

Exercise walk-through

5.3

Mendelian Genetics

AP Biology

Non-Mendelian patterns

Many traits break Mendel's simple dominant/recessive rule:

Incomplete dominance

: red + white $\rightarrow$ pink

Codominance

: AB

blood (both show)

Multiple alleles

:

I^A, I^B, i

Sex-linked

: colour

blindness

**Polygenic
taxis**

& epis-

: a smooth range

Non-Mendelian patterns, continued

father:		X^B	Y
mother	X^B	$X^B X^B$	$X^B Y$
	X^b	$X^B X^b$	$X^b Y$
		carrier daughter	color-blind son

- **Incomplete dominance** : heterozygotes are a blend (red $\times$ white $\rightarrow$ pink).
- **Codominance** : both alleles show fully (AB blood type).
- **Multiple alleles, polygenic** traits (many genes, like height), **pleiotropy** (one gene, many effects), and **sex-linked** genes (on the X chromosome) all give more complex ratios.

Worked example – the chi-square test

A monohybrid cross predicts 3 : 1. Of 80 offspring, 55 show the dominant trait and 25 the recessive. Do the data fit?

- expected: 60 and 20
- $\chi^2 = \sum \frac{(o - e)^2}{e} = \frac{25}{60} + \frac{25}{20} = 0.42 + 1.25 = 1.67$
- $df = 2 - 1 = 1$; the critical value at $p = 0.05$ is 3.84
- $1.67 < 3.84$, so **do not reject** the null hypothesis – the data fit

The null hypothesis is that any difference is **chance alone**. Failing to reject it is not proof the ratio is right, only that the deviation is unremarkable.

Exercises 2.1-2.3

2.1 How many recessive alleles are needed to show a recessive trait? [1]

2.2 For $Aa \times Aa$, state the phenotype ratio. [1]

2.3 What is the difference between genotype and phenotype? [1]

Exercises 2.1-2.3

2.1 How many recessive alleles are needed to show a recessive trait? [1]

2.1

- Two
-

2.2 For $Aa \times Aa$, state the phenotype ratio. [1]

2.2

- 3 dominant : 1 recessive
-

2.3 What is the difference between genotype and phenotype? [1]

2.3

- Genotype is the alleles present; phenotype is the observable trait

Exercise 3.1

3.1 A cross $Aa \times Aa$ gives a phenotype ratio of

[1]

☐

A 1:1

B 3:1

C 9:3:3:1

D all dominant

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D all dominant

3.1 B

- 3:1

Exercise 3.2 (a)

3.2 In pea plants, tall (T) is dominant to short (t). Cross $Tt \times tt$.

(a) Complete a Punnett square.

[2]

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3.2 In pea plants, tall (T) is dominant to short (t). Cross $Tt \times tt$.

(a) Complete a Punnett square.

[2]

(a)

- Square gives Tt, Tt, tt, tt

Exercise 3.2 (b)

3.2 In pea plants, tall (T) is dominant to short (t). Cross $Tt \times tt$.

(b) State the genotype and phenotype ratios.

[2]

Exercise 3.2 (b)

3.2 In pea plants, tall (T) is dominant to short (t). Cross $Tt \times tt$.

(b) State the genotype and phenotype ratios.

[2]

(b)

- Genotype 1 Tt : 1 tt ; phenotype 1 tall : 1 short

Exercise 3.3

3.3 A tall plant of unknown genotype is crossed with a short plant, and some short offspring appear. State the tall parent's genotype, with a reason. [2]

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3.3

- Tt – a short offspring is tt , so it received a t from the tall parent, which must therefore carry a t