Heredity

* The biological science, which deals with the mechanism of heredity / inheritance and causes of variation within same species is termed as genetics

* Variation

→ The differences in the characters or traits among the individuals of a species are called variations.

→ A few variations are also produced during asexual mode of reproduction due to small inaccuracies

* Types of Variation

(i) Environmental Variation:

> It is caused by our environment including factors like dirt, polluting, chemical radiation and are not inherited

> They do not play any role in heredity

(ii) Genetic Variation:

> Variation in germ cell of organism which are heritable and are passed on to next generation during reproduction.

* Importance of Variation:

(i) Variations are the basis of heridity

(ii) Adaptability to adverse condition is due to variations.

(iii) New varities of an organism may arise due to genetic variation and form raw materials for evolution

(iv) Helps in survival of species.

* Heridity

The transmission of characters or traits from one generation to another is known as inheritance or heridity.

* Inherited traits:

Inherited traits are those characteristics which are recieved by offspring from their parents and are controlled by genes.

=> Attached and free earlobes are two variation found in human population.

Gene => A functional unit of heredity present on chromosomes of cell nucleus.

-> It is composed of DNA and codes for one polynucleotide (protein).

Chromosome => A long rod-like structure in a nucleus which appears during cell and carry genes.

Allele => A pair of contrasting characters is called allele or allelomorph.

Dominant allele	Recessive allele
a) An allele that marks the presence of a recessive allele in the phenotype	a) An allele whose expression is marked by the presence of dominant allele.
b) Dominant alleles for a trait are usually expressed if an individual is homozygous dominant or heterozygous Eg: T (tallness in pea)	b) The recessive alleles are expressed only in homozygous recessive condition. Eg:- t (dwarf in pea) in Tt

* Genotype:- Genetic composition of an individual

* Phenotype:- The observable characters of an organism i.e. physical features.

- When only one allele pair is considered in cross breeding it is called monohybrid cross.

- When two allelic pairs are used for crossing, it is called dihybrid cross.

- Mendel had conducted several hybridisation experiments on garden pea (Pisum Sativum)

- The no. of characters studied by Mendel in pea plant were 7

- The number of Chromosomes in Pisum sativum is 14 (2n)

- Mendel selected garden pea for the experiment because:

(i) These grow quickly and are easier to study.

(ii) Pea plant can be crossed or self-pollinated and have a flower structure that limits accidental contact.

(iii) Garden pea had a number of clear cut differences, which were easy to observe like length of stem i.e. tall or short.

(iv) Large number of seeds produced.

* Characteristics Studied by Mendel:

Sr.No	Trait	Studied	Dominant	Recessive
1	Plant	Height	Tall (T)	Dwarf
2	Flower	Position	Axillary (A)	Terminal
3	Pod	colour	Green (G)	Yellow
4	Pod	shape	Full	Constricted
5	Flower	colour	Violet (V)	White
6	Seed	shape	Round	Wrinkled
7	Seed	Colour	Yellow	Green

* Mendel's principles of Inheritance:

i) Law of Dominance:

Law of dominance states that the only one factor express itself in F_1 generation.

In a hybrid where both the contrasting alleles are present, only one allele called dominant allele is able to express its effect while other factor called recessive remains suppressed in F_1 generation.

* F_2 generation express both the dominant and hidden recessive factors in the ratio 3:1 in monohybrid cross.

* Inheritance of traits for one contrasting character:

→ Mendel crossed a pure tall pea plant (TT) with pure dwarf pea plant and observed that all progeny were hybrid tall (Tt) i.e. only one of the traits was able to express itself in F_1 generation.

→ The other trait called recessive trait remains suppressed

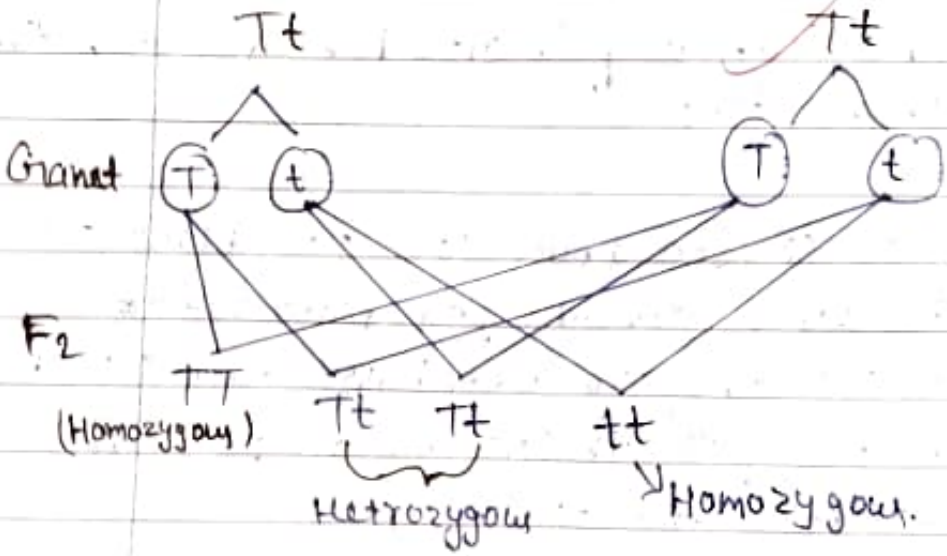
Parents ♀ TT × ♂ tt

(Tall parent Homozygous) | (Dwarf parent Homozygous)

Tt

F_1 generation (All hybrid tall Hetrozygous)

→ However when he self crossed plants of F_1 generation, he observed that 1/4th of the plants were dwarf and three fourth were tall



Law of Segregation:

(ii)

* Law of segregation states that when a pair of contrasting characters are brought together in a hybrid; these factors do not mix up but simply associate themselves and remain together and seperate again at the time of gamete formation.

* Also c/a "law of purity of gamete" because each gamete is pure in itself i.e. having (either T for tallness) or t (for dwarfness).

(iii) Law of Independent Assortment:

* State that the genes of different characters located in different pairs of chromosomes are independent of one another in their segregation during gamete formation.

* Inheritance of traits for two visible contrasting character:—

→ Mendel took pea plant with two contrasting characters i.e. green round seed and yellow wrinkled seed.

→ When the F1 progeny were obtained they were round and yellow are dominant traits.

→ Mendel then allowed F_1 progeny to be self crossed to obtain F_2 progeny

→ He found that seeds were round yellow, round green wrinkled yellow and some were wrinkled green.

→ Ratio he found was 9:3:3:1 with above characterstics.

Parents Ry × ry

Ro Yy
(round yellow)

×

F_1	↓ F_2	Ration
315 round	yellow	9
108 round	green	3
101 wrinkled	yellow	3
32 wrinkled	green	1

→ This shows that the two characterstics 'R' and 'y' are not linked to each other so are independently inherited.

* How do traits get expressed?

Cellular DNA (Information source)
for synthesis of
↓
Proteins
enzyme work efficiency.
↓
More hormone produced
↓
Tallness of plant

* Sex Determination:

> The process by which sex (male/female) of a newborn individual is determined is called sex determination.

> In some species, environmental factors are important in determining the sex of the developing individuals.

* Sex Determination in Human Beings:

> Genetics is involved in the determination of sex of a child.

› A male cell has one X-Chromosome and Y-Chromosome so, it produces two type of sperms with genotype A+X and A+Y

› Female sex is homogametic

→ A female cell has both X-Chromosome it produces similar type of eggs with genotype A+X

Sex of the child depend upon what happens during fertilisation -

(i) If a sperm carrying X-Chromosome fertilises the egg. The child born will be female (XX).

(ii) If a sperm carrying Y-Chromosome fertilise the egg, the child born will be male (XY). Thus, the sperm or male cell determine the sex of the child.