Polygenic traits and codominance

Student activity • observation and reasoning

YEAR 11 / LESSON 93 / BIOLOGY + SCIENCE (DOUBLE AWARD)

The question

Why do many traits not fit a simple dominant–recessive model?

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

Equipment

- Student booklet, pencil and ruler
- Graph paper and allele-model cards

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

Course coverage: Shared Biology / Double Award: 3.22 polygenic features. Biology-only extension: 3.21B codominance.

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. Explain that many phenotypic features are influenced by multiple genes and by environment.

2. Use the supplied fictional height frequencies to sketch a histogram with touching equal-width bins, then contrast the continuous height variable with purple/white flower categories.

3. Explain why a complex trait cannot be predicted reliably from a single Punnett square.

4. Biology extension: define codominance as both alleles contributing detectably to the heterozygous phenotype.

5. Biology extension: use a fictional coat-colour model with C^R and C^W both expressed in C^RC^W individuals; distinguish visible contributions from blending into a new intermediate colour.

6. Biology extension: cross $C^RC^W \times C^RC^W$ and calculate genotype probabilities.

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

Shared content: most phenotypic features involve more than one gene. Codominance is a Biology extension. The coat-colour example is an explicit model; 1/4 C^RC^R, 1/2 C^RC^W and 1/4 C^WC^W are probabilities, not guaranteed counts. Fictional plant heights (cm), binned for a histogram: 10–<12: 2 plants; 12–<14: 6; 14–<16: 12; 16–<18: 7; 18–<20: 3. These invented counts illustrate a continuous variable; the distribution alone does not prove polygenic inheritance.

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

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1. What does polygenic mean?

2. Can environment affect a polygenic trait?

3. Why is one Punnett square insufficient for many traits?

4. Biology: define codominance.

5. Biology: is codominance the same as incomplete dominance?

6. Biology: what is the heterozygote probability in the stated cross?