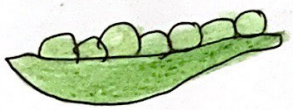
# 3.4 INHERITANCE

## MENDEL AND THE PRINCIPLES OF INHERITANCE

- He crossed different varities of pure bred pea plants and grew the seeds to determine their characteristics.
- Then he crossed the offsprings and grew the seeds to determine the characteristics.



conclusions:

- organisms have discrete factors that determine its characteristics. (genes)
- organisms have versions of these factors. (alleles)
- Parents contribute equally to the inheritance of offspring as a result of fusion between a randomly selected egg & sperm.

- One version is dominant over another and will completely express itself.

Laws:

1. Law of segregation:

when gametes are formed, alleles are separated so that each gamete carries only one allele for each gene.

## 2. Law of independent Assortment:

The segregation of alleles for one gene occurs independently to that of any other gene. (except in linked genes)

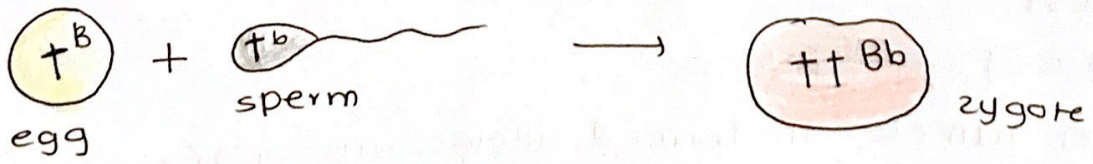
## 3. Principle of dominance:

Recessive alleles will be masked by dominant alleles. (except in cases of co-dominance).


# GAMETES

- Gametes are haploid and contain one allele of each gene.
- male and female gametes are different in size & motility.
- male gamete (sperm) is smaller but is able to move around whereas female gamete (egg) is bigger and doesn't move around.
- Parents pass genes through gametes.

∴ After fertilization, the zygote contains 2 alleles.



# ZYGOTES

- If the maternal & paternal alleles are the same, the zygote is homozygous and if they are different then it is heterozygous.

- males only have one allele for each gene located on a sex chromosome & are said to be hemizygous for that gene.

# SEGREGATION OF ALLELES

The diploid nucleus contains 2 copies of each gene but the haploid nucleus can only contain one.

- 2 copies of one allele

↓

each haploid will only receive one copy of this allele.

PP → (P) (P)

- 2 different alleles

↓

each haploid will receive either one of the alleles.

Pp → (P), (p)

The separation of alleles into different nuclei is called segregation.

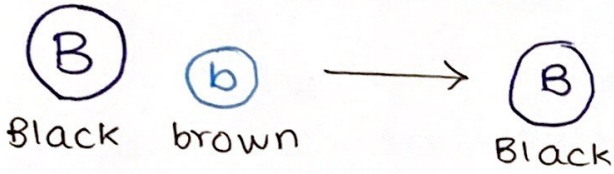
# DOMINANT, RECESSIVE AND CO-DOMINANT ALLELES

Genotype: the gene composition for a specific trait

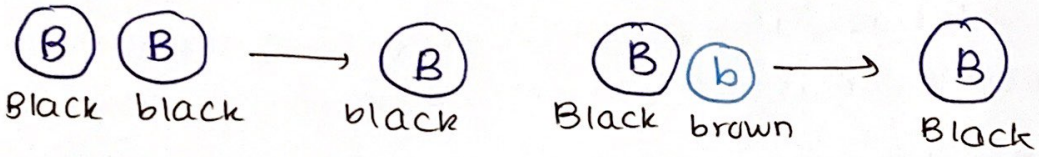
Phenotype: The observable characteristics of a specific trait.

## complete dominance

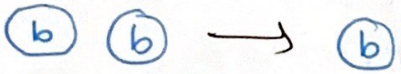
- One allele is expressed over the other.
- dominant allele will mask the recessive allele when in a heterozygous state.




- homozygous dominant and heterozygous will be indistiguishable phenotypically.




- The recessive trait only expresses itself when present in a homozygous state.




## Co dominance

- It occurs when pairs of alleles are both expressed equally in the phenotype of a heterozygous individual.

$C^B C^B \rightarrow$ Black

$C^B C^W \rightarrow$ Speckled

$C^W C^W \rightarrow$ White

- In humans, this can be seen in case of blood groups.

A → $I^A I^A / I^A i$

B → $I^B I^B / I^B i$

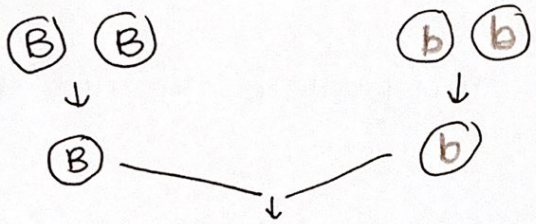
AB → $I^A I^B$

O → ii

# PUNNETT GRIDS

It is used for predicting the outcome of monohybrid genetic crosses.

Parental Generation




F1 generation

Bb → Genotype

Black → Phenotype


B b → maternal gametes on top

| | B | b |
|---|---|---|
| B | BB | Bb |
| b | Bb | bb |

↓ paternal genes on side

$F_2$ generation → Genotype - BB : Bb : bb
1 : 2 : 1

Phenotype - Black : Brown
= 3 : 1

# GENETIC DISEASES

Genetic diseases can be caused by recessive, dominant or co-dominant alleles.

**Due to recessive alleles -**

It only develops in individuals that do not have the dominant alleles of the gene usually because they have 2 recessive alleles.

- If one person has one allele for the genetic disease & one dominant allele, they don't show the symptoms of the disease but they can still pass it on. - carriers

Example: Cystic fibrosis

Due to dominant genes-

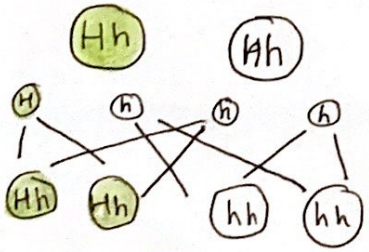
- only requires one copy of a faulty allele to cause the disorder
- homozygous dominant & heterozygous can both develop the disease.

Example: Huntington's disease

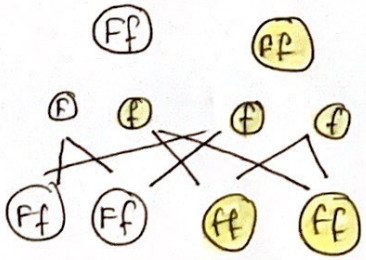
Co-dominance -

- requires one copy of the faulty allele to cause the disease.
- heterozygous individuals have a milder symptom compared to homozygous.

Example: sickle cell anaemia.




Huntington's (dominant)




cystic fibrosis (recessive)

# SEX LINKED GENES

It refers to when a gene controlling a characteristic is located on a sex chromosome (X or Y).

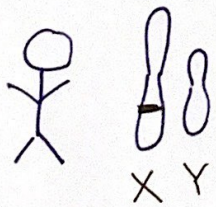
Y chromosome is shorter than X chromosomes.

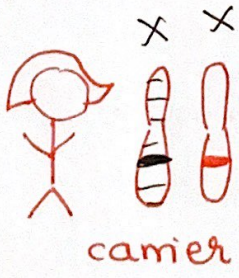
Hence, sex-linked conditions are usually X-linked.

Sex-linked inheritance patterns differ from autosomal patterns due to the fact that chromosomes aren't paired in males.

- This leads to the expression of sex-linked traits being pre-dominantly associated with a particular gender.

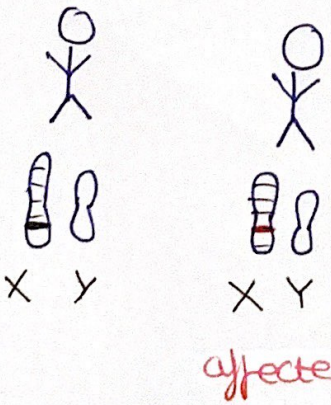
Parents




← defective allele.

Offsprings (recessive gene disorder)




Only one offspring gets affected (male).

## Trends:

- only females can be carriers
- males will always inherit an X-linked trait from their mother.
- females cannot inherit an X-linked recessive condition from an unaffected father.