Determination of Sex

Members of almost all species are often divided into two sections according to the kind of gamete or sex cell produced by them male sex and female sex. The word **sex** has been derived from Latin word sexus meaning section or separation. However, some of the lowest forms of plant and animal life are found to have several sexes.

Each mating type is physiologically capable of conjugating with its own type only. Further, in organisms in which the number of sex reduced to just two, sexes may reside in different individuals or within the same individual.

An animal possessing both male and female reproductive organs is usually referred to as a **hermaphrodite**. The sex cells and reproductive organs form the **primary sexual characters** of male and female sexes. Besides these primary sexual characters, the male and female sexes differ from each other in many somatic characters known as **secondary sexual characters**.

The phenomenon of molecular, morphological, physiological or behavioral differentiation between male and female sexes is called **sexual dimorphism**.

Genetically controlled sex determining mechanism

Most of the mechanisms of the determination of the sex are under genetic control and they may be classified into following categories :
1. Sex chromosome mechanism or Heterogamesis;
2. Genic balance mechanism;
3. Male haploidy or haplodiploidy mechanism;
4. Single gene effects.

Sex Chromosomal Mechanisms (Heterogametic)

1. Discovery of sex chromosomes.

In sexually dimorphic dioecious organisms besides morphological and behavioral differences between both sexes, the sexual diversity also occurs at the level of chromosomes. The chromosomal differences

between the sexes of several dioecious species were found earlier in the course of cytological investigations.

German biologist, **Henking** in 1891 while studying spermatogenesis of the squash bug, Pyrrhocoris, noted that meiotic nuclei contained 11 pairs of chromosomes and an unpaired element is moved to one of the poles during the first meiotic division. **Henking** called this unpaired element a "**x body**" and interpreted it as a nucleolus.

In 1905, **Edmund Wilson** noted that females of Protenor (another hemipteran bug) have 7 pairs of chromosomes, whereas males have 6 pairs and an unpaired chromosome, which **Wilson** called the **X chromosome**. One member of the heteromorphic pair appears identical to the member of a pair in the female; she called this the X chromosome. The other member of the heteromorphic pair is never found in females; she called this the **Y chromosome.**

2. Types of sex chromosomes.

In dioecious organisms, thus, two types of chromosomes were recognised which are as follows :

(i) Autosomes. The chromosomes which have no relation with the sex and contain the genes which determine the somatic characters of the individuals are known as **autosomes** (**A**).
(ii) Sex chromosomes. The chromosomes which are responsible for the determination of sex are known as **sex chromosomes**, e.g., X and Y chromosomes.

3. Structure of sex chromosomes.

The X and Y sex chromosomes exhibit structural differences. The cytological studies have shown that the X chromosomes of most organisms are straight, rod-like and comparatively larger than Y chromosomes. The Y chromosome is smaller in size with one end slightly curved or bent to one side in Drosophila; in man no such curvature of Y chromosome occurs. The X chromosomes have large amount of euchromatin and small amount of heterochromatin. The

euchromatin has large amount of DNA material, hence, much genetic information.

The Y chromosome contains small amount of euchromatin and large amount of heterochromatin. The Y chromosome has little genetic information, therefore, sometimes it is referred to as genetically **inert** or **inactive**.

TYPES OF SEX CHROMOSOMAL MECHANISM OF SEX DETERMINATION

In dioecious diploidic organisms following two systems of sex chromosomal determination of sex have been recognized:

(a) Heterogametic males.
(b) Heterogametic females.

Heterogametic Males

In this type of sex chromosomal determination of sex, the female sex has two X chromosomes, while the male sex has only one X chromosome. Because, male lacks a X chromosome, therefore, during gametogenesis produces two types of gametes, 50 per cent gametes carry the X chromosomes, while the rest 50 per cent gametes lack in X chromosomes. Such a sex which produces two different type of gametes in terms of sex chromosomes, is called **heterogametic sex**. The female sex, because, produces similar type of gametes, is called, **homogametic sex**.

Heterogametic Females

In this type of sex chromosomal determination of sex, the male sex possesses two homomorphic X chromosomes, therefore, is homogametic and produces single type of gametes, each carries a single X chromosome. The female sex either consists of single X chromosome or one X chromosome and one Y chromosome. The female sex is, thus, heterogametic and produces two types of eggs, half with a X chromosome and half without a X chromosome (with or without a Y chromosome). To avoid confusion with that of XX-XO and XXXY types of sex determining mechanisms, instead of the X and Y alphabets, Z and W alphabets are generally used respectively.