Chapter- 1

Heredity and Evolution

* Heredity ⇒ The transmission of characters (traits) from the parents to their offsprings is called heredity.

Any heritable feature is a characters. The alternative forms of a character are called traits.

* Genetics ⇒ The branch of biology which deals with the study of heredity and variation is called genetics.

Father of genetics ⇒ Gregor Mendel.

His experiments were published in 1866 but were accepted in 1900, when De Vries, Karl Correns and Tschermak performed his experiments again.

Variation

⇒ The differences in the characters (or traits) among the individuals of a species is called variation.

There are types of variation:

1) Somatic variation ⇒ It takes place in body cells and it is neither transmitted nor inherited. It is also known as acquired traits.

2) Gametic variation ⇒ It takes place in gametes and it is inherited as well as transmitted. It is also known as inherited traits.

* Importance of variation ⇒ It increases the chances of survival of a species in changing environment.

Note: Offsprings are also called progeny.

* Chromosomes ⇒ It is a thread-like structure in the nucleus of cell formed of DNA which carries the genes.

* Genes ⇒ A gene is a unit of DNA on a chromosome which governs the synthesis of one protein that controls a specific characteristic of an organism.

Genes work in pairs and are represented by letters.

Genes were not discovered at the time when Mendel contributed his experiments. He used the term 'factors' instead of genes.

* Dominant gene ⇒ The gene which decides the appearance of an organism even in the presence of an alternative gene is known as a dominant gene.

* Recessive gene ⇒ The gene which can decide the appearance of an organism only in the presence of another identical gene is called a recessive gene.

* Genotype ⇒ It shows the genetic constitution of an organism. The ratio on the basis of gene combination is called genotypic ratio.

* Phenotype ⇒ The characteristic (or trait) which is visible in an organism is called its phenotype. The ratio on the basis of visible characters is called phenotypic ratio.

* F_1 generation ⇒ When two parents cross (or breed) to produce progeny, then their progeny is called first filial generation or F_1 generation.

Note: 'F' stands for filial.

* F_2 generation ⇒ When the first generation progeny cross among themselves to produce second generation progeny is called second filial generation of F_2 generation.

Gregor Mendel and his experiments

⇒ Gregor Mendel was the first scientist to make a systematic study of inheritance which involved the transfer of characteristics from parents to progeny.

He used different varieties of pea plants (pisum sativum). The different characteristics of pea plants were - height of plant, shape of seeds, colour of seeds and colour of flowers.

Why did he chose pea plants?

⇒ Mendel chose pea plants because of the following reasons:

- The different varieties have a clear cut differences (contrasting characters) which are easy to differentiate.
- It is naturally self-pollination.
- It has a short life span due to which one can study more generations in a less interval of time.

- The flowers are bisexual, so it is easy to cross-pollinate.

* Hybrid ⇒ A new form of plant resulting from a cross of different varieties of a plant is known as as hybrid.

* Monohybrid cross ⇒ When we breed two pea plants having one contrasting characteristic each to obtain new plants, then it is called monohybrid cross.

* Dihybrid cross ⇒ If we breed two pea plants having two contrasting characteristics each to obtain new plants, then it is called dihybrid cross.

* Inheritance ⇒ It is the transmission of genetically controlled characteristics from one generation to the next.

Mendel's laws of inheritance

⇒ Mendel contributed 3 laws of inheritance:

1) Law of dominance. → Monohybrid
2) Law of segregation. → Monohybrid
3) Law of independent assortment. — Dihybrid

Law of Dominance:

⇒ Out of a pair of contrasting characters present together, only one is able to express itself while the other remains suppressed. The one that expresses is the dominant character and the unexpressed one is recessive.

Parental generation ⇒ (Tall) TT × (Dwarf) tt

Gametes ⇒ T, t

F_1 generation ⇒ Tt (Tall) × Tt (Tall)

Gametes ⇒ T, t T, t

.	T	t
T	TT	Tt
t	Tt	tt

F_2 generation ⇒ TT, Tt, Tt, tt.

Phenotype ⇒ 3:1
Genotype ⇒ 1:2:1

* Contrasting characters ⇒ The characters which always appears in two opposing conditions are called contrasting characters.

Law of Segregation:

=> According to the law of segregation, the two members of a pair of 'factors' separate during the formation of gametes. They do not blend but segregate (separate) into different gametes. The gametes combine together by random fusion at the time of zygote formation.

Law of Independent Assortment:

=> According to this law, in inheritance of more than 1 pair of traits in a cross simultaneously, the factors responsible for each pair of traits are distributed independently to the gametes.

Dihybrid cross -

Parental generation => (Round yellow seeds) RRYY × (Wrinkled green seeds) rryy

Gametes => RY, ry

	RY	Ry
ry	RrYy	RrYy
ry	RrYy	RriYy

F1 generation ⇒ RrYy , RrYy , RrYy , RrYy
(Round-yellow seeds)

F1 cross ⇒ RrYy × RrYy

Gametes ⇒ RY, Ry, rY, ry RY, Ry, rY, ry

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Tall round ⇒ 9
Tall wrinkled ⇒ 3
Short round ⇒ 3
Short wrinkled ⇒ 1

Phenotype ⇒ 9:3:3:1 ✓

Note: The rules for the inheritance of traits given by Mendel are also applicable to the inheritance of traits in animals (including human beings).

How do these traits get expressed?

- Cellular DNA is the information source for making proteins in cell.
- Any characteristic depends on the amount of hormone produced. And the amount of hormone produced will depend on the efficiency of the process for making it.
- There are genes control the characteristics (or traits).

Sex determination:-

=> The process by which the sex of a person is determined is called sex determination.

- Genetic factors are responsible for sex determination.

- In humans, there are 23 pairs of chromosomes, out of which 22 pairs are called autosomes and the last pair is called sex chromosome.

* Sex chromosomes => The chromosomes which determines the sex of a person.

XX => Female.
XY => Male.

Parent => XX (Female) | XY (Male)

Gametes => X | X, Y

F1 generation => XX , XY.

Note: Sex of children is determined by what they inherit from their father, and not from their mother.

How are Blood groups inherited?

- A person has one of the four blood groups - A, B, AB, O.
- There are 3 types of genes which determine blood groups - I^A, I^B, I^O.
- I^A and I^B show no dominance over each other, so they are codominant. But, they show dominance over I^O. So, I^O is recessive.

⇒ (i) If genotype is $I^A I^A$, then blood group will be A.

⇒ (ii) If genotype is $I^B I^B$, then blood group will be B.

⇒ (iii) If the gene combination is $I^A I^B$, then blood group will be AB.

⇒ (iv) If the genotype is $I^O I^O$, then the blood group will be O.