# Extra-chromosomal inheritance-

→ Oscar Hertwig in 1870's, proposed the fact that the nucleus contains the units of inheritance.

→ The mechanism was clearly understood with the development of Mendel's laws of inheritance.

→ Further researches showed the genes as the hereditary units located in the chromosomes, which are enclosed in the nucleus.

→ But in 1950's Dr. Sanger & his colleagues suggested the possible role of cytoplasm in certain characters is controlled by the non-chromosomal genes.

→ In other animals and plants certain characters are inherited independent of the chromosomal genes.

→ The cytoplasm in such cases contains self hereditary particles formed of DNA.

→ These may be mitochondria, plastids or foreign organism etc.

→ The total self dupliating hereditary material of cytoplasm is called plasmon and the cytoplasmic units of inheritance are described as plasmagenes.

→ The crosses exhibiting following types of results may suggest extra-chromosomal inheritance.

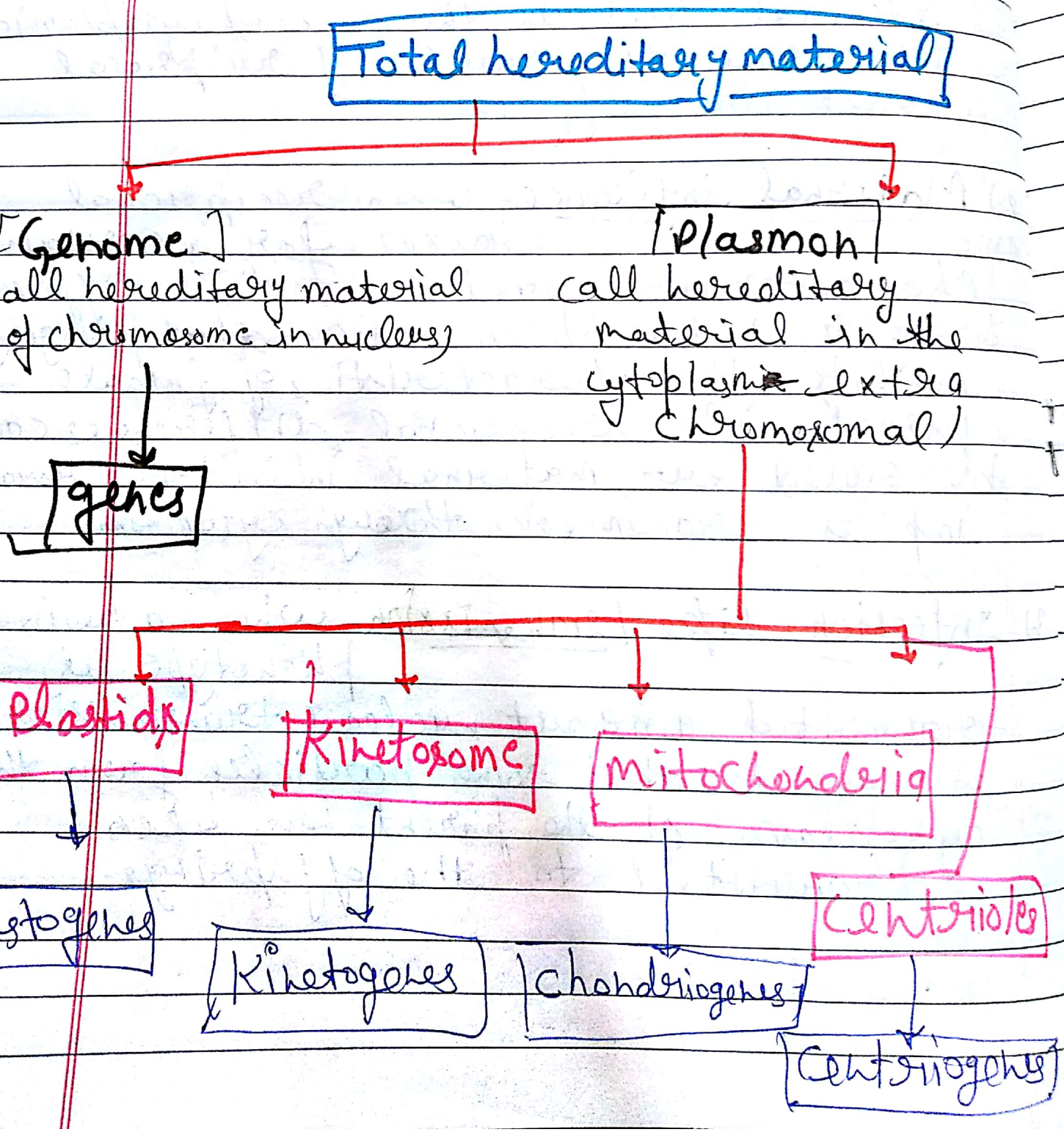
① Difference in reciprocal cross results - In case of chromosomal heredity, the results of reciprocal crosses are ordinary identical but in the case of cytoplasmic inheritance the results of reciprocal crosses are different.

2.) Maternal influence - when reciprocal crosses for a certain character are found to exhibit different results, it has been noticed that progeny exhibits the characteristics of female parent. If chromosomal differences can be ruled out, maternal inheritance usually implies transmission through cytoplasm.

3.) Infection - like transmission - when a heritable phenotype is transmitted without nuclear transmission. it suggests that some particles from the cytoplasm of the parent have been transmitted to the offsprings.

4. Indifference to nuclear substitution

When a particular genotype exhibiting a specific character is replaced by a nucleus having alternative genotype it does not change the phenotype and suggests the possibility of cytoplasmic inheritance.



5. Segregation and non-mendelian segregation-

segregation is characteristic of mendelian and chromosomal inheritance. Failure to show segregation may indicate extra-chromosomal heredity even if segregation occurs but in a fashion inconsistent with the segregation of chromosomes, the results may suggest the possibility of non-chromosomal inheritance.

* Examples of cytoplasmic inheritance in animals

① In case of maternal effect - shell coiling in snail.

② particles inheritance - kappa particles in Paramecium aurelia.

① Shell coiling in snail - The direction of coiling of the shell in water snail Limnaea, illustrates the influence of maternal genes acting through effects produced in the cytoplasm. Snails exhibit two types of coiling of their shell;-

(i) Dextral - those snails coiled towards right are known as dextral.

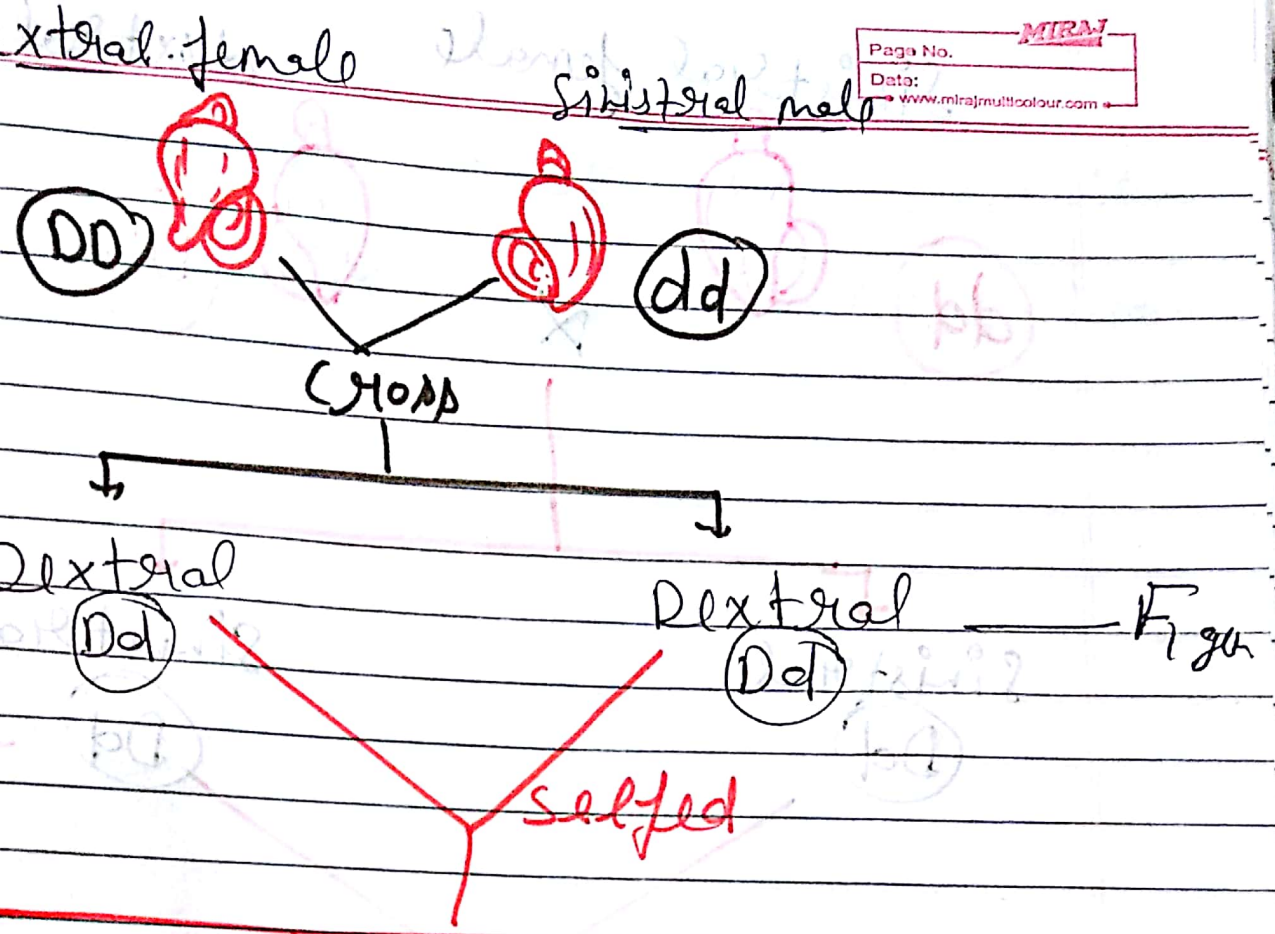
(ii) Sinistral - those snails coiled towards left are called sinistral.

- The dextral coiling is dominant and is governed by the gene **D**. The sinistral coiling is recessive and is determined by the gene **d**.

→ The experiments of **Boycott, Diver and Gautric** and explanation given by **Sturtevant** indicate that the character of coiling is determined by the gene of the mother and not by the individual's own gene.

(a) If a dextral female is crossed with sinistral male, all the $F_1$ offspring possess dextral shell irrespective of the fact that a few of them possessed recessive genes and were supposed to develop sinistral coiling.

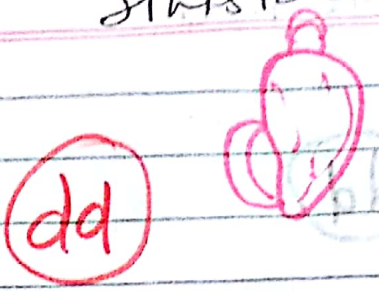
(b) In a reciprocal cross between sinistral female and dextral male and the $F_1$ offsprings which according to their genotype were supposed to be dextral, were found to develop sinistral shell coiling and in $F_2$ generation all the offspring developed dextral coiling.




→ all offspring in $F_2$ gen. shell coiling showed dextral type.

Sinistral female

dextral male



dd

DD

X

Sinistral

Dd

Sinistral

Dd

— F1

selfed

DD

Dd

Dd

dd

Dextral

dextral

dextral

dextr

inbreeding

all dextral

all sinistral