why do genetic changes have different effects?

Use the supplied examples, record your reasoning and correct it using evidence.

Equipment

- Student booklet, pencil and ruler
- Fictional variation and labelled sequence-model cards

Paper, modelling and written reasoning only. No chemicals or biological samples are handled.

Course coverage: Shared Biology / Double Award: 3.33–3.34. Biology-only extension: 3.35B–3.36B DNA changes and phenotype.

Plan, model or apparatus sketch

Draw and label the apparatus or biological model; identify one limitation.

Method and reasoning

Read the whole sequence before starting

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1. Classify fictional examples of variation as genetic, environmental or an interaction of both.

2. Define mutation as a change in genetic material and explain that it does not occur because an organism needs a particular benefit.

3. Distinguish a mutation in a reproductive lineage that may be inherited from a body-cell mutation not normally passed to offspring.

4. Biology extension: use a simple sequence model to show that some DNA changes alter amino-acid sequence while others do not.

5. Biology extension: explain why even an amino-acid change may have little effect, depending on protein function and context.

6. Biology extension: compare neutral, harmful and beneficial effects without claiming all mutations cause disease or improvement.

Cleanup

- Return models and keep the corrected work.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Mutations generate new genetic variation. Their phenotypic effects vary; many have no detectable effect, some have small effects and some have large effects. Selection acts on consequences in a particular environment rather than causing the needed mutation. Fictional examples: a plant inherits purple-flower alleles; an otherwise identical plant grows less in low light; plant height depends on inherited alleles and growing conditions. Biology sequence model (coding DNA, 5′ to 3′): TTT → TTC gives mRNA UUU → UUC, both phenylalanine; TTT → TTA gives UUU → UUA, phenylalanine → leucine. These are illustrative codons, not complete genes.

Example / trial	Observation / evidence	Explanation / limit
Evidence / comparison		
Explanation		
Limit / correction		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

YEAR 11 / LESSON 97 / BIOLOGY + SCIENCE (DOUBLE AWARD)

1. Can environment affect phenotype?

2. Do mutations arise because they are needed?

3. Must every body-cell mutation be inherited?

4. Biology: must every DNA change alter an amino acid?

5. Biology: must an amino-acid change alter phenotype strongly?

6. Can the effect depend on environment?