

# 30.1 Inheritance, variation and probability

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

KEY WORDS allele • genotype

## Objective

Inheritance, variation and probability. Supported SL 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?

- Two parents can carry a recessive **allele** without expressing the associated phenotype. Their children do not have to match the parents phenotypically.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

### ■ Build the model

- An allele is a variant of a gene. A **genotype** lists alleles; a phenotype is the expressed characteristic, influenced by genotype and sometimes environment. Dominant and recessive describe the relationship between alleles, not how common they are.
- allele: A variant of a gene; genotype: The alleles an organism carries.

Constructed Aa × aa cross

|   | A  | a  |                             |
|---|----|----|-----------------------------|
| a | Aa | aa | One allele from each parent |
| a | Aa | aa |                             |

Equal-probability model combinations

Boxes show possible outcomes, not a fixed sequence of births.

### ■ Choose evidence that can test it

- In a simple monohybrid cross  $Aa \times Aa$ , gametes carry A or a. Combining independent gametes gives AA, Aa, Aa and aa. The predicted probabilities describe many possible fertilizations, not a fixed order of children.
- Write parental genotypes and gametes before making the grid. State the inheritance model and phenotype key. Use a pedigree to check consistency with a model; do not infer certainty from a small family alone.

### ■ 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:  $Aa \times Aa$  with complete dominance. Probability of aa =  $1/4 = 25\%$ . Probability of the dominant phenotype =  $3/4 = 75\%$ . If four children are born, there is no guarantee that exactly one has the recessive phenotype.

### Example:

In  $Aa \times aa$ , what percentage of offspring are predicted to be aa? Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

### ■ Check the conclusion and its limits

- A dominant allele can be rare. Mutation is a source of new variation; selection changes the relative success of existing variants rather than directing mutations toward a goal.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

### Warn:

A dominant allele must be the most common allele in a population. This claim is false: A dominant allele can be rare. Mutation is a source of new variation; selection changes

the relative success of existing variants rather than directing mutations toward a goal.

**Key:**

Inheritance, variation and probability: In a simple monohybrid cross  $Aa \times Aa$ , gametes carry A or a. Combining independent gametes gives AA, Aa, Aa and aa. The predicted probabilities describe many possible fertilizations, not a fixed order of children.

## 2 Practice

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**2.1** What does a 25% probability in  $Aa \times Aa$  mean? Choose one answer.

- **A** Exactly one of every four siblings must be aa
  - **B** Each fertilization has probability one quarter of aa under this model
  - **C** The fourth child must be aa
- [1]

**2.2** In  $Aa \times aa$ , what percentage of offspring are predicted to be aa? Show the relation, substitution and units.

[2]

**2.3** Decide whether this claim is true and justify: A dominant allele must be the most common allele in a population.

[2]

**2.4** A variant of a gene: write the technical term.

[1]

## 3 Exam-style questions

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**3.1** For  $Aa \times aa$  under complete dominance, find the probability that two independently conceived offspring both have the recessive phenotype. Does a family of two have to match the ratio?

[4]

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