

## Science 10 1.2 Checking Your Understanding Questions – KEY

1. Explain how Mendel used selective breeding to learn more about heredity.

Mendel performed breeding experiments on pea plants. He selected parents whose phenotypes he knew, and observed the numerical patterns of phenotypes in the offspring. In this way, he was able to determine some basic laws of heredity which are the basis for principles of genetics today.

2. In terms of experimental design, why was it important that Mendel used true-breeding plants to explore patterns of inheritance?

We can apply our current understanding of genotypes and phenotypes to Mendel's understanding of genetics. What Mendel referred to as "true-breeding", we now know as "homozygous".

It was important for Mendel to use homozygotes in his breeding experiments because, due to the law of segregation, this allowed him to control which allele was passed on to the F<sub>1</sub> offspring, and so on. If he had not used homozygotes but instead had classified plants purely based on their phenotypes, Mendel may never have arrived at the conclusions he did.

3. Explain the differences between the following sets of terms and give an example of each term:
  - a. **Dominant and recessive.** For a trait governed by this type of dominance, the heterozygote will have the same phenotype as the homozygous dominant individual. E.g. if round (R) is dominant to wrinkled (r) seed shape in pea plants, then the heterozygote Rr will be round just like the RR individual.
  - b. **Genotype and phenotype.** Genotype is the combination of alleles that an individual has. Phenotype is the trait that the individual expresses. E.g. using the same example from 3a, genotype would be "Rr" and phenotype would be "round seed shape".
  - c. **Homozygous and heterozygous.** These are both ways of describing genotype. Homozygous means both alleles for that trait are the same; heterozygous means that the individual has two different alleles for the trait.
4. The diagram below represents the genotypes of two parents and one gamete from each parent. [see textbook for diagram]
  - a. What is the genotype of the offspring?

The genotype of the offspring is Hh.

- b. What is the phenotype of the offspring? Explain your reasoning.

The offspring will have the "widow's peak" phenotype. We can see from the symbols used for the alleles that H is dominant to h. Therefore, in the heterozygous offspring, the phenotype will be the same as the dominant allele: widow's peak.

5. Suppose that two siblings both have attached earlobes, and their parents have unattached earlobes. Unattached earlobes are represented as  $E$ , and attached earlobes are represented by  $e$ . What are the genotypes of the parents? Explain your reasoning.

To have the attached earlobe phenotype, the genotypes of the siblings must both be  $ee$ . Due to the law of segregation, one  $e$  allele must have come from dad, and one  $e$  allele must have come from mom.

We also know that the parents have unattached earlobes. This means that each parent has at least one  $E$  allele.

Therefore, both parents are heterozygotes: their genotype is  $Ee$ .

6. Copy the Punnett square into your notebook. The ability of a person to roll his or her tongue is dominant ( $T$ ) and the inability is recessive ( $t$ ). Fill in the blank genotypes and describe the phenotypes for each.

	$T$	$T$
$T$	$TT$ Tongue-roller	$TT$ Tongue-roller
$t$	$Tt$ Tongue-roller	$Tt$ Tongue-roller

7. In pigeons, the checker pattern of feathers ( $F$ ) is dominant to the non-checker pattern ( $f$ ). Suppose a checkered pigeon with the genotype  $Ff$  mates with a non-checkered pigeon. Draw a Punnett square to predict the genotypes of their offspring.

	$F$	$f$
$f$	$Ff$	$ff$
$f$	$Ff$	$ff$

Genotypic ratio of offspring is 1  $Ff$ : 1  $ff$ .

8. A white-flowered plant is crossed with a red-flowered plant. What is the likely mode of inheritance if the offspring produced are:
- Plants with pink flowers? incomplete dominance
  - Plants with red flowers? dominant (Mendelian)
9. How does sex-linked inheritance occur?

Sex-linkage occurs when the gene of interest is located on one of the sex chromosomes: X or Y. This affects heredity because genetic males and genetic females will inherit the traits in different proportions.

10. The Punnett square shows the genotype of the female parent and the genotypes of the offspring.  $X^B$ =Normal;  $X^b$ =red-green colour vision deficiency; Y=Y chromosome
- What is the genotype of the male parent?  $X^bY$
  - What is the phenotype of the male parent? Red-green colour deficiency

11. Sometimes breeders of plants and animals need to know if a plant or animal that has a dominant phenotype has a genotype that is homozygous dominant or heterozygous. One way to determine this is by doing a test cross. A test cross involves:

- Mating the individual of unknown genotype with an individual who is homozygous recessive for the trait
- Analyzing the phenotypes of the offspring

Explain how this helps breeders identify the unknown genotype.

Let A and a represent the alleles for this hypothetical trait. As shown from all the possible test crosses below, from the frequency of the phenotypes in the offspring, you can determine the genotype of the unknown parent.

Test Cross: AA x aa		
	A	A
a	Aa	Aa
a	Aa	Aa
Genotypic Ratio: all Aa		
Phenotypic Ratio: all dominant trait		

Test Cross: Aa x aa		
	A	a
a	Aa	aa
a	Aa	aa
Genotypic Ratio: half Aa, half aa		
Phenotypic Ratio: half dominant, half recessive		

Test Cross: aa x aa		
	a	a
a	aa	aa
a	aa	aa
Genotypic Ratio: all aa		
Phenotypic Ratio: all recessive trait		