SCIENCE FOUNDATIONS

Genotype and phenotype

Difficulty level: Intermediate

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Overview of the concept

This is how you tell the difference between the hidden gene letters a person carries and the trait you can actually see, like brown eyes that can hide a blue-eyed gene. Two parents with brown eyes can have a blue-eyed child if both of them carry the hidden gene. A dog breeder uses this to predict which puppies in a litter might show a coat colour neither parent shows. Knowing genotype and phenotype tells you why what you see is not the whole story, and why a trait can hide for a generation and then reappear.



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Rule

Genotype and phenotype: the genotype is the gene letters an organism carries, such as BB, Bb, or bb. Each gene letter is called an allele. The phenotype is the trait you can actually see.

One dominant allele is enough to show the dominant trait, so BB and Bb have the same phenotype. Only bb, with no dominant allele, shows the recessive trait. A genotype with two different alleles, like Bb, is called heterozygous.

Worked examples

EXAMPLE 1

Q BB and Bb pea plants: same phenotype or different?

SOLUTION

Read genotypes: BB has two dominant alleles, Bb has one.

Apply dominance: one dominant allele is enough to show the trait.

Conclude: both show the dominant phenotype.

The result is same phenotype, different genotypes.

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EXAMPLE 2

Q bb pea plant: genotype and phenotype?

SOLUTION

Read the genotype: bb, two recessive alleles.

Use dominance: with no dominant allele around, the recessive trait is the one that shows.

State both: genotype bb, recessive phenotype.

The result is genotype bb, recessive phenotype.

Practice questions

1 RR and Rr rose plants (R = red flowers): same phenotype or different?

- A Same phenotype, different genotypes
- B Different phenotypes, same genotype
- C Same phenotype, same genotype
- D Different phenotypes, different genotypes

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2 What does heterozygous mean?

- A Two different alleles, like Bb
- B Two identical alleles, like BB
- C No dominant allele
- D Two different genes

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3 A rr rose plant (r = white flowers): state its genotype and its phenotype.

- A Genotype rr, recessive phenotype
- B Genotype rr, dominant phenotype
- C Genotype RR, recessive phenotype
- D Genotype Rr, dominant phenotype

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4 **Two brown-eyed parents have a blue-eyed child. What must each parent's genotype be? B is the brown-eye allele and b is the blue-eye allele.**

A Both BB

B Both Bb

C One BB and one bb

D Both bb

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5 **Genotype definition?**

A Allele combination

B Observable trait

C Number of chromosomes

D Type of cell

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6 Phenotype definition?

- A Observable trait
- B Allele combination
- C Number of chromosomes
- D Type of cell

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7 Phenotype of Bb if B is dominant?

- A Dominant
- B Recessive
- C Hidden
- D Mixed

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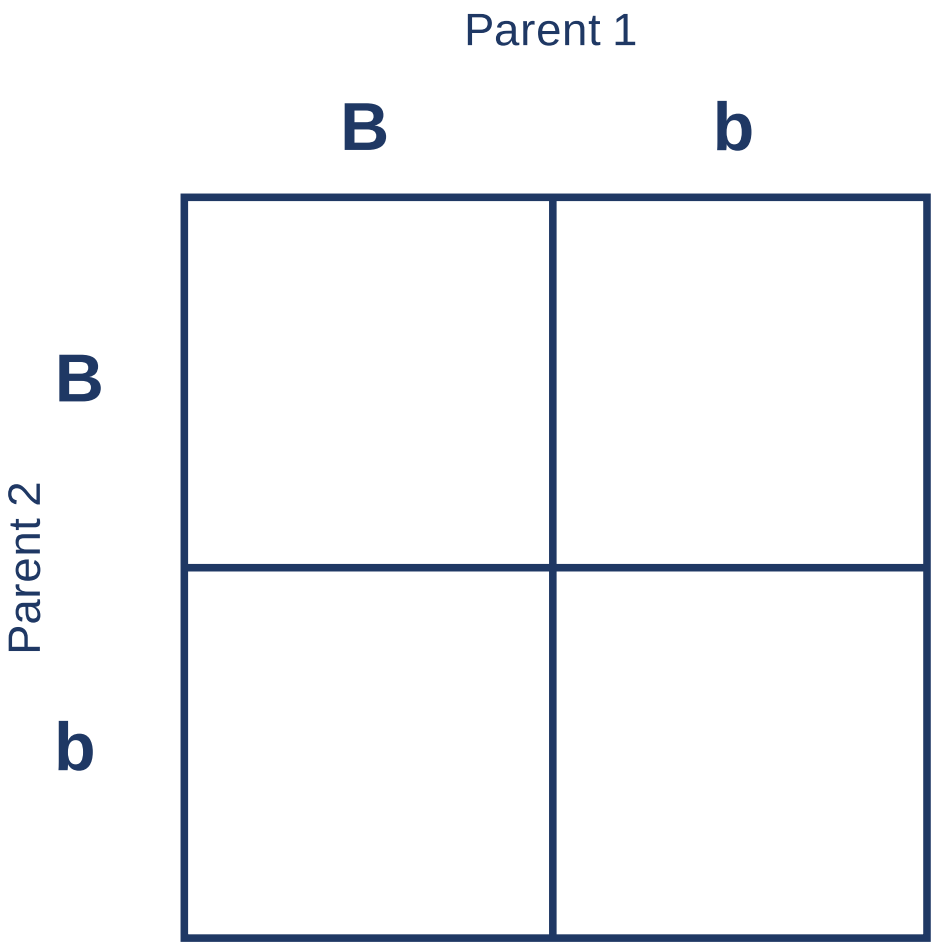
8 **Two heterozygous pea plants (Bb × Bb) are crossed. What is the genotypic ratio of the offspring? Use the Punnett square.**



A 1:2:1

B 3:1

C 1:1:1:1

D 2:1

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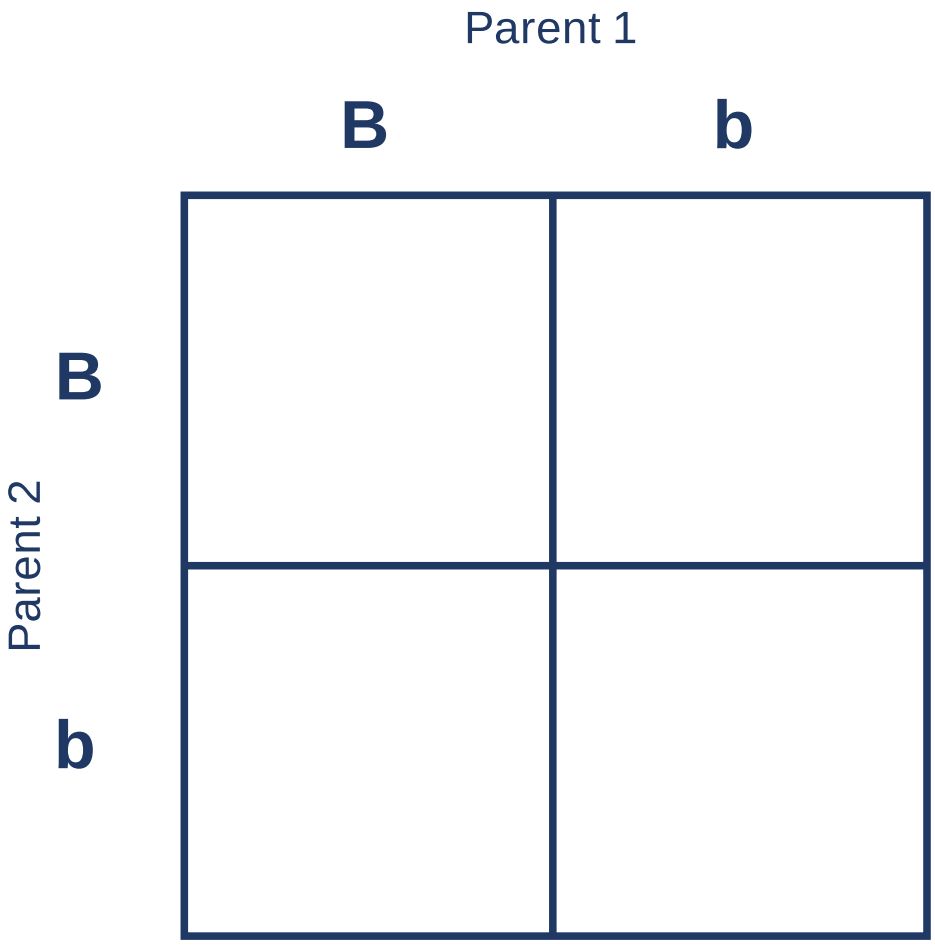
9

Two heterozygous pea plants (Bb × Bb) are crossed. What is the phenotypic ratio of the offspring? Use the Punnett square.



A 3:1

B 1:2:1

C 1:1

D 2:1

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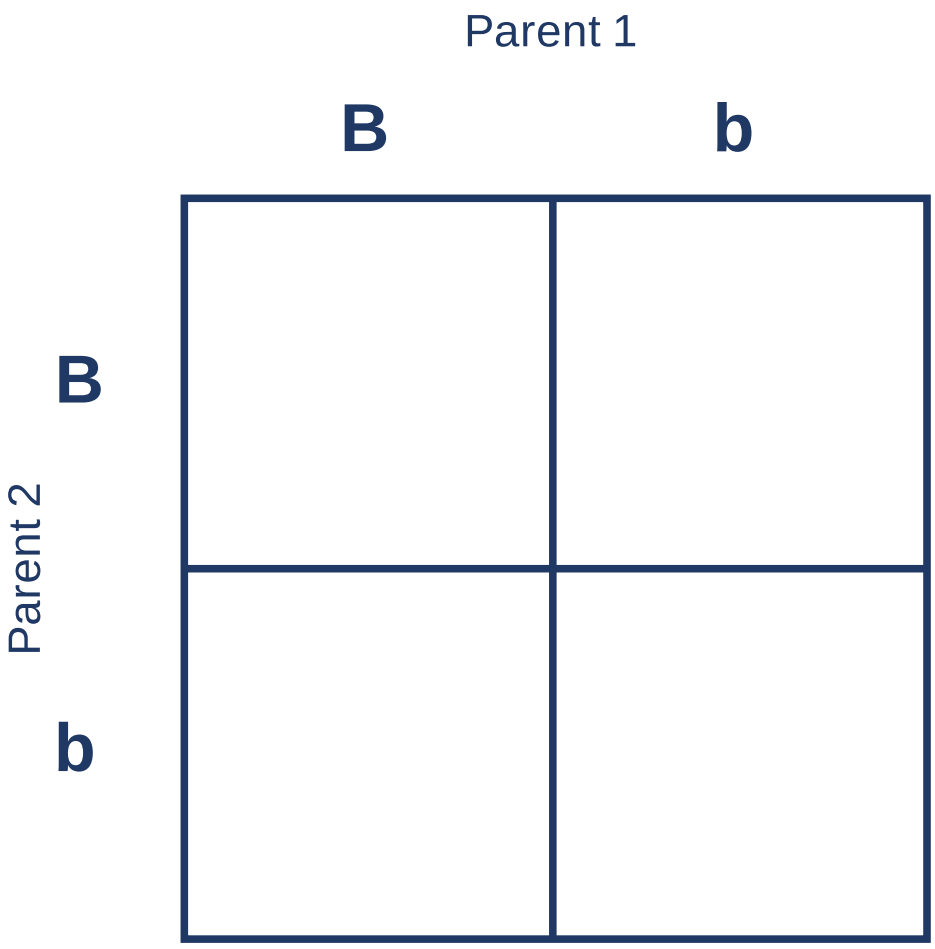
10 **Two heterozygous pea plants (Bb × Bb) are crossed. What is the probability that an offspring shows the recessive phenotype? Use the Punnett square.**



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ANSWER KEY

1. Same phenotype, different genotypes

2. Two different alleles, like Bb

3. Genotype rr, recessive phenotype

4. Both Bb

5. Allele combination

6. Observable trait

7. Dominant

8. 1:2:1

9. 3:1

10. $\frac{1}{4}$

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