30.1 Inheritance, variation and probability

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS allele • genotype

Objective

Inheritance, variation and probability. Original classroom practice for IB SL; not an official IB paper.

1 Key knowledge and worked examples

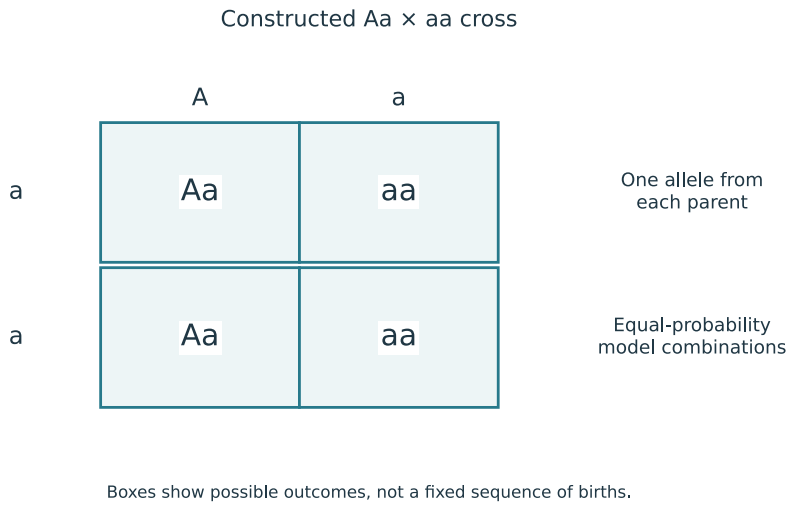
What would explain this observation?

- Two parents can carry a recessive **allele** without expressing the associated phenotype. Their children do not have to match the parents phenotypically.

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.

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Choose evidence that can test it

- In a simple monohybrid cross Aa × 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.

In the lab: 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

- Known: Aa × 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.

Your turn: In Aa × aa, what percentage of offspring are predicted to be aa?

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.

Not true: A dominant allele must be the most common allele in a population. Dominant describes how an allele is expressed in a heterozygote, not how common it is. A dominant allele can be rare in a population and a recessive allele can be common; frequency depends on inheritance and selection, not dominance.

Key:

- An allele is a variant of a gene.
- In a simple monohybrid cross Aa × Aa, gametes carry A or a.
- Watch for: A dominant allele can be rare.

■ **Write from an expected count of 4**

- In Aa times Aa, 16 offspring are produced.
- The expected number of aa is 4. That is a probability, not a guarantee. Dominant does not mean most common.

2 Practice

2.1 What does a 25% probability in Aa × 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 × 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]

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3 Exam-style questions

3.1 For Aa×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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Solutions

2.1 B The 25% is a probability for each fertilization under the model: each child of Aa x Aa parents has a one-quarter chance of aa. Chance has no memory, so no fixed number of aa children is guaranteed in any family of four.

2.2 Aa gives A or a with equal probability; aa gives only a. P(aa)=1/2=50%.

2.3 False. Dominant describes how an allele is expressed in a heterozygote, not how common it is. A dominant allele can be rare in a population and a recessive allele can be common; frequency depends on inheritance and selection, not dominance.

2.4 allele. allele means A variant of a gene.

3.1 $(1/2)^2=1/4$. Mendelian probabilities describe repeated independent outcomes; a family need not contain one child of each phenotype. State complete dominance and independence.

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