

# Dihybrid Cross Worksheet

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Name: \_\_\_\_\_

Date: \_\_\_\_\_

Trait key: T = tall / t = short; R = round seed / r = wrinkled seed; Y = yellow seed / y = green seed; P = purple / p = white; B = black fur / b = white fur; F = unaffected / f = cystic fibrosis allele.

Total: 26 marks

## Part A Genotypes and phenotypes. [3]

For each genotype, state whether it is homozygous dominant, homozygous recessive or heterozygous, and give the phenotype.

| Q  | Genotype | Homozygous dominant / recessive / heterozygous | Phenotype |
|----|----------|------------------------------------------------|-----------|
| 1. | TT       |                                                |           |
| 2. | Tt       |                                                |           |
| 3. | tt       |                                                |           |
| 4. | rr       |                                                |           |
| 5. | RR       |                                                |           |
| 6. | Rr       |                                                |           |

## Part B Monohybrid crosses. [8]

Complete each Punnett square, then give the genotype and phenotype ratios.

7. In pea plants, tall (T) is dominant to short (t). Cross two heterozygous tall plants.

[2]

| X | T | t |
|---|---|---|
| T |   |   |
| t |   |   |

Genotype ratio: \_\_\_\_\_

Phenotype ratio: \_\_\_\_\_

# Dihybrid Cross Worksheet

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Name: \_\_\_\_\_ Date: \_\_\_\_\_

8. Purple flowers (P) are dominant to white flowers (p). Cross a heterozygous purple plant with a white plant. [2]

|   |   |
|---|---|
| X | p |
| P |   |
| p |   |

Genotype ratio: \_\_\_\_\_

Phenotype ratio: \_\_\_\_\_

9. In guinea pigs, black fur (B) is dominant to white fur (b). A black guinea pig and a white guinea pig have some white babies. What is the black parent's genotype? Show the cross. [2]

|   |   |
|---|---|
| X | b |
| B |   |
| b |   |

Genotype ratio: \_\_\_\_\_

Phenotype ratio: \_\_\_\_\_

10. Cystic fibrosis is a recessive disorder (f). Two parents are both carriers (Ff). What is the chance that their child has cystic fibrosis? [2]

|   |   |   |
|---|---|---|
| X | F | f |
| F |   |   |
| f |   |   |

Genotype ratio: \_\_\_\_\_

Phenotype ratio: \_\_\_\_\_

## Part C Probability. [3]

11. In question 7, the cross produces 200 offspring. About how many are short? [1]

# Dihybrid Cross Worksheet

Name: \_\_\_\_\_ Date: \_\_\_\_\_

12. In question 7, what fraction of the tall offspring are heterozygous? [1]

\_\_\_\_\_

13. The carrier couple in question 10 already has one child with cystic fibrosis. What is the chance their next child has it? [1]

\_\_\_\_\_

**Part D** The dihybrid cross. [5]

14. List the four possible gametes of an RrYy plant. [1]

\_\_\_\_\_

15. Complete the 4 x 4 Punnett square for RrYy x RrYy. [3]

| X  | RY | Ry | rY | ry |
|----|----|----|----|----|
| RY |    |    |    |    |
| Ry |    |    |    |    |
| rY |    |    |    |    |
| ry |    |    |    |    |

16. Give the phenotype ratio of the offspring. [1]

\_\_\_\_\_

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Date: \_\_\_\_\_

## Part E More dihybrid problems. [5]

17. Cross RrYy x rryy (a test cross). Give the phenotype ratio.

[2]

| X  | RY | Ry | rY | ry |
|----|----|----|----|----|
| ry |    |    |    |    |

Phenotype ratio: \_\_\_\_\_

18. Cross RRYy x rrYy. Give the phenotype ratio.

[2]

| X  | rY | ry |
|----|----|----|
| RY |    |    |
| Ry |    |    |

Phenotype ratio: \_\_\_\_\_

19. For AaBb x AaBb, use the product rule to find the probability of an aabb offspring.

[1]

\_\_\_\_\_

## Part F Spot the mistake. [2]

20. A student says: "A 3 : 1 ratio means that if a couple has four children, exactly three will show the dominant trait." [1]  
Explain the error and correct it.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

21. A student writes the gametes of an RrYy plant as Rr and Yy. Explain the error and correct it.

[1]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# Dihybrid Cross Worksheet — ANSWER KEY

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## Part A Genotypes and phenotypes

| Q  | Genotype | Type                 | Phenotype |
|----|----------|----------------------|-----------|
| 1. | TT       | Homozygous dominant  | tall      |
| 2. | Tt       | Heterozygous         | tall      |
| 3. | tt       | Homozygous recessive | short     |
| 4. | rr       | Homozygous recessive | wrinkled  |
| 5. | RR       | Homozygous dominant  | round     |
| 6. | Rr       | Heterozygous         | round     |

## Part B Monohybrid crosses

### 7. Tt x Tt

|   |    |    |
|---|----|----|
| X | T  | t  |
| T | TT | Tt |
| t | Tt | tt |

Genotype ratio: 1 TT : 2 Tt : 1 tt

Phenotype ratio: 3 tall : 1 short

### 8. Pp x pp

|   |    |
|---|----|
| X | p  |
| P | Pp |
| p | pp |

Genotype ratio: 1 Pp : 1 pp

Phenotype ratio: 1 purple : 1 white

### 9. Bb x bb

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|   |    |
|---|----|
| X | b  |
| B | Bb |
| b | bb |

Genotype ratio: 1 Bb : 1 bb

Phenotype ratio: 1 black : 1 white

The black parent is Bb. It must carry b to produce bb offspring.

## 10. Ff x Ff

|   |    |    |
|---|----|----|
| X | F  | f  |
| F | FF | Ff |
| f | Ff | ff |

Genotype ratio: 1 FF : 2 Ff : 1 ff

Phenotype ratio: 3 unaffected : 1 cystic fibrosis

1/4 = 25% chance of cystic fibrosis. There is also a 1/2 chance of being an unaffected carrier (Ff).

## Part C Probability

11.  $1/4 \times 200 = 50$  short plants.

12. Tall offspring are 1 TT + 2 Tt, so 2/3 of them are heterozygous.

13. Still 1/4. Each conception is an independent event - the previous child does not change the odds.

## Part D The dihybrid cross

14. Gametes: RY, Ry, rY, ry

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15. Completed square:

| X  | RY   | Ry   | rY   | ry   |
|----|------|------|------|------|
| RY | RRYY | RRYy | RrYY | RrYy |
| Ry | RRYy | RRyy | RrYy | Rryy |
| rY | RrYY | RrYy | rrYY | rrYy |
| ry | RrYy | Rryy | rrYy | rryy |

16. Phenotype ratio: 9 round yellow : 3 round green : 3 wrinkled yellow : 1 wrinkled green

Genotype ratio: 1 RRYY : 2 RRYy : 1 RRYy : 2 RrYY : 4 RrYy : 2 Rryy : 1 rrYY : 2 rrYy : 1 rryy

## Part E More dihybrid problems

17. RrYy x rryy - gametes RY, Ry, rY, ry x ry.

| X  | RY   | Ry   | rY   | ry   |
|----|------|------|------|------|
| ry | RrYy | Rryy | rrYy | rryy |

Phenotype ratio: 1 round yellow : 1 round green : 1 wrinkled yellow : 1 wrinkled green

18. RRYy x rrYy - every offspring is Rr, so all are round; Yy x Yy gives 3 yellow : 1 green.

| X  | rY   | ry   |
|----|------|------|
| RY | RrYY | RrYy |
| Ry | RrYy | Rryy |

Phenotype ratio: 3 round yellow : 1 round green

19.  $P(aa) \times P(bb) = 1/4 \times 1/4 = 1/16$ . The genes assort independently, so the probabilities multiply.

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## Part F Spot the mistake

20. A ratio is a probability for each offspring, not a guaranteed count. Each child independently has a  $\frac{3}{4}$  chance of showing the dominant trait, so a family of four can easily be 4 : 0 or 2 : 2. The ratio is what you approach over large numbers of offspring.

21. A gamete carries ONE allele of each gene, not both alleles of one gene. Rr and Yy are gene pairs, not gametes. The four gametes are RY, Ry, rY and ry.

Marking note: Part B is worth 2 marks per cross - one for a correctly filled square, one for both ratios. In Part D the square carries 3 of the 5 marks, so a student who sets up the gametes correctly and slips on one box should not lose the part.