SCIENCE FOUNDATIONS

Mendelian genetics

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how gardeners predict the colours of pea flowers or breeders predict a puppy's coat, from the simple rules of how gene versions separate and recombine. Mendel's pea plants showed that traits pass down in predictable patterns, not at random. A farmer breeding wheat for disease resistance still uses the same rules to choose which plants to cross. Knowing Mendelian genetics tells you how to work out the odds of a trait showing up in the next generation, before a single seed is planted.



Rule

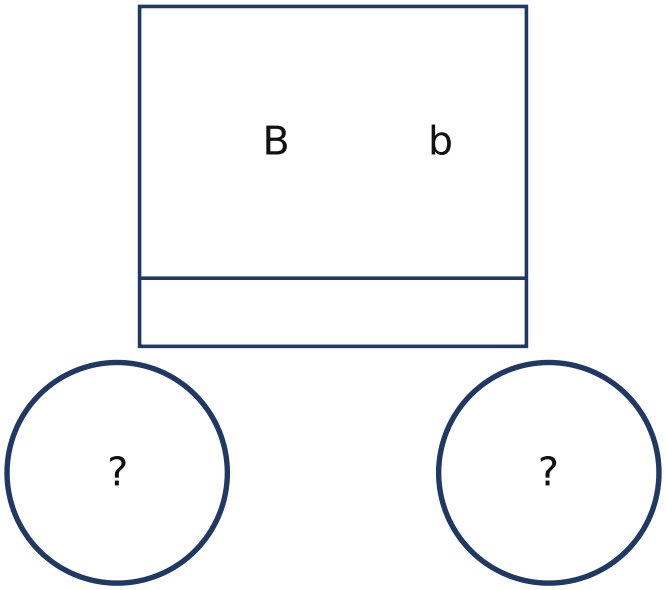
Mendelian genetics: allele pairs separate into gametes, so each offspring gets one allele for each gene from each parent. Different genes sort independently. A dominant allele shows with one copy; a recessive allele shows only with two copies.

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Worked examples

EXAMPLE 1

Q A pea plant is heterozygous Bb for flower colour, B dominant. What gametes can it make?



SOLUTION

Segregation: the B and b alleles separate into different gametes.

Each gamete gets one allele for this gene.

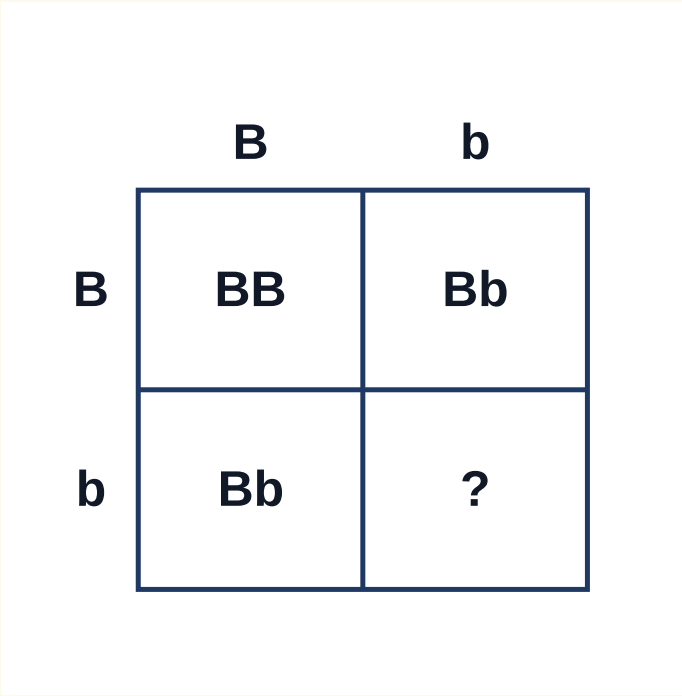
List them: B gametes and b gametes, equally.

The result is gametes B and b.

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EXAMPLE 2

Q Why do two heterozygous parents sometimes have a recessive child?



SOLUTION

Each parent can pass the recessive allele: both make b gametes.

A child getting b from both parents is bb.

Recessive shows only with two copies, so bb shows the trait.

The result is bb child shows the recessive trait.

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Practice questions

1 A pea plant is heterozygous Tt for height, with T dominant. What gametes can it make, and in what proportions?

- **A** T gametes and t gametes, in equal proportions
- **B** Only T gametes
- **C** T gametes and t gametes, 3 to 1
- **D** Only t gametes

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2 A pea plant is heterozygous Rr for seed shape, with R dominant. What gametes can it make?

- **A** Only R gametes
- **B** R gametes and r gametes
- **C** Only r gametes
- **D** R gametes and r gametes, 3 to 1

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3

Two heterozygous Rr pea plants are crossed, with R dominant for round seeds. Explain how a wrinkled rr child can result, and what trait the child shows (its phenotype).

A. Each parent can pass R, so a child getting R from both is RR and is wrinkled

B. Each parent can pass r, so a child getting r from both is rr and is wrinkled

C. The child gets r from one parent only and is rr

D. Wrinkled seeds come from the mother only

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4 Two heterozygous Tt plants are crossed. What fraction of their children would you expect to be short (tt)?

- **A** 1 in 2
- **B** 1 in 4
- **C** 3 in 4
- **D** All of them

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5 State the law of segregation in one line.

- **A** Allele pairs stay together in gametes
- **B** Allele pairs separate into gametes
- **C** Genes blend together in gametes
- **D** Gametes get two alleles for each gene

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6

State the law of independent assortment in one line.

A Different genes always stay together

B Genes sort by size

C Different genes sort independently

D Each gene sorts with its pair

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7

How many alleles for each gene does an offspring get from each parent?

A One

B Two

C None

D Four

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8 **A Bb parent is crossed with a bb parent. What genotypes can the children have?**

- **A** BB and Bb
- **B** Bb and bb
- **C** Only Bb
- **D** BB and bb

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9 **What is an allele?**

- **A** A version of a gene
- **B** A whole chromosome
- **C** A cell that makes gametes
- **D** A trait that always shows

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10 **A heterozygous Aa plant is crossed with a heterozygous Aa plant. What gametes does each parent make, and can they have an aa child? Explain.**

- **A** Each makes only A gametes; no, an aa child is not possible
- **B** Each makes A and a gametes; yes, an aa child is possible
- **C** Each makes A and a gametes; no, an aa child is not possible
- **D** One parent makes A gametes and the other makes a gametes; yes, an aa child is possible

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ANSWER KEY

1. T gametes and t gametes, in equal proportions

2. R gametes and r gametes

3. Each parent can pass r, so a child getting r from both is rr and is wrinkled

4. 1 in 4

5. Allele pairs separate into gametes

6. Different genes sort independently

7. One

8. Bb and bb

9. A version of a gene

10. Each makes A and a gametes; yes, an aa child is possible

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