

Cytoplasmic inheritance OR Non-chromosomal inheritance

Introduction:-

Nuclear genes are not the sole vehicle of inheritance. Certain extra nuclear genes or DNA molecules in the cytoplasm of many prokaryotic & eukaryotic cells also help in the transmission of characters.

Cytoplasmic extranuclear genes are DNA molecules of plasmids, mitochondria, chloroplast, endo-symbionts which does not resemble with that of genes of nuclear chromosome & is known by different names. Such as non-mendelian, non-chromosomal, cytoplasmic, extra-nuclear inheritance & extra-nuclear genetic systems.

Extra chromosomal inheritance & non-chromosomal inheritance in eukaryotes.

Some most important examples of extra chromosomal inheritance in eukaryotes.

1. Maternal inheritance :-

(A) Shell Coiling in Snail :-

Shell of the snail is spirally coiled - clockwise coiling of the shell is called dextral & anticlockwise coiling is called sinistral. Sinistral

coiling is dominant among dextral.

Genetic constitution of sinistral form is ss & genetic constitution of dextral form is SS or Ss . S gene is dominant over s .

a) Cross between sinistral female snail with a dextral male snail.

Sinistral female snail \times Dextral male snail



F₁-generation (Ss)
Sinistral male

Should be dextral according to Mendelian inheritance

Sinistral male

(Ss)

\times (Ss)

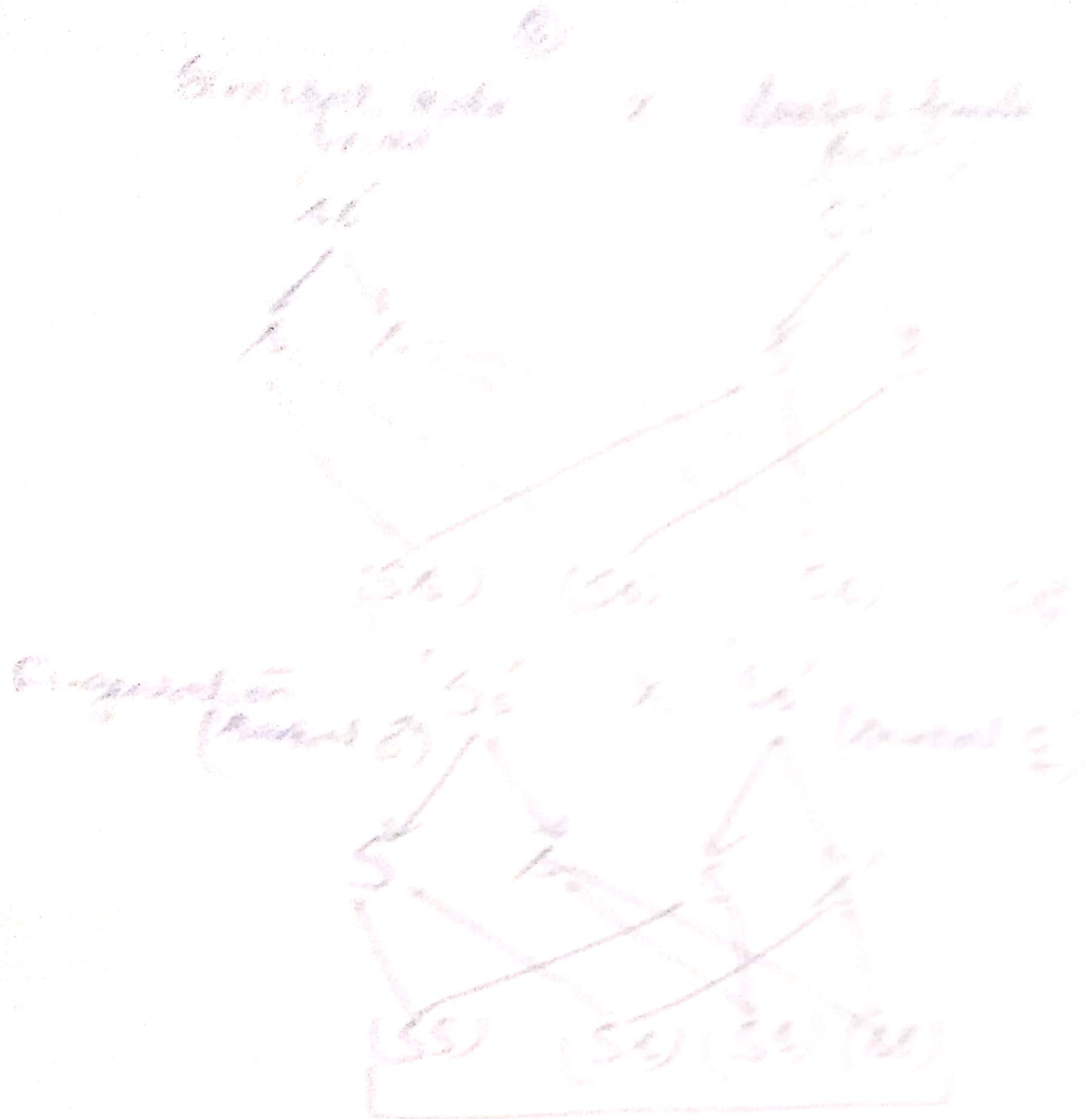
(dextral female)

F₂-generation (SS) (Ss) (Ss) (ss)

All dextral (because mother is dextral)

show, phenotype is expressed by the phenotype of mother

(b) Cross between a sinistral male snail with a dextral female snail.



All derived

From the above, it becomes clear that the direction of the crossing depends not on the genotype of individuals but on the phenotype of individuals - maternal effect

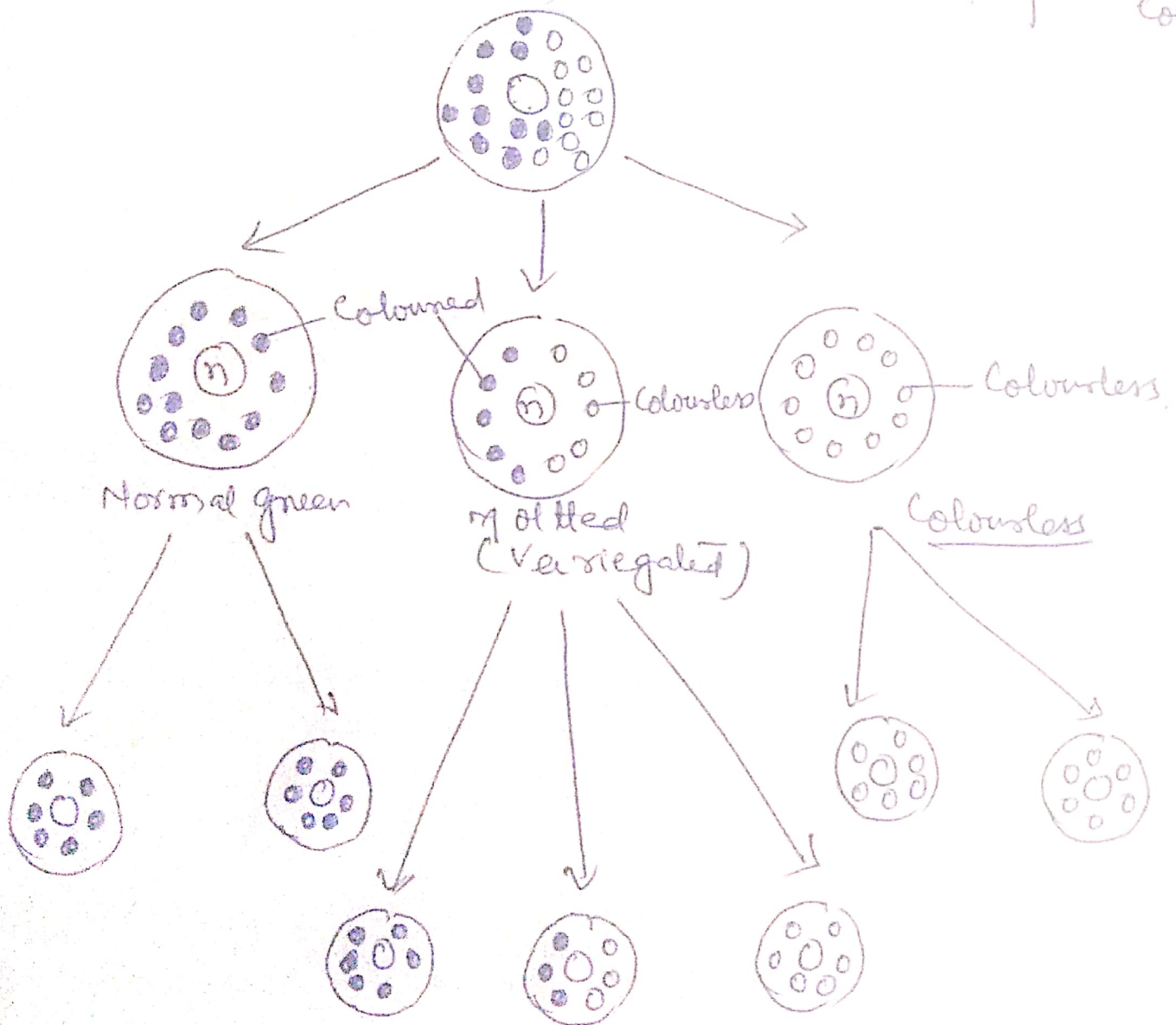
(2) Extra nuclear inheritance by cellular organelles
Maternal inheritance due to cytoplasm and mitochondria is explained by the following examples.

(A) - Plastid inheritance in *Dioscorea* (14 years old)
In *Dioscorea* and 3 types of branches & leaves are found.

(4)

1. Completely green
2. Completely pale green
3. Completely variegated.

leucoplast - ○
Colourless
Chromoplast - ●
Coloured
Chloroplast - ⊙
Coloured



Fig! - Distribution of green plastids
↳ leucoplast during gamete formation

(5)

1. female branch ♀ x ♂ male branch
(green) (green, pale, Variegated)

F₁-generation - Green Plants only.

2. female branch ♀ x ♂ male branch
(pale) (green, pale, Variegated)

F₁-generation - Pale Plants only

3. female branch ♀ x ♂ male branch
(Variegated) (Green, pale, Variegated)

F₁-generation

Green, pale & Variegated plants only
leaves

From the cross, it is clear that Plastids inheritance is '4'o' clock Plasmid shows dependent on the nature of female branch.

(B) KAPPA PARTICLES :-

In Paramecium, T.H. SONNEBORN discovered that when 2-races of Paramecium are crossed, one race sometimes dies. Race which survives is called Killer and which dies is called Sensitive.