

Exercise walk-through

7.5

Hardy-Weinberg Equilibrium

AP Biology

Hardy–Weinberg equilibrium

A **null hypothesis** : a population that is *not* evolving. It holds only with no mutation, no selection, no gene flow, large size, random mating.

$$p + q = 1$$

$$\underbrace{p^2}_{\text{hom. dom.}} + \underbrace{2pq}_{\text{het.}} + \underbrace{q^2}_{\text{hom. rec.}} = 1$$

From one measurement

16% show the recessive trait, so $q^2 = 0.16$.

$$q = \sqrt{0.16} = 0.4, \quad p = 0.6$$

$$p^2 = 0.36, \quad 2pq = 0.48$$

Check: $0.36 + 0.48 + 0.16 = 1.00$.
If real data differ, the population is **evolving**.

Hardy-Weinberg

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

p frequency of allele A
 q frequency of allele a
 p^2 frequency of genotype AA
 $2pq$ frequency of genotype Aa
 q^2 frequency of genotype aa

H-W equilibrium: no selection, mutation, migration, drift, or non-random mating

Hardy-Weinberg: allele frequencies p and q give genotype frequencies p^2 , $2pq$, q^2

Exercises 2.1-2.3

2.1 Write the two Hardy-Weinberg equations.

[2]

2.2 If $q = 0.3$, find p .

[1]

2.3 What genotype does q^2 represent?

[1]

Exercises 2.1-2.3

2.1 Write the two Hardy-Weinberg equations. [2]

2.1

- $p + q = 1$ and $p^2 + 2pq + q^2 = 1$
-

2.2 If $q = 0.3$, find p . [1]

2.2

- $p = 1 - 0.3 = 0.7$
-

2.3 What genotype does q^2 represent? [1]

2.3

- Homozygous recessive

Exercise 3.1

3.1 In Hardy-Weinberg, the frequency of heterozygotes is

[1]

☐

A p^2

B q^2

C $2pq$

D $p + q$

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3.1 In Hardy-Weinberg, the frequency of heterozygotes is

[1]

☐

A p^2

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C $2pq$

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3.1 C

- $2pq$

Exercise 3.2 (a)

3.2 In a population, 9% of individuals show a recessive trait.

(a) Find q and p .

[3]

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3.2 In a population, 9% of individuals show a recessive trait.

(a) Find q and p .

[3]

(a)

- $q^2 = 0.09$, so $q = 0.3$; $p = 1 - 0.3 = 0.7$

Exercise 3.2 (b)

3.2 In a population, 9% of individuals show a recessive trait.

(b) Find the frequency of heterozygotes.

[2]

Exercise 3.2 (b)

3.2 In a population, 9% of individuals show a recessive trait.

(b) Find the frequency of heterozygotes.

[2]

(b)

- $2pq = 2(0.7)(0.3) = 0.42$ (42%)

Exercise 3.3

3.3 State two conditions that must hold for a population to stay in Hardy-Weinberg equilibrium. [2]

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3.3

- Any two: no natural selection, no mutation, no gene flow (migration), random mating, very large population