CHAPTER – 3
HEREDITY AND GENETICS

P. 28 CHECK YOUR PROGRESS 1

A. Match the Column A with Column B.

1. c **2.** a **3.** e **4.** b
5. d

P. 33 CHECK YOUR PROGRESS 2

A. Mendel conducted his experiments on garden pea (*Pisum sativum*) because of the following reasons:

- Pea plants have several distinct varieties.
- Pea plant bears bisexual flowers.
- Due to self-fertilization, it is easy to get pure lines for several generations.
- As it is an annual plant, it is possible to study several generations within a short span of time.
- The flowers of pea plant are easy to handle.
- Each plant can produce large number of seeds in single generation.

B. Fill in the blanks.

1. 3 : 1 **2.** 9 : 3 : 3 : 1
3. homozygous **4.** heterozygous
5. Dominance

P. 37 CHECK YOUR PROGRESS 3

A. Answer these questions.

1. Sex chromosomes

2. In human beings, out of 23 pairs of chromosomes, a specific pair, i.e., the 23rd pair of chromosomes determines the sex of the individual. These are called sex chromosomes. All the other 22 pairs of chromosomes are termed as autosomal chromosomes or autosomes.

The sex chromosomes determine the sex of the individual but autosomes carry genes which control somatic traits and play no role in sex determination.

3. Inheritance of non-sexual characters or traits due to the presence of an allele on sex chromosome is called sex-linked inheritance.

4. Genetic engineering is a technique in which the genetic constitution of an organism can be altered by introducing new genes or replacing existing genes into its chromosomes. For example, insulin producing genes are introduced in a bacteria to produce insulin.

P. 37 EXERCISES

I. Multiple-Choice Questions

A. Choose the most appropriate answer.

1. b **2.** b **3.** b **4.** b
5. b **6.** c **7.** a **8.** b
9. c **10.** b

II. Assertion–Reason Type Questions

A. 1. b **2.** c **3.** c **4.** b

III. Very Short Answer Type Questions

A. Complete the following paragraph by filling in the blanks (1) to (5) with appropriate words.

1. monohybrid
2. F_1
3. dominant
4. F_2
5. recessive

B. Name the following.

1. Haemophilia **2.** Defective tooth enamel
3. Genotype **4.** Homogametic
5. Heterogametic **6.** Phenotype
7. *Pisum sativum* **8.** Recessive allele
9. Monohybrid **cross** **10.** Chromosome

C. Identify the odd term in each set and name the category to which the remaining three belong.

1. Odd term – Night blindness; category of other three – Inherited conditions

2. Odd term – Typhoid; category of other three – Genetic disorders

IV. Short Answer Type Questions

A. Differentiate between the following.

1. Genes are the units of heredity. A gene is a specific DNA segment on a chromosome which controls the expression of a character.

The genetic constitution of an organism in which the genes are present in various combinations is called genotype.

2. Each gene has two alternative forms of a character producing different effects. These alternative forms are called alleles.

Genes are the units of heredity. A gene is a specific DNA segment on a chromosome which controls the expression of a character.

3. Chromosomes are filamentous bodies present in the nucleus, composed of chromatin material (DNA–RNA protein complex). They can be defined as a strand of DNA molecule associated with proteins. Chromosomes are the hereditary vehicles found in the nucleus of a cell. Chromosomes contain genes which are carriers of heredity.

   Genes are composed of DNA. A gene (segment of DNA) codes for the synthesis of a specific protein which controls the expression of a particular characteristic in an individual. Thus, gene is the basis of heredity found on a chromosome.

4. The genetic constitution of an organism in which the genes are present in various combinations is called genotype.

   Phenotype is the externally visible expression of genes, which is an inherited feature in an individual's appearance.

5. Law of Dominance states that when two homozygous individuals with one or more sets of contrasting characteristics are crossed, the characteristics which appear in the F_1 hybrids are dominant and those which do not appear in F_1 generation are recessive.

   Law of Segregation states that when a pair of allele is brought together in a hybrid, the members of the allelic pair remain together without mixing and separate or segregate from each other when the hybrid forms gametes. It is also known as the law of purity of gametes.

6. Out of the two alleles of a gene, the allele which masks any phenotypic effect of any recessive allele is called dominant allele or gene.

   The allele that is masked or suppressed is the recessive allele or gene.

7. In human beings, out of 23 pairs of chromosomes, a specific pair, i.e., the 23^{rd} pair of chromosome determines the sex of the individual. These are called sex chromosomes.

   All the other 22 pairs of chromosomes are termed as autosomal chromosomes or autosomes. The autosomes carry genes which control somatic traits and have no bearing on the sex. The two members of each pair of homologous autosomes are similar in size and shape, but this may not be true for the sex chromosomes.

8. A cross between two parents representing contrasting forms of a single trait is called monohybrid cross.

   A dihybrid cross is one in which parents with two pairs of traits with contrasting characters are crossed.

B. Answer these questions.

1. Mendel named the heredity units as 'factors'.

2. Determining the sex of an individual at prenatal stage is called sex determination. In human beings there are two types of sex chromosomes – X and Y. An egg contains X chromosomes, while a sperm contains either X or Y chromosome.

   When the sperm and the egg unite to form a zygote, each individual inherits one of the two possible combinations of sex chromosomes.

   A zygote with two X chromosomes (one from mother and one from father) develops into a girl while a zygote with one X chromosome (from mother) and one Y chromosome (from father) develops into a boy.

   Sex of an individual is determined purely due to chance and neither mother nor father can be blamed for it.

3. Colour blindness and haemophilia.

4. Selecting pea plants was one of the most important factors in the success of Mendel's experiment because of his meticulous and careful observations about its features.

   The features that were advantageous for the experiments were:

   Shorter lifespan so that a large number of generations can be studied and examined.

   Presence of contrasting variants of features.

   Ease of rearing or cultivation.

   Since all these features were present in the garden pea plant, Mendel's experiment was successful.

5. Law of Segregation states that when a pair of allele is brought together in a hybrid, the members of the allelic pair remain together without mixing and separate or segregate from each other when the hybrid forms gametes. Therefore, it is also known as the law of purity of gametes.

6. Haemophilia is caused by recessive allele located on the X chromosome. It is more common in males than females since males are XY, so they only have one X chromosome that they inherit from their mother. So, if the X chromosome contains the gene responsible for hemophilia, there is no normal X chromosome to mask it.

7. The branch of science that deals with the mechanism responsible for similarities and differences among closely related species is called genetics.

8. Law of Dominance states that when two homozygous individuals with one or more sets of contrasting characteristics are crossed, the characteristics which appear in the F_1 hybrids are dominant and those which do not appear in F_1 generation are recessive.

9. A dihybrid cross is one in which two varieties of pea plants having two contrasting characters are crossed to study inheritance of two pairs of triats simultaneously.

10. Autosomes are chromosomes that carry genes which control somatic traits and play no role in sex determination. There are 22 pairs of autosomal chromosomes.

V. Long Answer Type Questions

A. Answer these question.

1. Genotype of offsprings when both parents are Bb or heterozygous for black fur – BB, Bb and bb.

   The genotype of offsprings can be deduced on the basis of the following Punnet square.

Father ↓ / Mother →	B	b
B	BB	Bb
b	Bb	bb

VI. Structured/Application/Skill Type Questions

A. 1. 50% probability that the son will have haemophilia.

2. X-linked inheritance

3. X chromosome

B. 1. **i** – YR, **ii** – YR, **iii** – yr, **iv** – YyRr, **v** – YyRr, **vi** – YyRr

2. Yellow round seeds.

3. Yellow round seeds, Green round seeds, Yellow wrinkled seeds and Green wrinkled seeds.

4. 9 : 3 : 3 : 1

5. Law of independent assortment

C. 1. Genotype of mother – bb

2. Phenotype – Blue eye

3. 1 : 1

D. 1. Punnet Square

♀ / ♂	TR	TR
tr	TtRr	TtRr
tr	TtRr	TtRr

2. Genotype – TtRr

   Phenotype – Tall plant bearing red-coloured flowers

3. Law of independent assortment states that when a dihybrid organism forms gametes, each gamete receives one allele from each allelic pair and the assortment of alleles of different characteristics during gamete formation is independent of their parental combinations.

4. Tall plant with red-coloured flowers, Tall plant with white-coloured flowers, Dwarf plant with red-coloured flowers and Dwarf plant with white-coloured flowers.

5. 9 : 3 : 3 : 1

6. TR, Tr, tR and tr

E. 1. Sweet pea plant having axial flowers with round seeds.

2. Axial flowers with round seeds, Terminal flowers with round seeds, Axial flowers with wrinkled seeds and Terminal flowers with wrinkled seeds.

3. 9 : 3 : 3 : 1

4. Law of independent assortment – It states that when a dihybrid organism forms gametes, each gamete receives one allele from each allelic pair and the assortment of alleles of different characteristics during gamete formation is independent of their parental combinations.