Develop Your Skills

Another characteristic that Mendel observed in his pea plants was pea shape. A pea was either round or wrinkled. He found that the dominant trait was round (R), and the recessive trait was wrinkled (r). In this activity, you will practise using some of the vocabulary already introduced in this unit and determine phenotypic and genotypic ratios for the cross described below.

Questions

1. What is the phenotype of a plant whose genotype is heterozygous for pea shape?

Rr

2. What is the phenotype if the genotype is homozygous recessive for pea shape?

rr

3. Fill in this Punnett square to show the cross between a heterozygous and homozygous recessive for pea shape (Rr × rr).

	R	r
r	Rr	rr
r	Rr	rr

4. Assume 40 pea plants were produced.
   a) How many plants have round peas? approx. 20
   b) How many plants have wrinkled peas? approx. 20
   c) What is the phenotypic ratio of round peas compared to wrinkled peas? 1:1

5. Assume that 60 pea plants were produced.
   a) How many plants are heterozygous? approx. 30
   b) How many plants are homozygous dominant? 0
   c) How many plants are homozygous recessive? approx. 30
   d) What is the genotypic ratio of heterozygous plants compared to homozygous recessive plants? 1:1

2.1.2 Review Questions

1. A homozygous white hamster is crossed with a heterozygous brown hamster.
   a) Which trait is dominant, white or brown?

brown

   b) Write the genotype for the white hamster and for the brown hamster.

white: hh

brown: Hh

   c) Complete a Punnett square showing the cross between the white and brown hamsters.

	h	h
H	Hh	Hh
h	hh	hh

   d) What percentage of hamster offspring are likely to be white? 50%

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2. If a litter of 8 hamsters is born as a result of the cross in question 1, how many of them are likely to be white? 4

3. A short-tailed cat mates with a long-tailed cat resulting in 100% of the offspring having long tails. Then the same short-tailed cat mates with a different long-tailed cat. This time 50% of the offspring have long tails and 50% have short tails. Explain how this can happen.

Let alleles be short-tail (t) & long-tail (T).
Suppose F_0 are TT × tt.
Then F_1 will be 100% Tt (long-tail).
2nd cross: Tt (F_1) × tt

	T	t
t	Tt	tt
t	Tt	tt

⇒ 50% Tt (long-tail), 50% tt (short-tail)

4. Corn plants can be either tall or short. Imagine a homozygous tall corn plant crossed with a heterozygous tall corn plant.
   a) Which trait is dominant, tall or short?

   tall

   b) Complete a Punnett square for this cross.

	T	T
T	TT	TT
t	Tt	Tt

   c) What percentage of the offspring do you predict to be
   - homozygous? 50%
   - heterozygous? 50%

   d) What percentage of the offspring do you predict to be tall? 100%

   e) What is the phenotypic ratio of tall plants compared to short plants? all tall

5. In hand clasping, the left thumb on top is dominant and the right thumb on top is recessive. A man notices that when he clasps his hands he prefers to have his right thumb on top. The man has two sons, both of whom also prefer to have their right thumbs on top. Is it possible that the boys' mother has a preference for having her left thumb on top? Explain your answer.

Yes: if the man is homozygous dominant and the boys' mother is homozygous recessive.

6. A certain dog is heterozygous for a dark spot on its back. The presence of the spot is the dominant (A) trait. Having no spot at this location is the recessive trait. (a)
   a) Complete a Punnett square for the cross of two dogs that are heterozygous for the dark spot.

	A	a
A	AA	Aa
a	Aa	aa

   b) In a litter of 8 puppies, how many of them are likely to have no spot on their backs? 2

   c) Is it possible that all 8 puppies could be missing the spot? Explain your answer.

Yes. The Punnett square only predicts outcomes; the actual outcome will depend on probability (e.g. in Mendel lea simulation.)