SCIENCE FOUNDATIONS

Punnett squares

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how a family works out the odds of a child inheriting a trait like attached earlobes, or a farmer predicts the coat colours in a litter of puppies. A genetic counsellor uses the square to show parents the chances for each possible outcome, not a guarantee of one. A dog breeder plans a litter by working out which coat colours the puppies could show. Knowing Punnett squares tells you how to turn what two parents carry into odds for their children, before any baby is born.

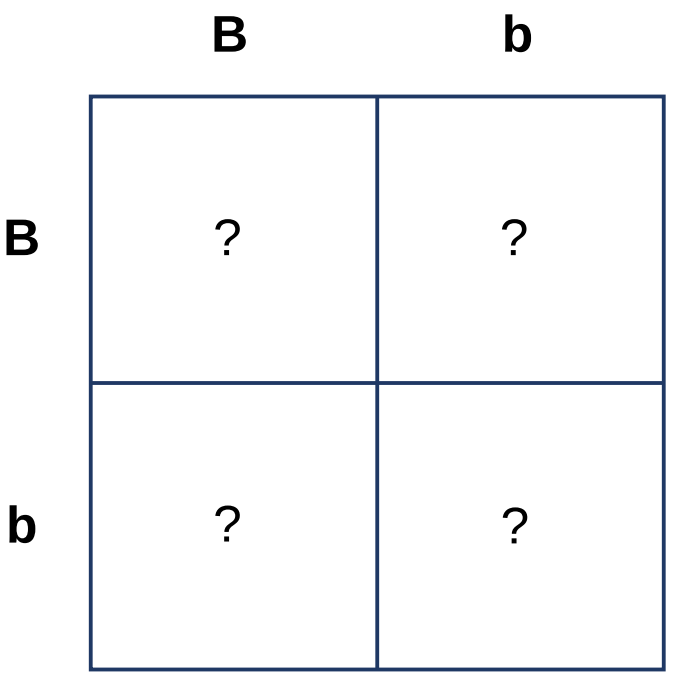


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Worked examples

EXAMPLE 1

Q You cross two heterozygous Bb pea plants, where B is dominant. What genotypes and phenotypes result?



SOLUTION

Write B and b across the top, B and b down the side.

Fill the boxes: BB, Bb, Bb, bb

Each of the four boxes is equally likely.

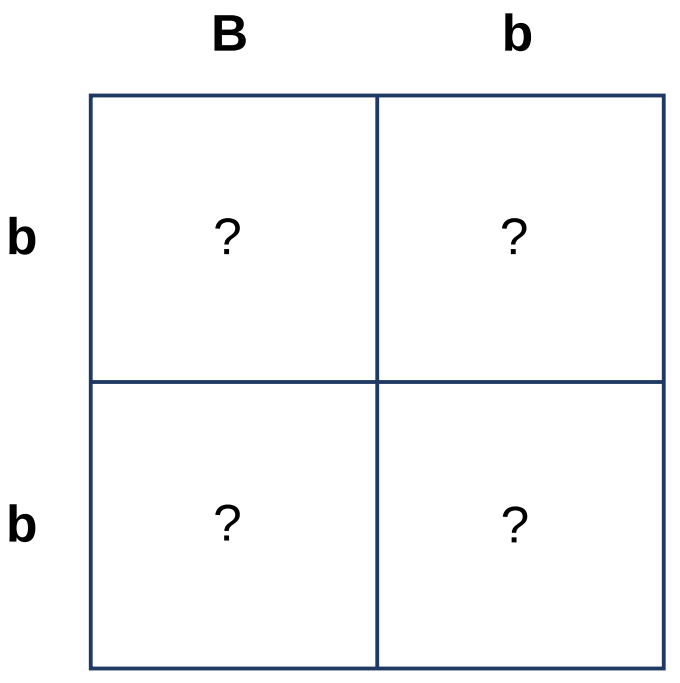
Count: genotypes 1 BB, 2 Bb, 1 bb; phenotypes 3 dominant, 1 recessive

The result is 1 BB, 2 Bb, 1 bb; 3 dominant, 1 recessive.

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EXAMPLE 2

Q You cross a Bb pea plant with a bb pea plant, where B is dominant. What genotypes and phenotypes result?



SOLUTION

Write B and b across the top, b and b down the side.

Fill the boxes: Bb, Bb, bb, bb

Count: genotypes 2 Bb, 2 bb; phenotypes 2 dominant, 2 recessive

The result is 2 Bb, 2 bb; 2 dominant, 2 recessive.

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Practice questions

1 **Cross two heterozygous Rr pea plants (R dominant for round seeds). Give the genotype and phenotype ratios.**

- **A** Genotypes 1 RR, 2 Rr, 1 rr; phenotypes 3 round, 1 wrinkled
- **B** Genotypes 1 RR, 2 Rr, 1 rr; phenotypes 1 round, 3 wrinkled
- **C** Genotypes 2 Rr, 2 rr; phenotypes 2 round, 2 wrinkled
- **D** Genotypes 4 Rr; phenotypes 4 round

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2 Cross two heterozygous Tt pea plants (T dominant for tall). What is the chance a child is short (tt)?

- **A** 1 in 4
- **B** 1 in 2
- **C** 3 in 4
- **D** 4 in 4

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3 Cross Tt with tt (T dominant for tall). Give the genotype and phenotype ratios.

- **A** Genotypes 2 Tt, 2 tt; phenotypes 2 tall, 2 short
- **B** Genotypes 1 TT, 2 Tt, 1 tt; phenotypes 3 tall, 1 short
- **C** Genotypes 4 Tt; phenotypes 4 tall
- **D** Genotypes 2 TT, 2 tt; phenotypes 2 tall, 2 short

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4 Cross RR with Rr (R dominant for round seeds). Give the genotype ratio of the children.

- **A** 2 RR, 2 Rr
- **B** 1 RR, 2 Rr, 1 rr
- **C** 4 Rr
- **D** 2 Rr, 2 rr

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5 Where do the parent alleles go in a Punnett square?

- **A** One parent across the top, one down the side
- **B** Both parents across the top
- **C** Both parents down the side
- **D** One parent in each box

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6

How is each box in a Punnett square filled?

A By combining its row and column alleles

B By copying the top parent only

C By copying the side parent only

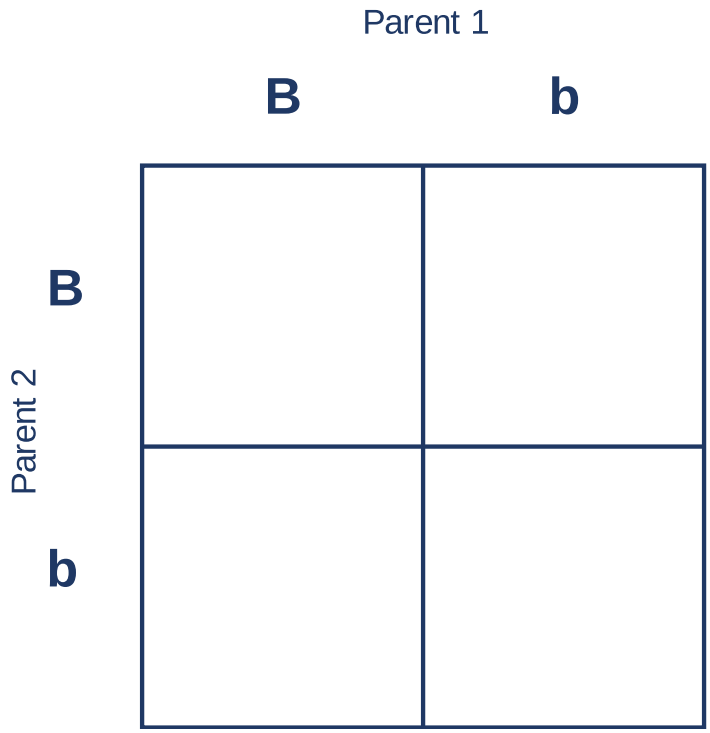
D By picking an allele at random

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7 **Are all boxes in a Punnett square equally likely? Use the Punnett square.**



A Yes

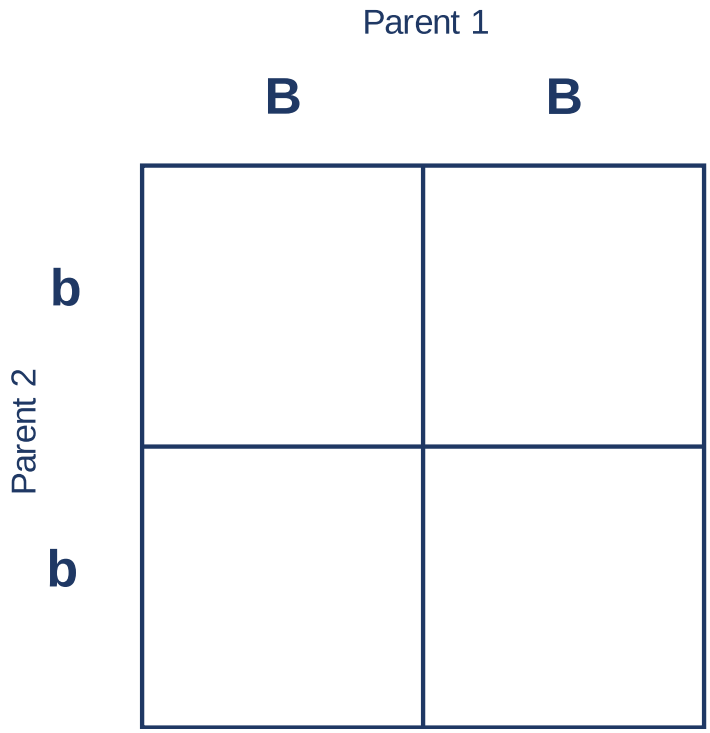
B No

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8 **Cross BB with bb. What children result? Use the Punnett square.**



- **A** All Bb
- **B** All BB
- **C** All bb
- **D** Half Bb, half bb

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9

What is a genotype?

A The allele combination

B The observable trait

C The number of chromosomes

D The parents' appearance

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10

What is a phenotype?

A The observable trait

B The allele combination

C The number of chromosomes

D The parents' appearance

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ANSWER KEY

1. Genotypes 1 RR, 2 Rr, 1 rr; phenotypes 3 round, 1 wrinkled

2. 1 in 4

3. Genotypes 2 Tt, 2 tt; phenotypes 2 tall, 2 short

4. 2 RR, 2 Rr

5. One parent across the top, one down the side

6. By combining its row and column alleles

7. Yes

8. All Bb

9. The allele combination

10. The observable trait

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