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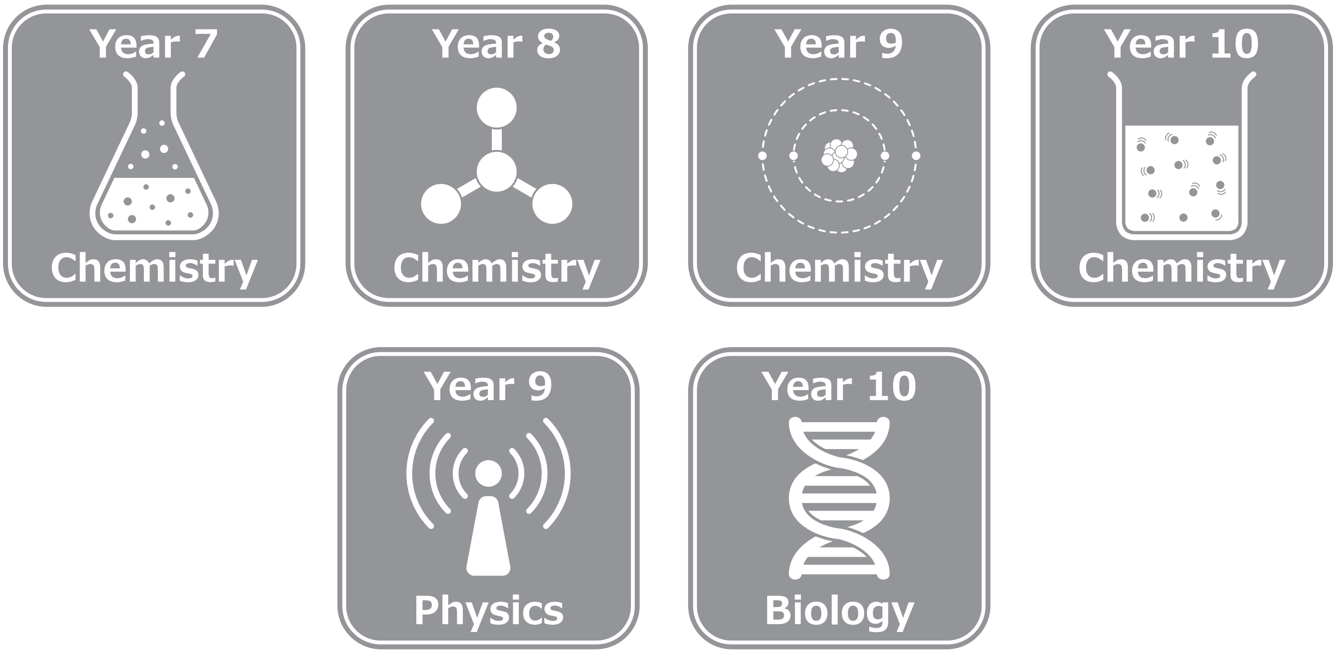

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Punnett Squares – Sex-Linked Inheritance

Key Learning Idea

➤ Punnett squares can be used to predict genotypes and phenotypes of offspring for traits that are sex-linked.

Content

- Constructing Punnett squares for traits that are: (i) X-linked with dominant and recessive inheritance, and (ii) X-linked with codominant inheritance.
    - Determining parental alleles.
    - Determining possible genotypes of male and female offspring.
    - Determining possible phenotypes of male and female offspring.
    - Determining probabilities of different genotypes and phenotypes in male and female offspring.
- Determining genotypes of parents based on phenotypes observed in male and female offspring.

Learning Checklist

By the end of this worksheet students will be able to:

✓ Use a Punnett square to determine the possible genotypes and phenotypes of male and female offspring for traits that are X-linked.

✓ Use a Punnett square to determine the probabilities of different genotypes and phenotypes in male and female offspring for traits that are X-linked.

✓ Determine genotypes of parents based on the numbers of different phenotypes observed in male and female offspring for traits that are X-linked.

2.3c Punnett Squares – Sex-Linked Inheritance

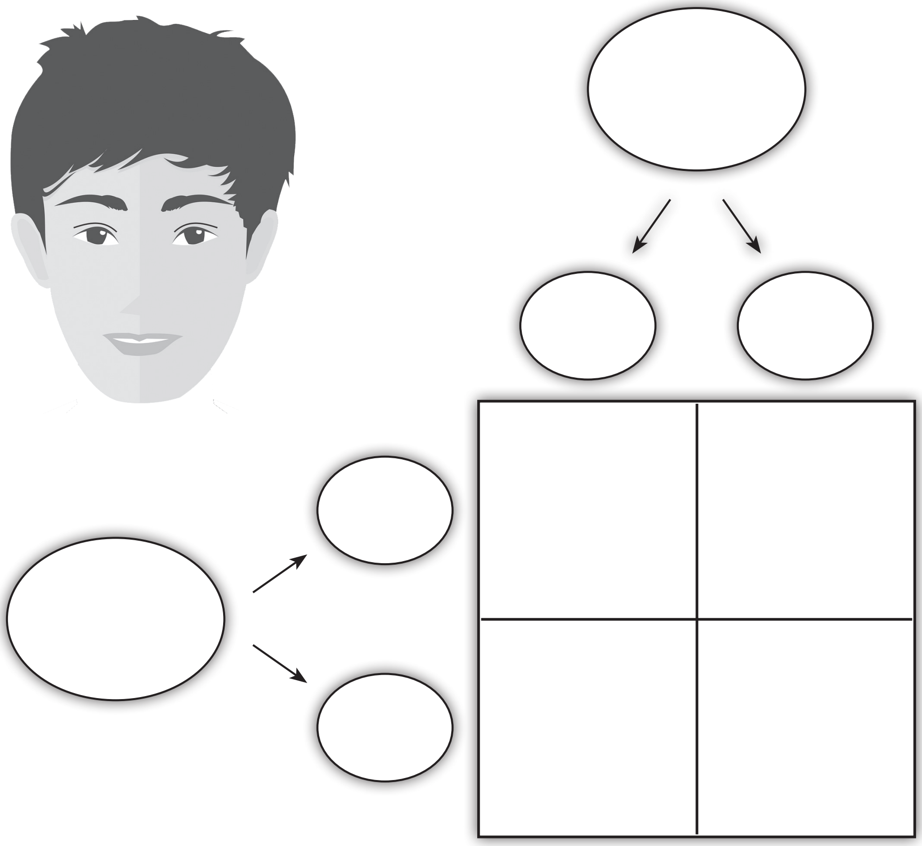
Sex Linkage and Dominance

In humans, the gene associated with red-green colour blindness is located on the X chromosome. The allele for normal vision (X^B) is dominant over the allele for red-green colour blindness (X^b).

Use this information to answer questions 1-4.

1. **(a)** Complete the Punnett square to show the offspring of a hemizygous dominant male and a heterozygous female.

Include the genotypes and phenotypes of offspring.



(b) For sons, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

(ii) Colour blindness?
_____ in _____ or _______ %

(c) For daughters, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

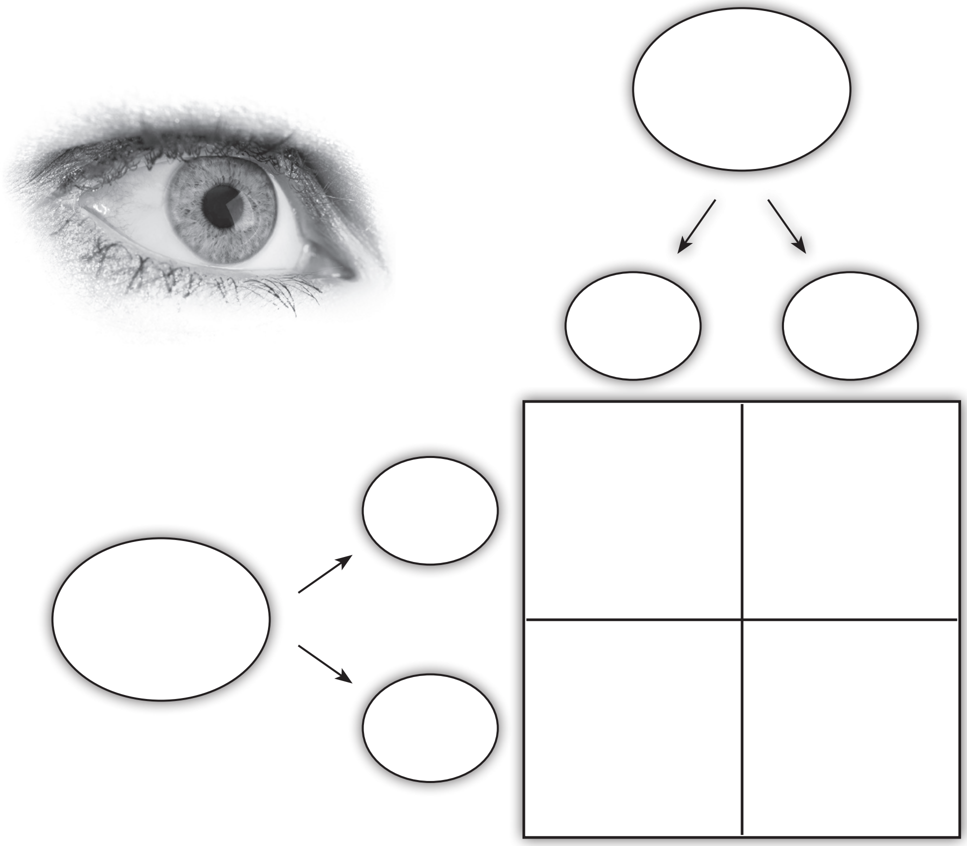
(ii) Colour blindness?
_____ in _____ or _______ %

(d) What is the probability of daughters being carriers (unaffected heterozygotes)?

_____ in _____ or _______ %

2. **(a)** Complete the Punnett square to show the offspring of a hemizygous dominant male and a homozygous recessive female.

Include the genotypes and phenotypes of offspring.



(b) For sons, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

(ii) Colour blindness?
_____ in _____ or _______ %

(c) For daughters, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

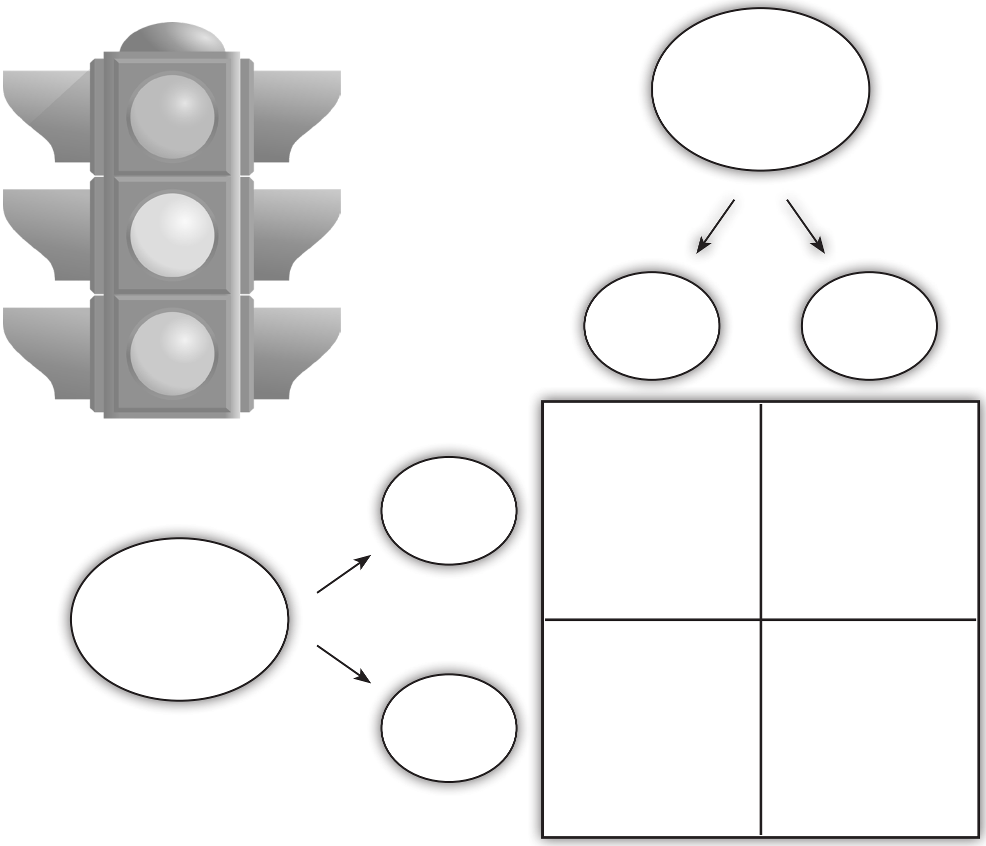
(ii) Colour blindness?
_____ in _____ or _______ %

(d) What is the probability of daughters being carriers?

_____ in _____ or _______ %

3. **(a)** Complete the Punnett square to show the offspring of a hemizygous recessive male and a homozygous dominant female.

Include the genotypes and phenotypes of offspring.



(b) For sons, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

(ii) Colour blindness?
_____ in _____ or _______ %

(c) For daughters, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

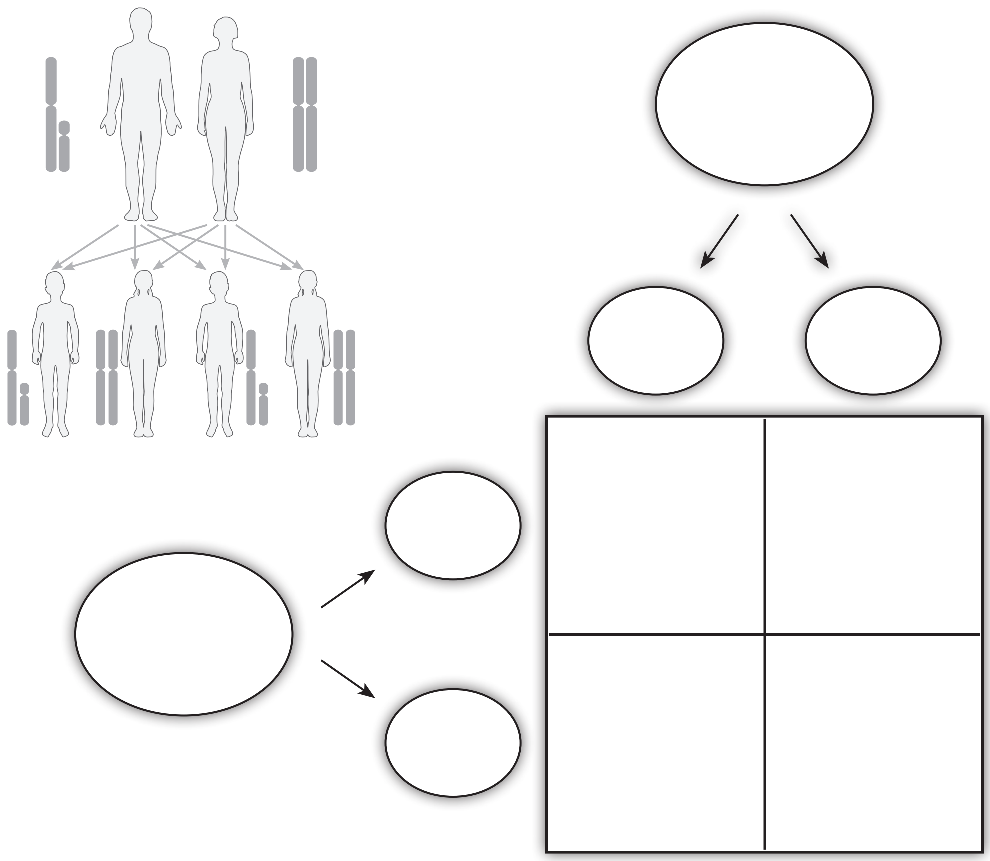
(ii) Colour blindness?
_____ in _____ or _______ %

(d) What is the probability of daughters being carriers?

_____ in _____ or _______ %

4. **(a)** Complete the Punnett square to show the offspring of a hemizygous recessive male and a heterozygous female.

Include the genotypes and phenotypes of offspring.



(b) For sons, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

(ii) Colour blindness?
_____ in _____ or _______ %

(c) For daughters, what is the probability of:

(i) Normal vision?
_____ in _____ or _______ %

(ii) Colour blindness?
_____ in _____ or _______ %

(d) What is the probability of daughters being carriers?

_____ in _____ or _______ %

2.3c Punnett Squares – Sex-Linked Inheritance

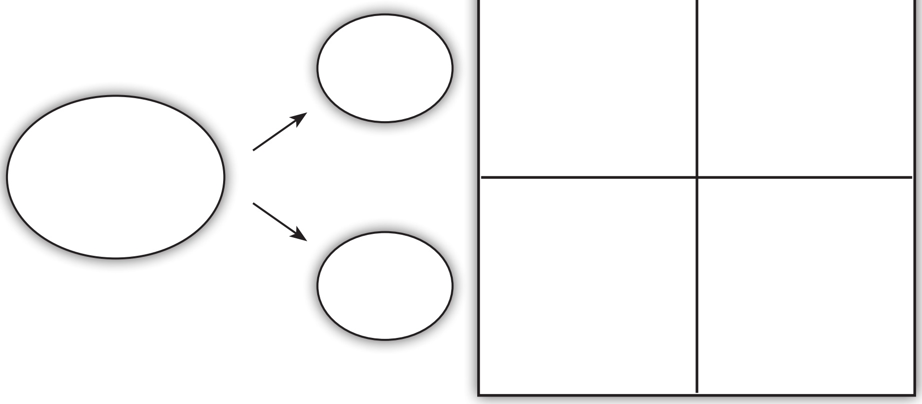
Sex Linkage and Codominance

In cats, the gene associated with orange fur colour is located on the X chromosome. The allele for black fur (X^B) and the allele for orange fur (X^O) exhibit codominance, with heterozygotes having black and tan fur, known as the 'calico' phenotype.

Use this information to answer questions 5-8.

5. **(a)** Complete the Punnett square to show a cross between a black male and a calico female.

Include the genotypes and phenotypes of offspring.



(b) For male offspring, what is the probability of:

(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

(c) For female offspring, what is the probability of:

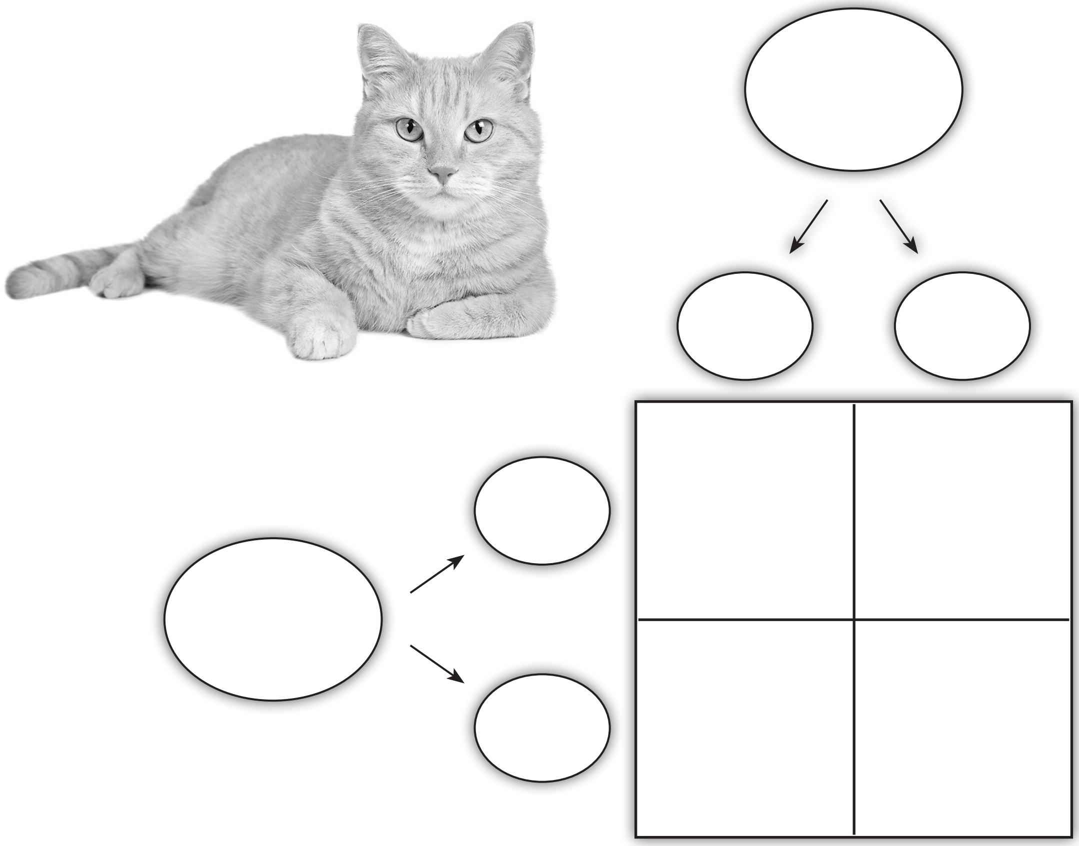
(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

6. **(a)** Complete the Punnett square to show a cross between a black male and an orange female.

Include the genotypes and phenotypes of offspring.



(b) For male offspring, what is the probability of:

(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

(c) For female offspring, what is the probability of:

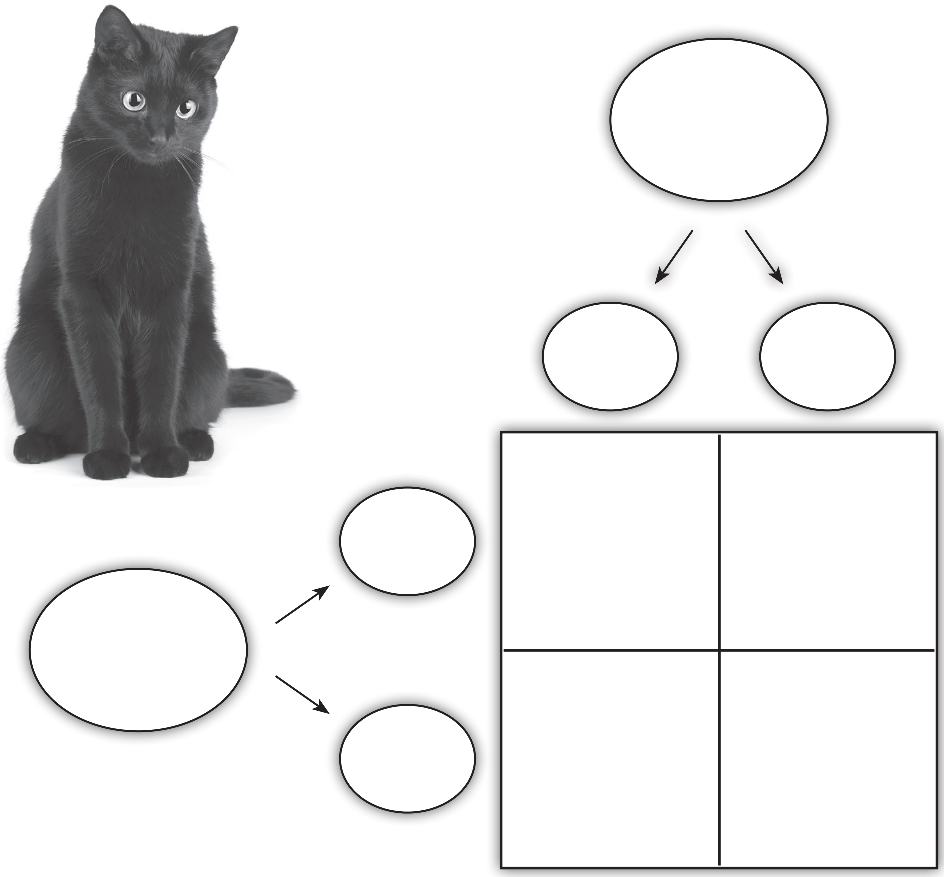
(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

7. **(a)** Complete the Punnett square to show a cross between an orange male and a black female.

Include the genotypes and phenotypes of offspring.



(b) For male offspring, what is the probability of:

(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

(c) For female offspring, what is the probability of:

(i) Black fur?
_____ in _____ or _______ %

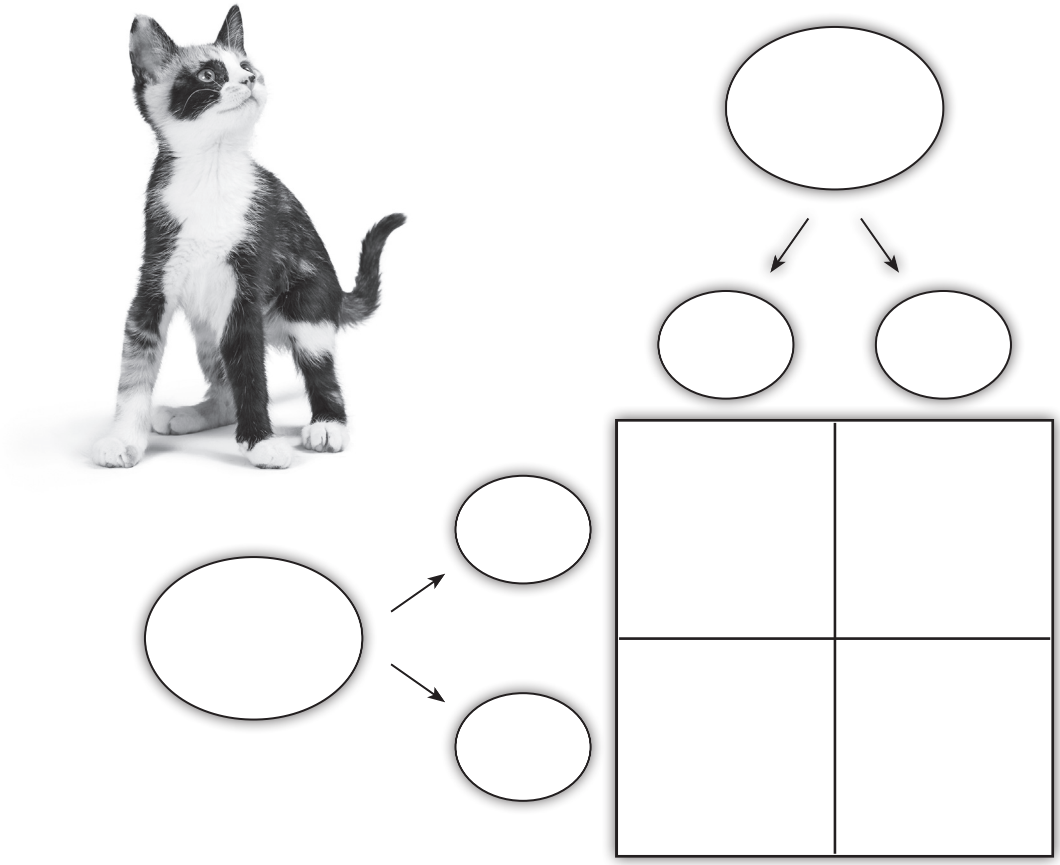
(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

Punnett Squares – Sex-Linked Inheritance

8. **(a)** Complete the Punnett square to show a cross between an orange male and a calico female.

Include the genotypes and phenotypes of offspring.



(b) For male offspring, what is the probability of:

(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

(c) For female offspring, what is the probability of:

(i) Black fur?
_____ in _____ or _______ %

(ii) Calico fur?
_____ in _____ or _______ %

(iii) Orange fur?
_____ in _____ or _______ %

Punnett Squares – Sex-Linked Inheritance

9. In fruit flies, the gene associated with white eye colour is located on the X chromosome. The allele for red eye colour (X^R) is dominant over the allele for white eye colour (X^r).

(a) What is the only possible genotype for red-eyed male fruit flies? ____________________

(b) What is the only possible genotype for white-eyed male fruit flies? ____________________

(c) What are the two possible genotypes for red-eyed female fruit flies? ____________________

(d) What is the only possible genotype for white-eyed female fruit flies? ____________________

(e) A red-eyed male fruit fly was mated with a red-eyed female fruit fly, resulting in:

22 red-eyed male offspring
19 white-eyed male offspring
43 red-eyed female offspring

What can you say about the genotype of the female parent? Use a Punnett square to support your answer.

____

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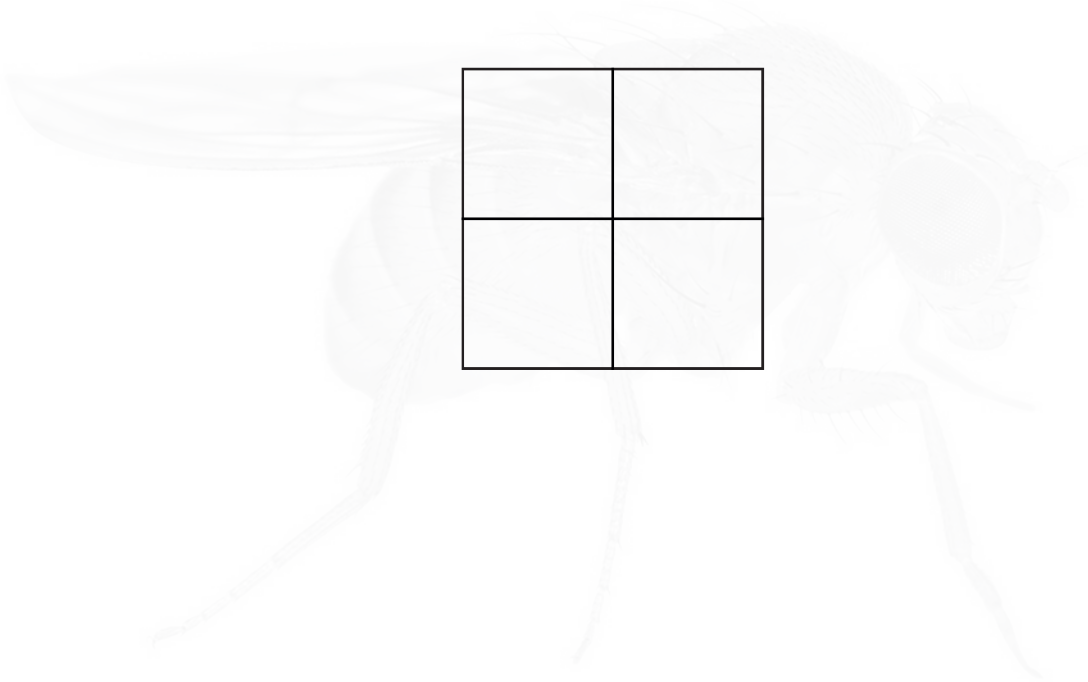
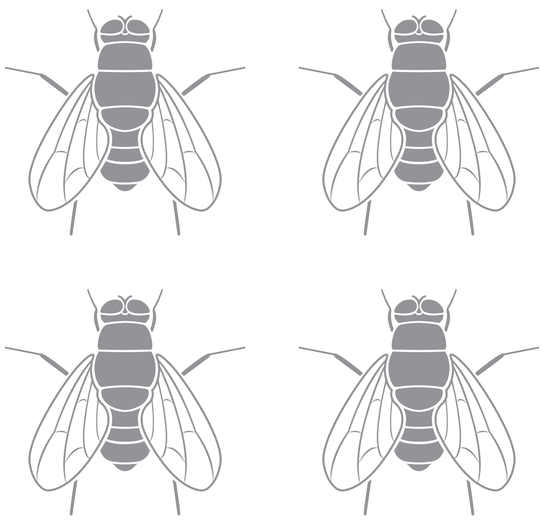


(f) A white-eyed male fruit fly was mated with a red-eyed female fruit fly, resulting in:

27 red-eyed male offspring
26 red-eyed female offspring

What can you say about the genotype of the female parent? Use a Punnett square to support your answer.



(g) Two fruit flies were mated, resulting in:

36 white-eyed male offspring
31 red-eyed female offspring

What can you say about the genotype and phenotype of both parents? Use a Punnett square to support your answer.

(h) The fruit flies in question (e) went on to produce 76 more offspring. What are the predicted numbers of each phenotype for male and female offspring?

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