Chap 8: Heredity

1. What is heredity? Who is called the Father of Genetics?

Heredity is the passing of traits (characteristics) from parents to their offspring through genes. It explains why children look like their parents.

Gregor Johann Mendel is called the Father of Genetics. He did experiments on garden pea plants and found the basic rules of inheritance.

2. Why did Mendel choose the garden pea plant for his experiments?

• It has many clearly contrasting traits, like tall/short plants and round/wrinkled seeds.
• It has a short life cycle, so many generations can be studied quickly.
• It produces a large number of seeds.
• It normally self-pollinates, so pure lines can be kept. It can also be cross-pollinated easily by hand.

3. Define gene, allele, dominant trait and recessive trait.

Gene - A part of DNA that carries the information for a particular trait.

Allele - Different forms of the same gene. eg: T (tall) and t (short).

Dominant trait - A trait that shows itself even when only one copy of its allele is present (TT or Tt). It is written with a capital letter.

Recessive trait - A trait that shows itself only when both alleles are recessive (tt). It is written with a small letter.

4. What is the difference between genotype and phenotype?

Genotype is the genetic makeup of an organism, that is, the alleles it carries. eg: TT, Tt, tt.

Phenotype is the visible character of an organism. eg: Tall, Short.

Genotype	Phenotype
TT	Tall
Tt	Tall (T is dominant, so t is hidden)
tt	Short

Different genotypes (TT and Tt) can have the same phenotype.

5. What is the difference between homozygous and heterozygous?

Homozygous - Both alleles of a trait are the same. eg: TT (pure tall), tt (pure short).

Heterozygous - The two alleles of a trait are different. eg: Tt (looks tall, but carries the allele for shortness).

6. Explain Mendel's monohybrid cross with a Punnett square.

Mendel crossed a pure tall plant (TT) with a pure short plant (tt).

F1 generation: All plants were tall (Tt).

F2 generation: F1 plants were self-pollinated (Tt x Tt).

	T	t
T	TT	Tt
t	Tt	tt

Phenotypic ratio: 3 Tall : 1 Short

Genotypic ratio: 1 TT : 2 Tt : 1 tt

7. How did Mendel's experiment show that traits are inherited as separate units?

In F1, all plants were tall. The short trait did not appear at all.

In F2, one-fourth of the plants were short, just as short as the original short plant.

If the traits had mixed, the plants would have been of medium height. Instead, the short trait was only hidden in F1 and came back unchanged in F2.

So each trait is controlled by a separate unit (gene), and each parent gives one copy of it to the offspring.

8. What is the result of a dihybrid cross?

Mendel crossed a tall plant with round seeds (TTRR) with a short plant with wrinkled seeds (ttrr).

F1: All plants were tall with round seeds (TtRr).

F2: Four types of plants were obtained in the ratio 9 : 3 : 3 : 1.

9 Tall, Round : 3 Tall, Wrinkled : 3 Short, Round : 1 Short, Wrinkled

New combinations (tall-wrinkled and short-round) appeared. This shows that the two traits are inherited independently of each other.

9. A tall plant (Tt) is crossed with a short plant (tt). What is the ratio of tall to short plants?

	T	t
t	Tt	tt
t	Tt	tt

Ratio: 1 Tall : 1 Short (50% tall, 50% short)

10. How is the sex of a child determined in humans?

Humans have 23 pairs of chromosomes. One pair is the sex chromosomes.

Women have XX, and men have XY.

All eggs from the mother carry an X chromosome. Half the sperms from the father carry X, and the other half carry Y.

• If a sperm with X fertilises the egg, the child is a girl (XX).

• If a sperm with Y fertilises the egg, the child is a boy (XY).

So the sex of the child depends on which sperm from the father fertilises the egg.

11. How many chromosomes does a child get from each parent? What are autosomes?

Human body cells have 46 chromosomes (23 pairs). The child gets 23 chromosomes from the mother (through the egg) and 23 from the father (through the sperm).

Autosomes - The 22 pairs of chromosomes that control body characters other than sex.

Sex chromosomes - The 1 pair that decides the sex of a person (XX or XY).

12. Why is variation important for a species?

Variation means the differences among individuals of the same species. It is caused mainly by sexual reproduction and by errors in DNA copying.

If all individuals were exactly alike, a sudden change in the surroundings, like a rise in temperature or a new disease, could wipe out the whole species.

With variation, some individuals may survive the change. So variation helps a species survive over a long time.