Toppersnotes
Unleash the topper in you

CSIR-NET

Council of Scientific & Industrial Research

LIFE SCIENCE

VOLUME – 6

DEVELOPMENT BIOLOGY, PLANT & ANIMAL PHYSIOLOGY

SIERRA INNOVATIONS

CONTENT

Genetics (Inheritance Biology)

Classification Of Livings

GENETICS (INHERITANCE BIOLOGY)

Gene interaction :-

→ when two or more different genes influence the outcome of single trait, this is known as a gene interaction.

Discovery - William Bateson & Reginald Punnett in 1906. They discovered an unexpected gene interaction when they studied crosses involving the sweet pea, Lathyrus odoratus.

ex. P generation White flowered plant × White flowered plant
CCPP ccPP

↓

All Purple
CcPp → F_1 gen

The F_1 hybrid plants are allowed to self fertilize

CcPp × CcPp

F_2 gen → Purple : White
9 : 7

9:3:3:1
↓ convert
9:7

Epistasis :-

Epistasis → Greek for standing upon

A Type of gene interaction where one gene masks or modifies the expression of another gene at distinct locus.

→ Any gene that masks the expression of another non-allelic gene is epistatic to that gene.

→ The gene suppressed is hypostatic.

→ Epistasis is diff from dominance. Epistasis is the interaction b/w diff genes (non-alleles). Dominance is the interaction b/w diff alleles of the same gene that is intra allelic.

① **Dominent Epistasis :-**

Dominant allele of one gene masks the effects of either allele of the second gene. It is termed as dominent epistasis

ex.

P_1 AAbb (Purple) × P_2 aaBB (Red)

↓

F_1 AaBb (Purple)

↓

F_2

12 Purple : 3 Red : 1 white

☆ Recessive epistasis :-

In the case of recessive epistasis, in a pair of non-allelic gen one produces its phenotypic effect independenty in a dominc state, but another cannot Produce a phenotypic effect independent.

Ratio 9:3:3:1 become 9 9:3:4

Pumple : 3 Red : 4 White

☆ Duplicate recessive epistasis :- (complementry gene interection)

If two non-allelic gone are invalve in a specific pathway & Finctional Products from both are required for expression, then one Homozygous recessive allele ant either allic pair would result in the mutant phenotyp

9:3:3:1 → 9:7

☆ Duplicate dominant interaction :-

9:3:3:1 ⟶ 15:1

☆ Pleiotropy :-

→ Mast of the biochemical pathways in the living organism are interconnected.

→ The term pleiotropy refers to the effect of a single gene on more then one character / trait
Some time one trait will be very evident & others will be less evident.

- Several characteristics may differ b/w individuals belonging to the same spps. These differences are termed variations.
- The mechanism of transmission of characters, resemblances as well as differences, from the parental generation to the offspring is called heredity. (आनुवंशिकता)
- The study of heredity, variations & envi. factor known as genetics.

Greek word **genno = give birth**

Genetics → (3 ~~fg~~ areas)
1) Classical genetics → Mendel's principle, Sex determination
2) molecular genetics → Genetic material
3) Evolutionary genetics → Popln genetics

Gregor Johann Mendel (1822-1884)

Rediscovered the Mendel's law - (1900)
1) Hugo de vries (Holland)
2) Carl correns (Germany)
3) Erich Tschermark (Austria)

→ He discovered that individual traits are inherited as discreate factors which retain their physical identity in a hybrid.
→ Later, these factors came to be known as gene.
→ A gene is defined as a unit of heredity.

* Allele :-
Each gene may exists in alternative forms known as allele.
* Homologous :- chromosome that carry the same set of genes in the same seq., although they may not necessarily carry identical alleles of each gene.

✡ Rh Blood group system :-

→ Rh antigen & Factor first on the plasma membrane.
→ Macacus rhesus → Monkey
→ The Rh antigens are located on two Rhesus protein
RhD and RhCE
→ RHD and RHCE are expressed only in RBCs.
→ More then 170 alleles of RHD gene have been found.
RhD protein carries D antigen
RhCE protein carries CE antigens in various combination
(Ce, cE, cE or CE)
→ The classification of Rh-positive and Rh-negative individuals is determined by the presence or absence of the D antigen on the surface of RBCs.
→ D antigen first on a person's RBC, the person is Rh^+
if absent Rh^-
Erythroblastosis fetalis (or hemolytic disease)

✡ Lethal allele :-

The alleles created by mutation in these gene are called lethal alleles. lethal alleles may be recessive or dominent.
4 catagories
① Early onset → early death of an organism
② Late onset → delayed effect
③ Conditional → kill organism under certain envi. condition
④ Semilethal → kill only some individuals. but not all.

✡ Penetrance :-

The percentage of individuals that shows a particular phenotype among those capable of showing it, is known as penetrance. ex. - Polydactyly in humen. (More then 5 finger)
→ A particular gene may produce diff. degrees of expression in diff. individuals. This is known as expressivity.

✡ Phenocopy :-

A phenotype that is not genetically controlled but looks like a genetically controlled one is c/d phenocopy. It is an environmentally induce phenotype that resembles the phenotype determined by the genotype.
ex. → phenocopy of Vit-D resistant rickets.

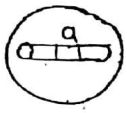
LAW OF GENETICS

→ **Allele:-** Alternate form of the gene
→ Different nose shape - Polymorphism
→ Eye colour is A Gene
but diff. Eye colour like blue, black, white eye is Allele
→ Mutation create Allele.
Mutation ≤ 1% of population

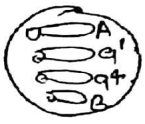
Diff nose shape

AGT — AGT — ATT
mutation

→ Local population in a particular area known as wild type
It is found in maximum popn

Haploid - 

Diploid 

tetraploid 

 → Alleles present on chromosome

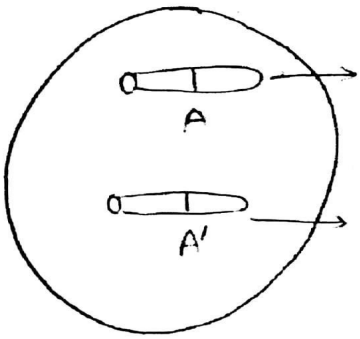
different allele representation-
eye colour - (Black eye - b^+, B, B^1, B^A)

✡ Diploid - two alleles of a gene
Haploid - Single alleles of a gene

→ Gene is not seen → The wrinkled phenotype of seed is due to the absence of Amylo pectin

✡ Law of Genetics

① Law of Dominence:- → Dominant & Recessive are not the properties of alleles or gene it is a relationship b/w 2 alleles, that is observed (Recessive) in Phenotype



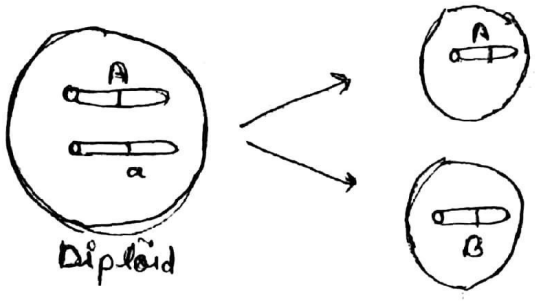
→ Tc, Ts low → ||| → β (White → Black)
Protein, UPS ↑, life ↓ (Protein degraded)

→ Tc, Ts ↑ → Protein ↑ (Dominent) → β → Kcat ↑, life ↑
β Turnover no ↑
Km low
Affinity ↑ (10^8 - 1 sec bind)
UPS ↓ low

β White → Blue

→ Blue colour is show in F_1 generation.

① Law of segregation :- (Law of purity of gamete)



① Law of Dominence :-

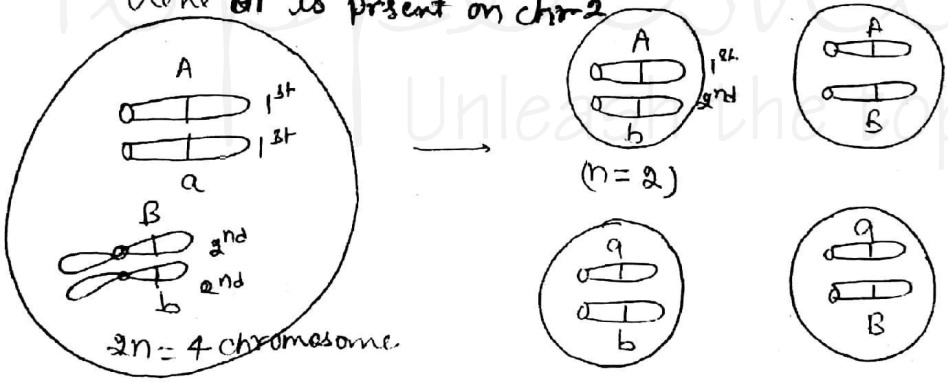
→ One allele of a gene conceal the effect of other allele of same gene

② Law of segregation :-

Gametes are Haploid

③ Law of independent assortment :-

Gene A is present on chr-1
Gene B is present on chr-2



Phenotype = 1 : 1 : 1 : 1

→ Allele can combined with any other allele of other gene two gene are not on diff chromosome

→ One allele of a gene can combined with any other allele of other gene. This is known as law of Independent assortment.

→ When 2 genes are not on diff chromosome their gamatic ratio is 1:1:1:1

LINKAGE

Linkage :-

→ two or more genes reside on the same chromosome, they are said to be linked and their transmission pattern is called linkage.

→ They may be linked together on the autosomes or on the sex chromosome. Gene that on diff. non-homologous chroms are called Unlinked gene.

→ Linked gene (genes on the same chromosome), however tends to stay together during the forn of gametes.

linked gene - on same chromosome
Unlinked gene - (on different chromosome)

✡ Limits of recombination :-

If two gene loci are, so far, apart in the chromosome that the probability of a chiasma forming b/w them is 100%. then 50% of the gametes will be the parental type (non-crossover) & 50% recombinent (crossover) type. when such dihybrid individuals are testcrossed, they are expected to produce progeny in a 1:1:1:1 ratio as would be expected for genes on diff chromosome. Recombination b/w two linked genes cannot exceed 50%. even when multiple crossovers occurs b/w them.

✡ Morgan's work :-

The effects of linkage were first evident in the result of a dihybrid cross in sweet pea by Batson & Punett in 1906

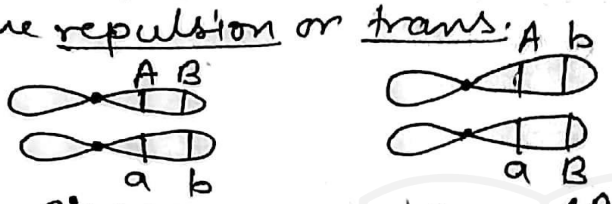
→ Morgan who first discovered the phenomenon of linkage. Morgan postulated that seprotion of linked gene occurs due to forn of chiasmata which represent points of genetic exchange. He used the term crossing over to describe the physical exchange leading to recombination

→ Morgan also proposed that two genes located relatively close to each other along a chromosome are less likely to have a chiasma b/w them as compared to the two genes which are farther apart on the chromosome

→ Drosophilla is unusual in that crossing over (hence recombination) does not occur in ♂ male. The results is that alleles located in a particular chromosomes show complete linkage in drosophilla males. Crossingover is also completely suppressed in female silkworms.

✡ Cis and trans configuration :-

Doubly heterozygous genotypes can be in two diff. configurations. when two linked genes on each chromosome are of the same type (i.e. both dominent, AB, or both recessive ab) the arrangment is c/d the coupling or cis. Alternatively, when two genes on each chromosome are of diff type (i.e. one dominent and one recessive allele, aB or Ab) the arrangment is the repulsion or trans.



Cis (AB/ab) ↓

AB = Parental combination

Ab = Recombinant

Trans (Ab/aB)

Ab = Parental combination

AB = Recombinent.

✡ Genetic mapping :-

The linkage of the gene in a chromosome can be represented in the form of a genetic map or linkage map or chromosomal map.

Discovery - Alfred Sturtevant

→ He used the frequency of crossing over (i.e. recombination frequency) b/w two genes to prepare the first genetic map of X-chromosome of Drosophilla

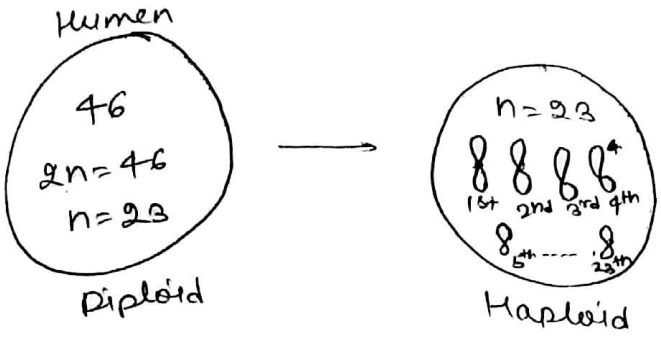
1% crossing over or recombination is equivalent to 1 map unit or 1 cM.

By analyzing percent recombination among the progeny of parents that are heterozygous for a no. of linked genes, a genetic map that places the gene in a linear array can be constructed so.

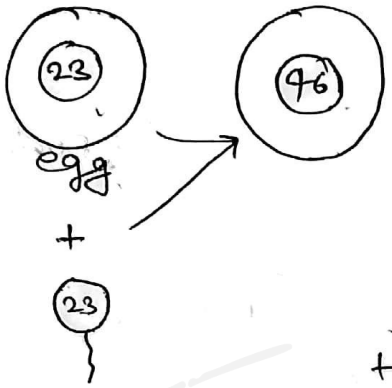
$$\text{Map distance} = \frac{\text{No. of Recombinent offspring}}{\text{Total no. of offspring}} \times 100$$

Unit = Map Unit or Centimorgan (cM)

1 cM = 1×10^6 bp

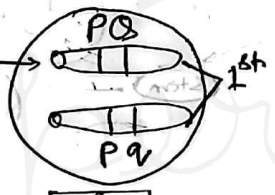


25000 gene
↓
23 Chromosome
↓
1 chr. — 1000 gene



In one sperm & one egg 23 Chromosome is present

Linked gene :- (Pair of the gene) when two or more gene tnt on same chromosome they are known as linked gene



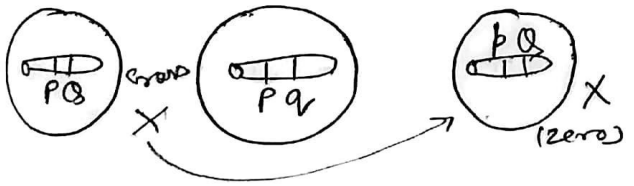
(PQ are gene not allele)

→ Link gene seprated on crossing over

→ Dominent & Recessive both chromosome on 1

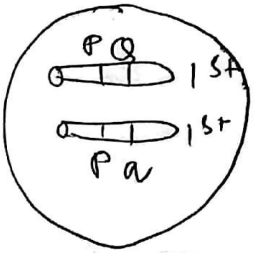
→ Dominent on one chromosome

→ One dominent allele and Recessive allele



The linked gene are tnt on same chromosome

→ Chromosal map = T. H Morgen



Phenotype = 1 : 0 : 0 : 1

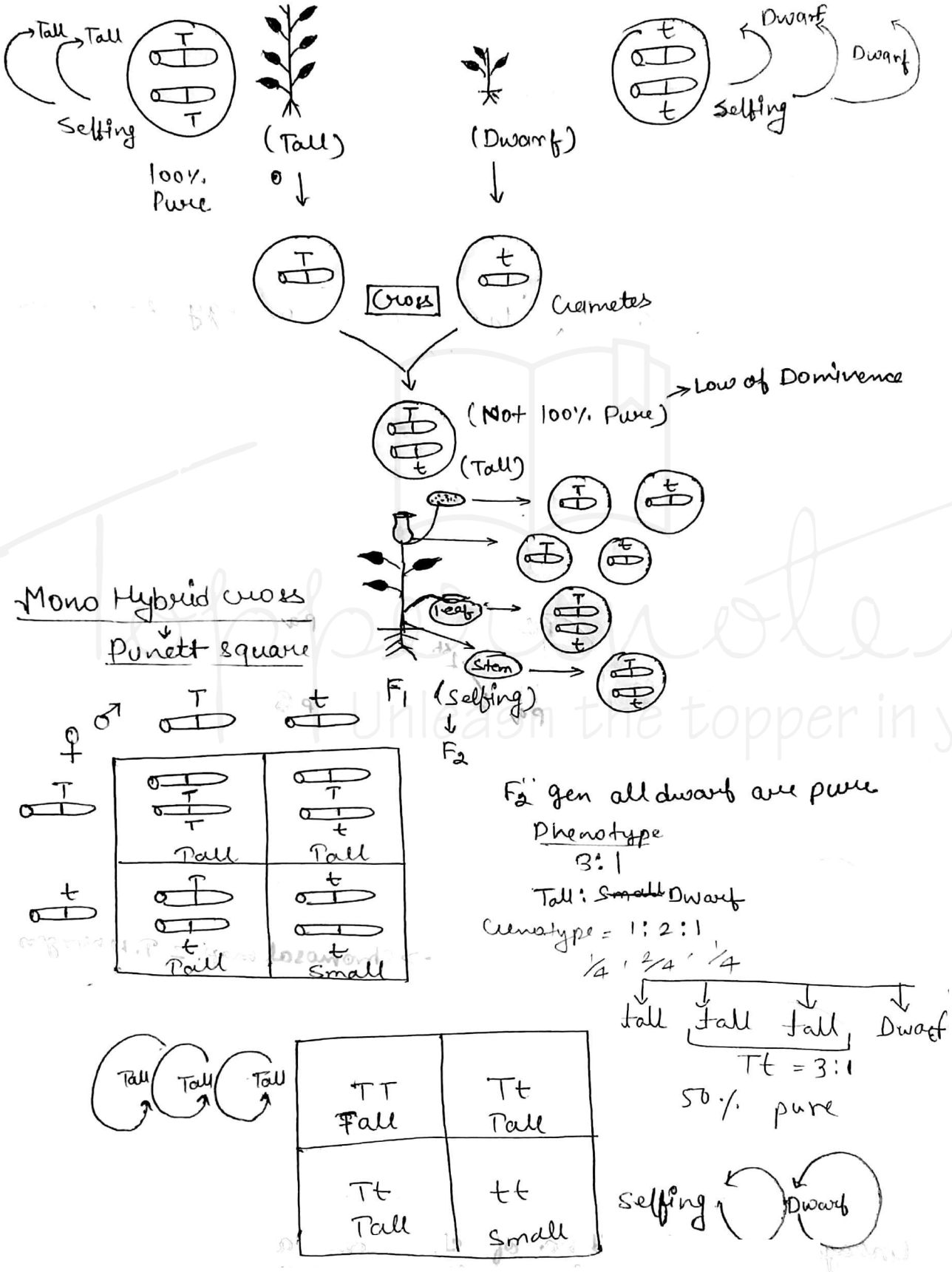
Gametic ratio daviates from 1:1:1:1 and it is 1:0:0:1

Linkage group = Haploid no. of chromosome are c/d as linked group

Haploid no. of Chromosome & sex chromosome

Female = 22+X Male = 22+X+Y

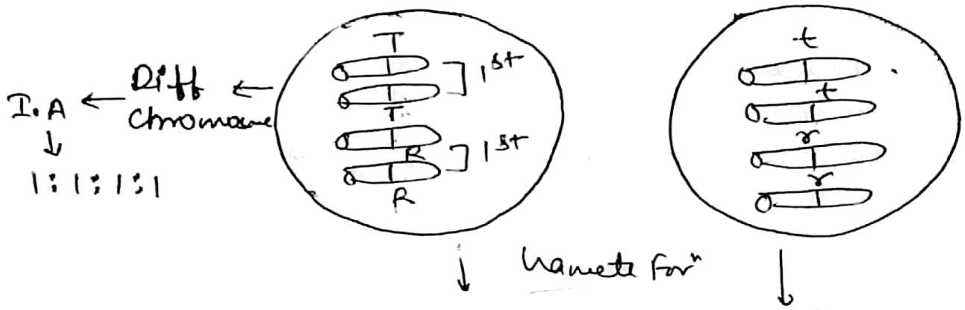
MONOHYBRID AND DIHYBRID CROSS



Dihybrid cross

Tall & Round

Dwarf & wrinkled



Dihybrid cross →

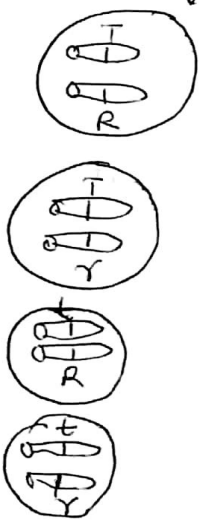
Tall & Round

Tall & Round

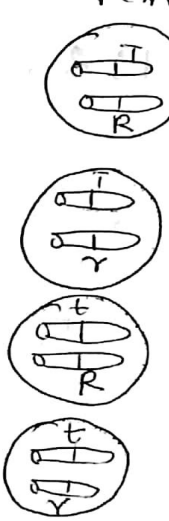
Phenotype :-

Tall & Round	:	Tall wrinkled	:	Dwarf Round	:	Dwarf wrinkled
9	:	3	:	3	:	1

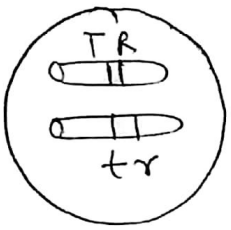
Gamete ↙ Male



Female



Linked gene



→ linked gene में both gene साथ में रहते हैं जिससे Tall & Round, Small & Wrinkled के साथ नहीं आ सकता।

Blue eyes & Normal Nose

Black eye & Pointed Nose

Gametes -

① Blue eyes & Normal Nose

② Blue eyes & Pointed Nose

③ Black eyes & Normal Nose

Black eyes & Pointed Nose

Punett square

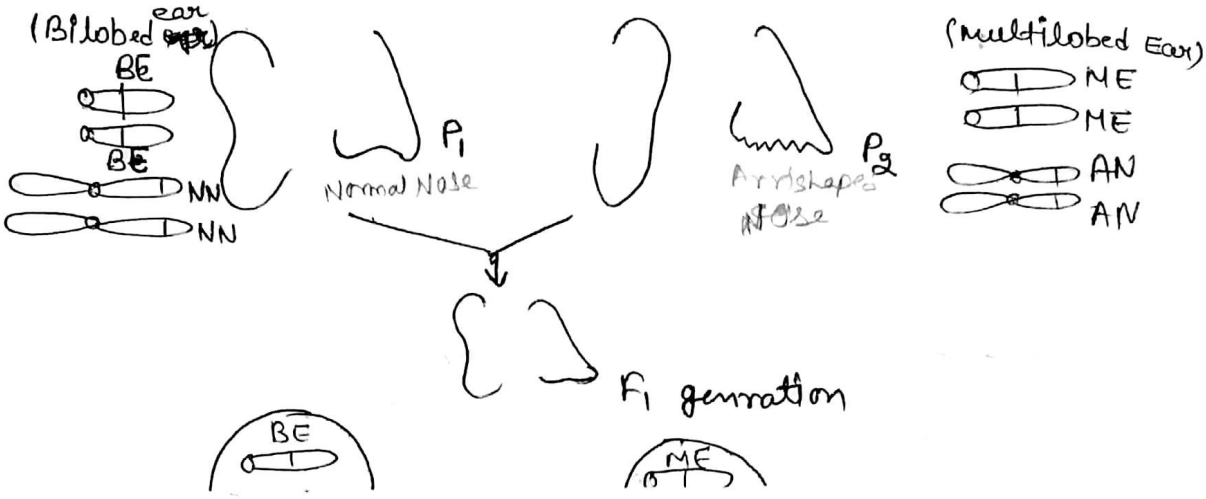
♀ \ ♂	TR	Tr	tR	tr
TR	TTRR Tall & Round	TTRr Tall & Round	TtRR Tall & Round	TtRr Tall & Round
Tr	TTRr Tall & Round	TTrr Tall & Wrinkled	TtRr Tall & Round	Ttrr Tall & Wrinkled
tR	TtRR Tall & Round	TtRr Tall & Round	ttRR Small & Round	ttRr Small & Round
tr	TtRr Tall & Round	Ttrr Tall & Wrinkled	ttRr Small & Round	ttrr Small & Wrinkled

Phenotype :- 9 : 3 : 3 : 1

Genotype :- 1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1

→ All alleles for any particular gene are found at a specific place on a chromosome called the locus for that gene.

✱ Test cross - The cross b/w f_1 & its recessive



Linkage group :-

→ All the gene present on a particular chromosome form a linkage group. ex-

In human – Male = 22 pairs autosome + 1X chro. + 1Y chro.
= 24 linkage group

Female = 22 pair autosome + 2X chromosome
= 23 linkage group

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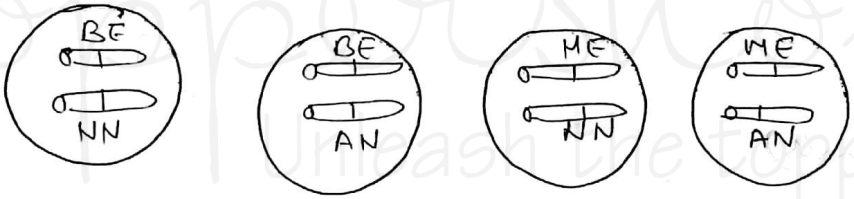
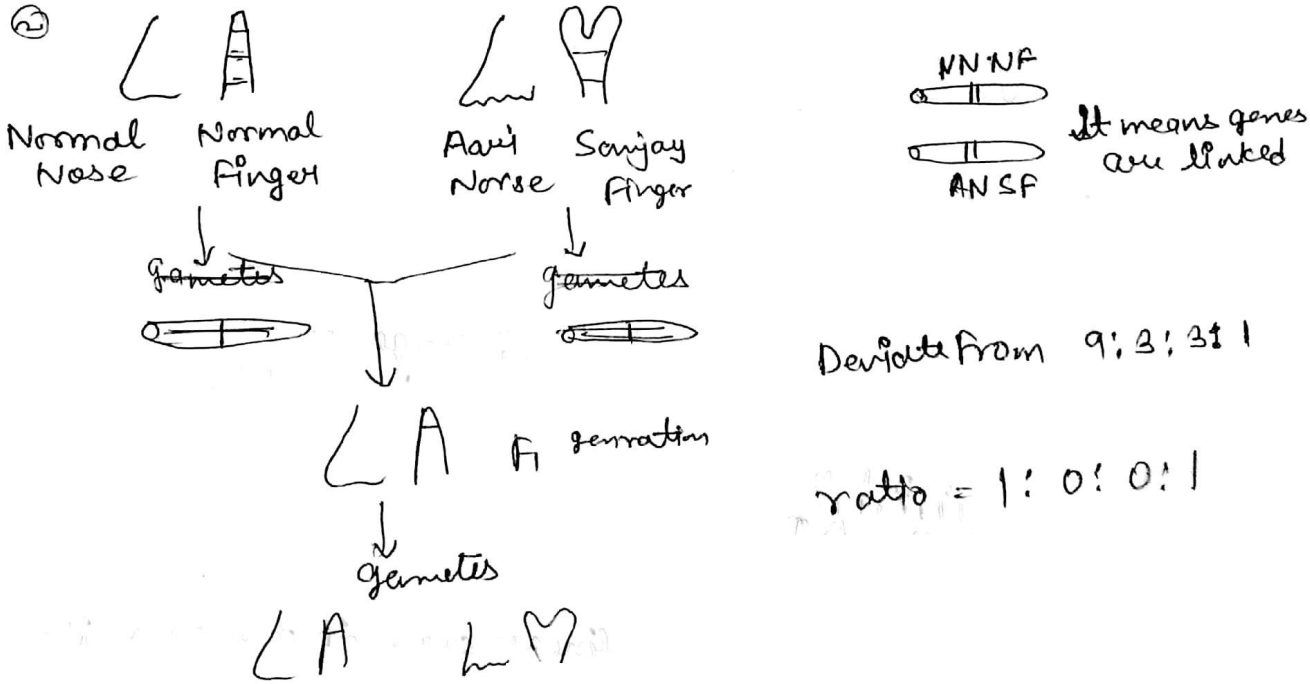
1 : 1 : 1 : 1 → Independent Assortment



→ Alleles on diff chromosome

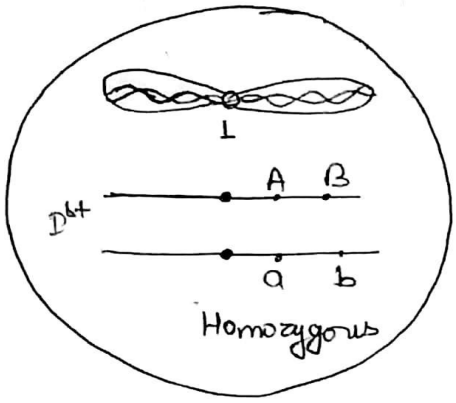
(2)



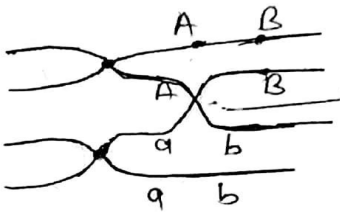
Deviate from 9 : 3 : 3 : 1

ratio = 1 : 0 : 0 : 1

Crossing over means recombination.
Chiasmata = Evidence of crossing over



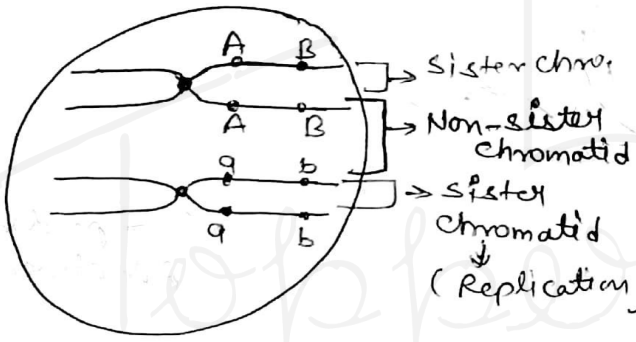
G1 phase



→ Normally 1 chiasmata is tht.
4 & 5 very rare

→ Chiasmata is variable like –

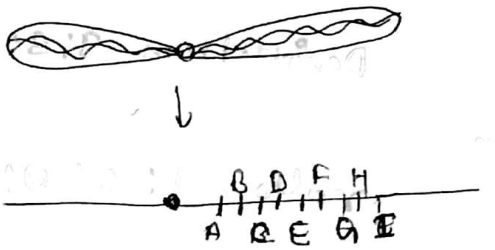
A = 1 C = 4
B = 3 D = 2
E = 7 → Fossils



S phase
(meiosis)

→ crossing over tht in non-sister chromatid.

→ In ~~one~~ chromosome on one crossing over second crossing is not found. becoz. by crossing over chromosome is break
→ 1 chromosome = 1 DNA



Linkage $\propto \frac{1}{\text{Distance}}$

→ ~~जितना~~ Distance ज्यादा होगी ~~उतना~~ linkage कम होगा।

→ genes are arrange in linear order that means distance b/w diff genes pair is diff.

Linkage frequency.

A-B = 30%
A-C = 10%
A-D = 20%
A-E = 60%
A-F = 99%

Seq → A F B E D C

→ F.A के पास

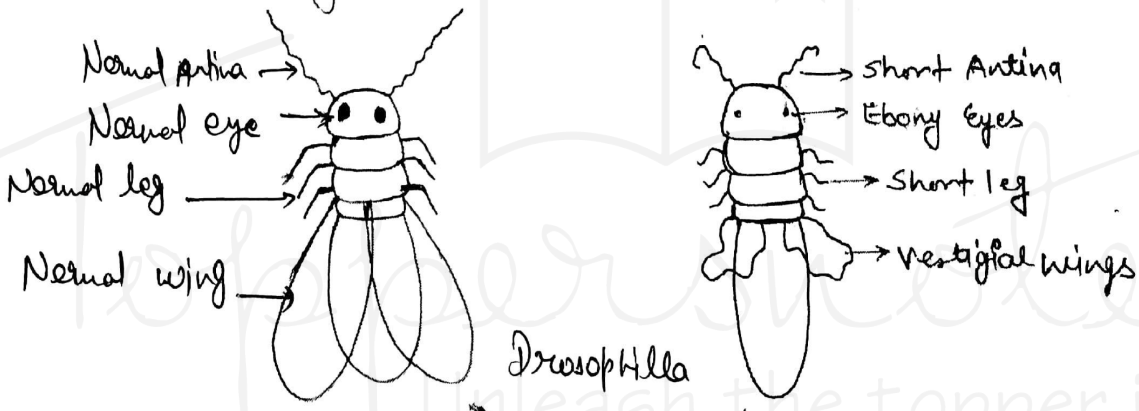
$L \propto \frac{1}{\text{crossing over}}$

crossing over ↑ तो Linkage ↓

→ Crossing over is a feature of germ cell.

→ Following type से identified कर सकते हैं -

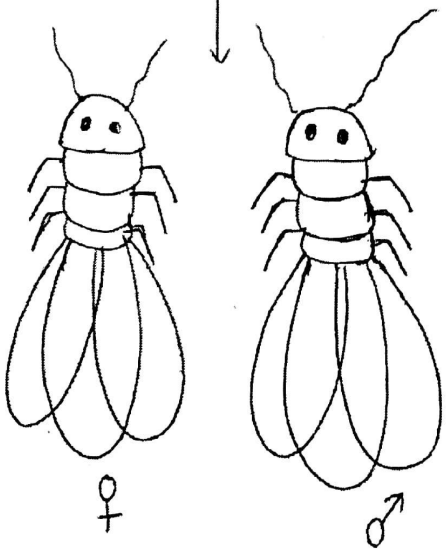
① according to F_1 gen. gametes
② By selfing



Selfing

9 : 3 : 3 : 1

N.W & N.leg | N.W & S.leg | V.W & N.leg | V.W. & S.leg



F_1 generation (Heterozygous)

(Progeny Male & female दोनों ही दिखाती है।