

Chapter → 4

Heredity

Heredity :- The transmission of characters / traits from one generation to the next generation is called heredity.

Variations :- The differences in the characters among the individual of the same species are called Variation.

Importance of variation

- (i) It brings adaptation in individuals.
- (ii) It helps in the survival of species.
- (iii) It is the basis of evolution.

Genetics :- The branch of biology that deals with the transmission of characters and variation is known as genetics.

* **Father of Genetics** → Gregor J Mendel
Genetics Term coined by William Bateson.

* Characters are type → ① Acquired ② Inherited traits

Difference A B/w Acquired vs inherited traits	
Acquired traits / somatic variation	Inherited traits / genotypic variation
These traits are neither inherited nor transmitted	These traits are can be inherited as well as transmitted

to the next generation	to the next generation.
→ These traits are acquired after birth	These traits are inherited from parent during reproduction
→ ex:- Acquiring knowledge, Boring off pinnacle.	ex:- skin colour, eye colour etc.

* DNA :- Thread like structure which carries all the information of our characters.

→ Watson & Crick explain structure of DNA. Double-stranded

* chromosome :- chromosome is coil form of DNA which carries genes. 

* Chromatin :- It is scattered form of DNA

* Gene :- Segment/portion of DNA which carries information for a particular character (20000 genes are present in human DNA).

* (2N) Diploid :- The chromosome no. in human ~~body~~ cells is present in pair is known as Diploid cell.

* (N) Haploid :- The chromosome no. in human cells is present in single is known as haploid.

→ All the cells in human body are diploid.

→ Except gametes → sperm & ovum → Haploid.

→ The Zygote is Diploid. Because 23 chromosome comes from male and 23 chromosome comes from

female, so the zygote is Diploid.

* Father DNA is called Paternal DNA.

* Mother DNA is called Maternal DNA.

→ In human cell total 46 chromosomes or 23 pairs are present.

Haploid (N) one copy of each chromosome.

Diploid ($2N$) Two copies of each chromosome.

Alleles (allelomorph)

Allele is an alternative variant / version / form of a gene. Two or more possible forms / version of a gene that are located at specific location on specific chromosome.

It have two types ① Dominant ② Recessive allele

- Dominant allele / gene vs Recessive allele / gene

→ Dominant allele is the stronger one from the two alleles. Recessive allele is the weaker one from the two alleles.

→ Denoted by capital letter Denoted by small letter.

* Dominant trait vs Recessive trait

→ Trait which appears due to expression of Dominant allele is called dominant trait. Trait which is suppressed due to effect of Dominant allele is called recessive traits.

→ Express itself in both
1) Homozygous condition
2) Heterozygous condition

Express itself only in
→ Homozygous condition

* Homozygous condition / Pure condition

(TT)

Identical alleles / gene

Homozygous dominant condition

Home → Similar zygous → character

T → Tallness → Dominant

t → dwarfness → Recessive

always T (Dominant express its character)

(tt)

Homozygous recessive condition

Plant show dwarf

* Heterozygous / Hybrid condition

(Tt)

Hetero → different

Different alleles / gene

→ Tall

* Genotype :- It is the description of genes present in an organism or combination of genes in an organism.

* The char Phenotype :- The characteristic (or trait) which is visible in an organism is called its phenotype or appearance of an organism.

Mendel and his contribution
 → He worked on pea plant (Pisum sativum) and proposed laws of inheritance.

Why did Mendel choose garden pea (Pisum sativum) in his experiments?

Property

Advantages of properties.

- Short life span :- Mature quickly so results of experiments were obtained in less time.
- Annual plant :- Many generations can be studied within a short period of time.
- Bisexual flower :- Mendel could conduct experiment as per his desire.
- Contrasting traits of :- large number of choice for seven characters Experiments.
- Large number :- Good number of data for statistical of offspring analysis.

Trait studied by Mendel.

Gene	Alleles / Gene	
Character	Dominant trait	Recessive traits
seed shape	Round	wrinkled
seed colour	yellow	green
flower colour	violet	white
pod shape	Green full	Yellow Constriction
pod colour	Green	Yellow
flower position	axial (at node)	at top (Terminal)
stem length	Tall	Short

Mendel law of Inheritance

Based on Monohybrid cross

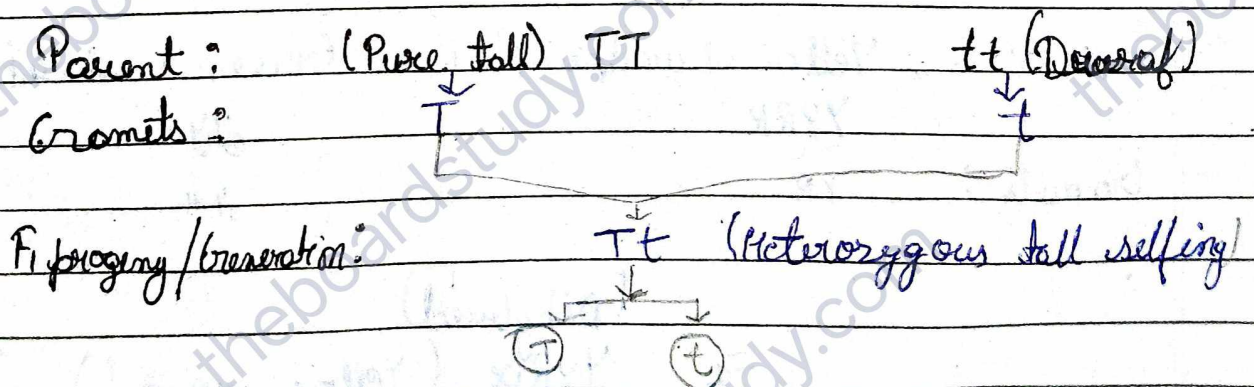
First law of Dominance
When an inherited pair of two alleles is heterozygous, the allele that is expressed is called dominant while the other is called recessive.

Second law of Dominance segregation (law of purity of Gametes)

During the gamete formation copies of gene or alleles are divided or segregated such that each gamete receives only one allele. + meiosis

Monohybrid cross :- It is a cross in which only one character is studied at a time.

In his first monohybrid cross, Mendel crossed a pure bred tall pea plant and a pure bred dwarf plant.



F₂ generation ?

	♂	♂	♀
♂	TT	Tt	
♀	Tt	tt	

Phenotype ratio : 3 tall : 1 dwarf

Genotype ratio : Pure tall : hybrid tall : dwarf
1 : 2 : 1

Monohybrid cross

② Based on Dihybrid cross

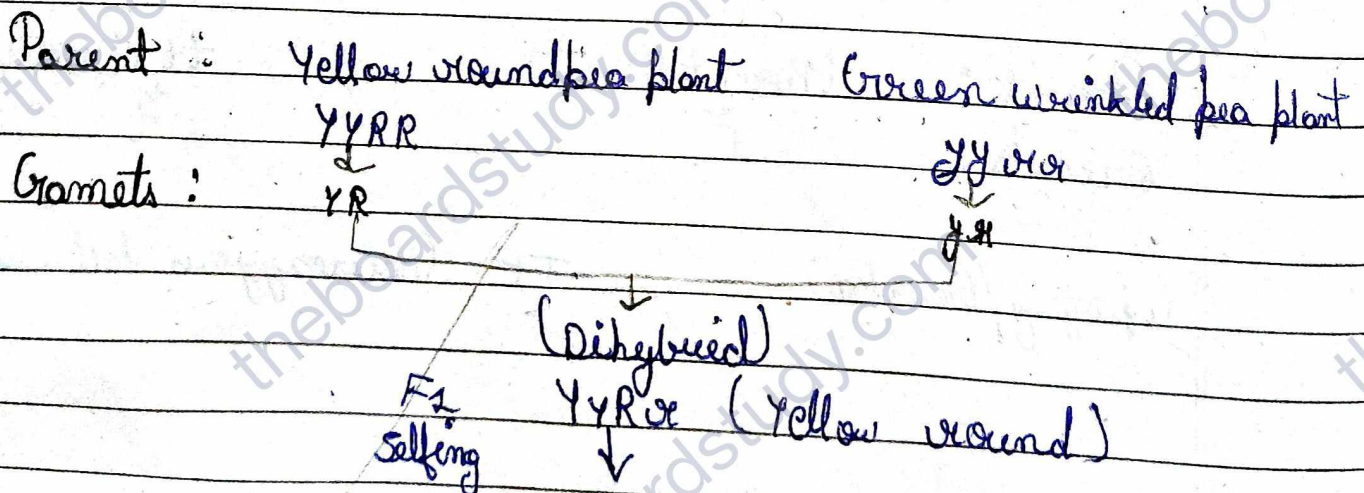
(2) Laws of Independent assortment

Alleles of two or more different genes get assorted into gametes independently of one another.

Dihybrid cross

A cross in which study of inheritance of two pairs of contrasting traits.

Phenotypic Ratio in F₂ Generation.



Generation of F_2

P	$YYRR$	$YyRr$	$yyRr$	$yyrr$
F_1	$YYRR$	$YyRr$	$YyRr$	$yyrr$
F_2 Generation	$YYRR$	$YyRr$	$YyRr$	$yyrr$
	$YYRr$	$YyRR$	$YyRr$	$Yyrr$
	$YYrr$	$YyRr$	$Yyrr$	$yyrr$
	$yyRR$	$YyRr$	$yyRr$	$yyrr$
	$yyRr$	$Yyrr$	$yyrr$	$yyrr$

Yellow

Phenotypic Ratio:

Yellow round : Green Round : Yellow wrinkled : green wrinkled
 9 : 3 : 3 : 1

Sex determination

The process by which sex of a new born individual is determined is

Factors determination sex determination

Non - Genetically

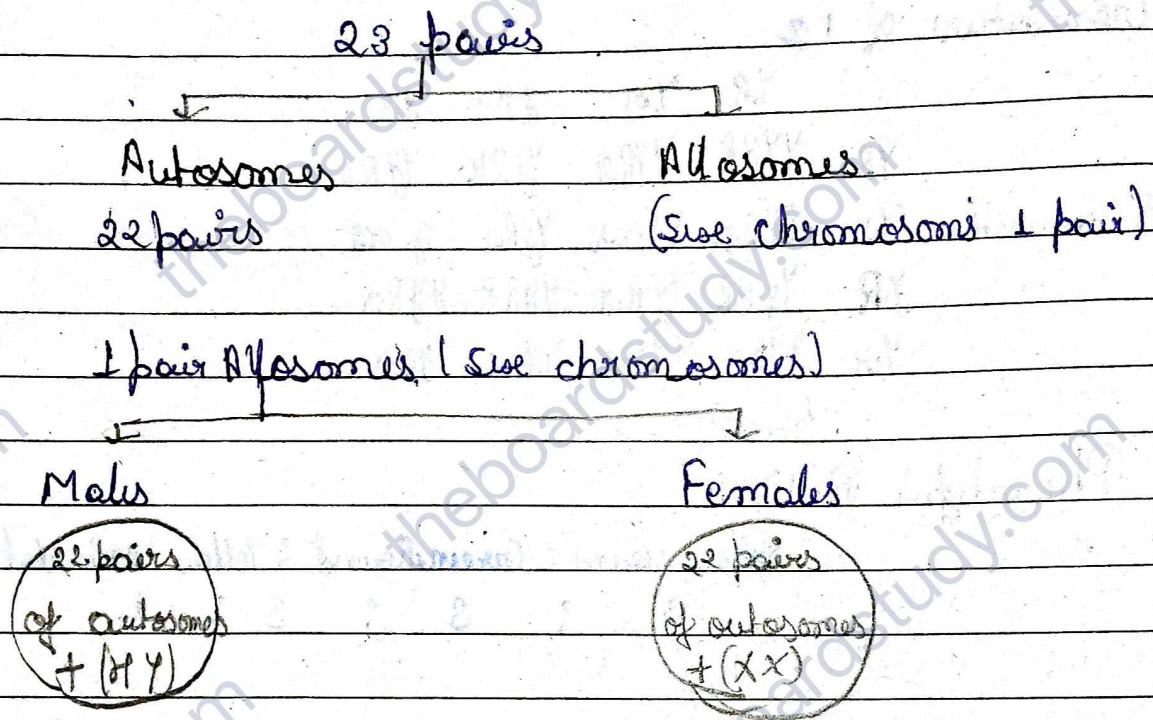
Environmental cues: In turtles, Alligators, crocodile, temperature at which fertilized eggs are kept determines sex

Genetically

In humans, genes inherited from parents decide the sex of the offspring.

In snails, individual can change sex

→ All cells in human body have total 46 chromosomes except ovum & sperm (23 chromosomes)



Difference b/w Autosomes & Allosomes

Autosomes	Allosomes (Sex chromosomes)
Chromosomes that are not really involved in determining sex.	Chromosome that have a part in defining a person's gender.

Males and females have similar	Males (XY) and females (XX) are dissimilar.
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In humans, there are usually 44, or 22 pairs	In human, there are usually two or one pair
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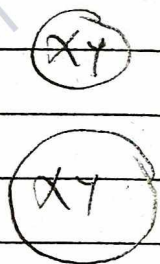
Sex determination in human beings

- If a sperm with X chromosome fertilises the egg (X) then the Zygote will have XX chromosome in the 23rd pair.
- A zygote with XX chromosome will develop into a girl child.
- If a sperm with Y chromosome fertilises the egg (X)

then the zygote will have XY chromosomes on the 23rd pair.

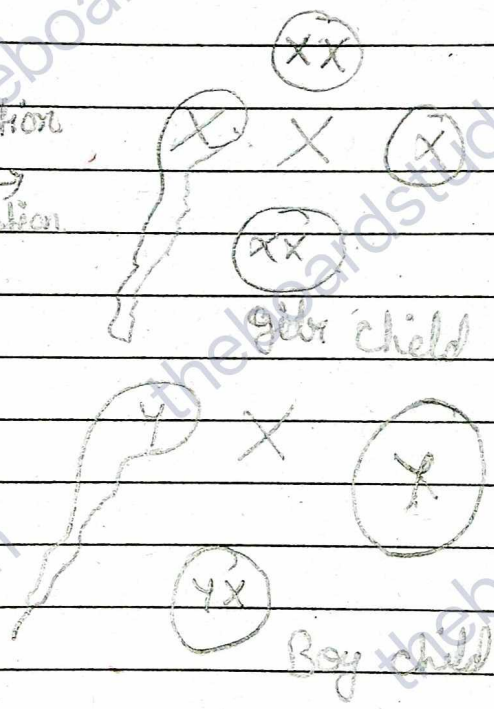
- A zygote with XY chromosome will be developed into a male child

Male



gamet formation
(meiosis)
Sperm formation

Female



Parents :

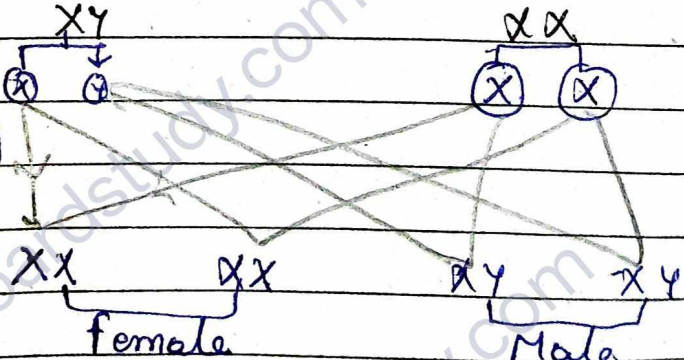
Father

Mother

Gametes

(Reproductive cells)

Zygote formed
after fusion
of gametes



offspring

50% probability
of a female child

50% probability
of a male child

	σ^X	X
X	XX	XX
Y	XY	XY

Phenotype ratio

Male : Female

1 : 1

Genotype Ratio

$XY : XX$

1 : 1