

Punnett Squares: Monohybrid Crosses

Key ideas

Alleles are versions of a gene. A capital letter is the **dominant** allele; a lowercase letter is the **recessive** allele. Each parent passes on **one** allele to each offspring (law of segregation).

Punnett square steps: 1. write each parent's genotype 2. put one parent's gametes across the top and the other's down the side 3. fill each box with one allele from each 4. count genotypes and phenotypes.

Ratios to know: $Aa \times Aa \rightarrow 1 AA : 2 Aa : 1 aa$ (3 : 1 phenotypes) · $Aa \times aa \rightarrow 1 : 1$ · $AA \times aa \rightarrow$ all Aa . Each box is a **25%** chance.

A Genetics vocabulary

4 marks

Write the letter of the matching definition (½ mark each).

- | | |
|-----------------------|---|
| 1. _____ Allele | a. The observable trait, such as green pods |
| 2. _____ Dominant | b. Having two different alleles for a gene (Gg) |
| 3. _____ Recessive | c. A different version of the same gene |
| 4. _____ Genotype | d. An allele that is hidden when a dominant allele is present |
| 5. _____ Phenotype | e. A sex cell (egg or sperm) that carries one allele of each gene |
| 6. _____ Homozygous | f. The pair of alleles an organism has (GG , Gg or gg) |
| 7. _____ Heterozygous | g. An allele that shows its trait whenever it is present |
| 8. _____ Gamete | h. Having two identical alleles for a gene (GG or gg) |

B Complete the Punnett squares

8 marks

Write the gametes on the outside, fill in the boxes, then give the ratios. 2 marks each.

9. Pea pods: green (G) is dominant to yellow (g). Cross $Gg \times Gg$.

Genotypes: _____

Phenotypes: _____

10. Rabbits: brown fur (B) is dominant to white (b). Cross $BB \times bb$.

Genotypes: _____

Phenotypes: _____

11. Dogs: wire hair (W) is dominant to smooth (w). Cross $Ww \times ww$.

Genotypes: _____

Phenotypes: _____

12. Rabbits: cross a homozygous brown rabbit with a heterozygous brown rabbit.

Genotypes: _____

Phenotypes: _____

C Probability

3 marks

13. In question 9, what percentage of the offspring will have yellow pods?

14. If the cross in question 9 produces 600 pods, about how many will be green?

15. If the same cross produces 80 plants, about how many will be homozygous dominant (GG)?

D Working backwards

3 marks

Find the parents' genotypes and explain how you know.

16. A brown rabbit and a white rabbit have 7 brown and 6 white babies. What are the parents' genotypes?

17. Two pea plants with green pods produce some offspring with yellow pods. What are the parents' genotypes?

18. A wire-haired dog and a smooth-haired dog have 24 puppies over several litters. All are wire-haired. What are the parents' most likely genotypes?

E The test cross

2 marks

19. A breeder has a brown rabbit but doesn't know if it is BB or Bb. What colour rabbit should it be crossed with in a test cross, and why?

20. Describe the offspring you would expect if the brown rabbit is BB, and if it is Bb.

F Human genetic disorders

4 marks

21. Huntington disease is caused by a **dominant** allele (H). A man who is Hh has children with a woman who is hh. What is the chance each child inherits the disease?

Genotypes: _____

Phenotypes: _____

Chance of HD: _____

22. Albinism is caused by a **recessive** allele (a). A carrier woman (Aa) has children with a man who has albinism (aa). What is the chance each child has albinism?

Genotypes: _____

Phenotypes: _____

Chance of albinism: _____

G Spot the mistake

2 marks

23. A student writes: "Dominant alleles are always the most common alleles in a population." Explain the error and correct it.

24. A student writes: "Gg is a recessive genotype because it contains the g allele." Explain the error and correct it.

Punnett Squares: Monohybrid Crosses

Name: _____

ANSWER KEY

Date: _____ Score: ____ / 26

Key ideas

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Punnett square steps: 1. write each parent's genotype 2. put one parent's gametes across the top and the other's down the side 3. fill each box with one allele from each 4. count genotypes and phenotypes.

Ratios to know: $Aa \times Aa \rightarrow 1 AA : 2 Aa : 1 aa$ (3 : 1 phenotypes) · $Aa \times aa \rightarrow 1 : 1$ · $AA \times aa \rightarrow$ all Aa . Each box is a **25%** chance.

A Genetics vocabulary

4 marks

Write the letter of the matching definition (½ mark each).

- | | |
|--------------------------|---|
| 1. <u>c</u> Allele | a. The observable trait, such as green pods |
| 2. <u>g</u> Dominant | b. Having two different alleles for a gene (Gg) |
| 3. <u>d</u> Recessive | c. A different version of the same gene |
| 4. <u>f</u> Genotype | d. An allele that is hidden when a dominant allele is present |
| 5. <u>a</u> Phenotype | e. A sex cell (egg or sperm) that carries one allele of each gene |
| 6. <u>h</u> Homozygous | f. The pair of alleles an organism has (GG, Gg or gg) |
| 7. <u>b</u> Heterozygous | g. An allele that shows its trait whenever it is present |
| 8. <u>e</u> Gamete | h. Having two identical alleles for a gene (GG or gg) |

B Complete the Punnett squares

8 marks

Write the gametes on the outside, fill in the boxes, then give the ratios. 2 marks each.

9. Pea pods: green (G) is dominant to yellow (g). Cross $Gg \times Gg$.

	G	g	
G	GG	Gg	Genotypes: <u>1 GG : 2 Gg : 1 gg</u>
g	Gg	gg	
	Phenotypes: <u>3 green : 1 yellow</u>		

10. Rabbits: brown fur (B) is dominant to white (b). Cross $BB \times bb$.

	b	b	
B	Bb	Bb	Genotypes: <u>all Bb</u>
B	Bb	Bb	
	Phenotypes: <u>all brown</u>		

11. Dogs: wire hair (W) is dominant to smooth (w). Cross $Ww \times ww$.

	w	w	
W	Ww	Ww	Genotypes: <u>1 Ww : 1 ww</u>
w	ww	ww	
	Phenotypes: <u>1 wire : 1 smooth</u>		

12. Rabbits: cross a homozygous brown rabbit with a heterozygous brown rabbit.

	B	b	
B	BB	Bb	Genotypes: <u>1 BB : 1 Bb</u>
B	BB	Bb	
	Phenotypes: <u>all brown</u>		

C Probability

3 marks

13. In question 9, what percentage of the offspring will have yellow pods?

1 out of 4 = 25%

14. If the cross in question 9 produces 600 pods, about how many will be green?

$3/4 \times 600 = 450$ green pods

15. If the same cross produces 80 plants, about how many will be homozygous dominant (GG)?

$1/4 \times 80 = 20$ plants

D Working backwards

3 marks

Find the parents' genotypes and explain how you know.

16. A brown rabbit and a white rabbit have 7 brown and 6 white babies. What are the parents' genotypes?

Bb × bb. White babies (bb) mean the brown parent must carry b; a 1 : 1 ratio matches Bb × bb.

18. A wire-haired dog and a smooth-haired dog have 24 puppies over several litters. All are wire-haired. What are the parents' most likely genotypes?

WW × ww. If the wire parent were Ww, about half the puppies would be smooth.

E The test cross

2 marks

19. A breeder has a brown rabbit but doesn't know if it is BB or Bb. What colour rabbit should it be crossed with in a test cross, and why?

A white (bb) rabbit. It can only pass on b, so any hidden b in the brown rabbit will show up as white babies.

17. Two pea plants with green pods produce some offspring with yellow pods. What are the parents' genotypes?

Gg × Gg. Each parent must carry a hidden g allele to produce gg offspring.

20. Describe the offspring you would expect if the brown rabbit is BB, and if it is Bb.

BB × bb: all brown. Bb × bb: about half brown, half white (1 : 1).

F Human genetic disorders

4 marks

21. Huntington disease is caused by a **dominant** allele (H). A man who is Hh has children with a woman who is hh. What is the chance each child inherits the disease?

	h	h	
H	Hh	Hh	Genotypes: 1 Hh : 1 hh 1 affected : 1 Phenotypes: unaffected
h	hh	hh	
			Chance of HD: 2/4 = 50%

22. Albinism is caused by a **recessive** allele (a). A carrier woman (Aa) has children with a man who has albinism (aa). What is the chance each child has albinism?

	a	a	
A	Aa	Aa	Genotypes: 1 Aa : 1 aa Phenotypes: 1 normal : 1 albino
a	aa	aa	
			Chance of albinism: 2/4 = 50%

G Spot the mistake

2 marks

23. A student writes: "Dominant alleles are always the most common alleles in a population." Explain the error and correct it.

Dominance only describes which allele is expressed, not how common it is. Huntington disease is dominant but rare.

24. A student writes: "Gg is a recessive genotype because it contains the g allele." Explain the error and correct it.

Gg is heterozygous. The dominant G is expressed, so the plant has green pods; only gg shows the recessive trait.