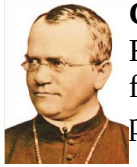
6 . UNRAVELLING GENETIC MYSTERIES

Heredity is the transmission of characters from parents to their offsprings.

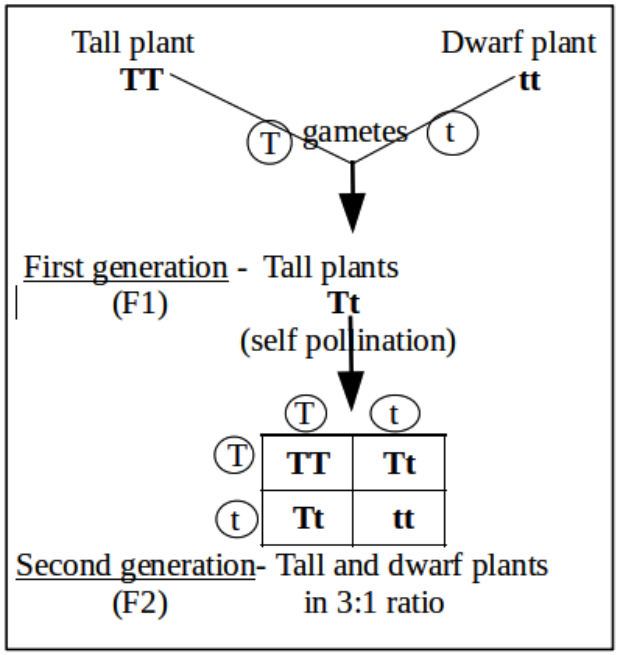
Variations are the features seen in offsprings that are different from their parents.

The branch of science which deals with heredity and variations is known as **Genetics**.



Gregor Johann Mendel is known as 'the Father of Genetics' because of his inferences from the hybridization experiments in pea plants (*Pisum sativum*) from 1856 to1863.

Considering one pair of contrasting traits (tallness-dwarfness) in garden pea plants, Mendel got plants in 3:1 ratio in the second (F2) generation:



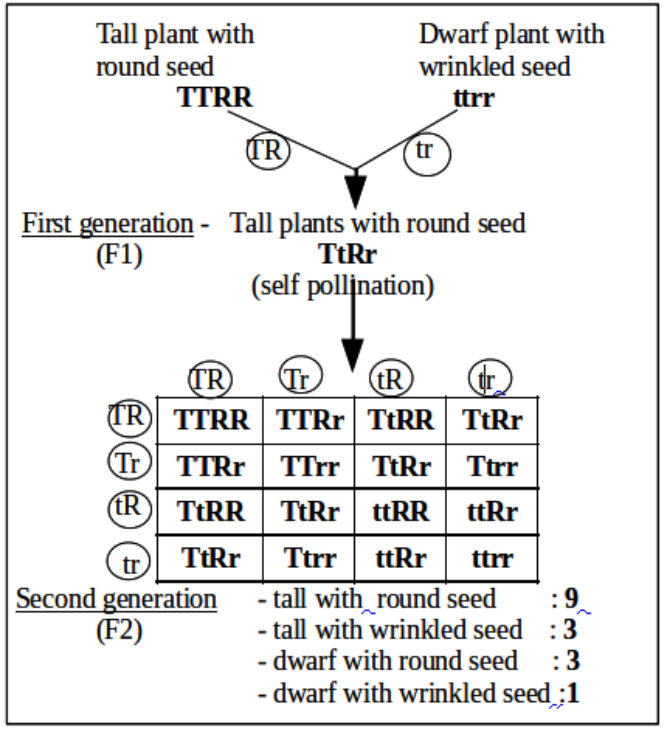
He conducted several hybridization experiments considering the following traits;

- Height of the plant (tall/dwarf) - Position of the flower (axial/terminal) - Shape of the seed (round/ wrinkled) - Colour of seed coat - Colour of cotyledon - Colour of fruit and - Shape of fruit.

The main inferences of Gregor Mendel:

- A trait is controlled by the combination of two factors.
- One trait is expressed (dominant trait) and the other remains hidden (recessive trait) in F1 generation.
- The trait which remains hidden in the first generation appears in the second generation.
- The ratio of the dominant and recessive traits in the second generation is 3:1 .

Considering two pairs of contrasting traits (tallness-dwarfness and round-wrinkled seeds), Mendel got plants in 9:3:3:1 ratio in the second (F2) generation:



***** Mendel inferred that the difference is due to the independent assortment of each character or trait.

The hereditary factors, described by him as letters, are now known as the genes.

Genes are the specific parts of DNA that control metabolic activities and responsible for specific characteristic feature of any organism.

The two different forms of a gene that controls a trait is called as '**alleles**'. (Eg:- Suppose 'Tt' is the factors responsible for the trait, 'height', the allele 'T' is for tallness and the allele 't' determines dwarfness.

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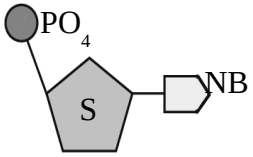
DNA, RNA -the nucleic acids

DNA (deoxyribo nucleic acid) and **RNA** (ribo nucleic acid) are made of **nucleotides** containing sugar, phosphate groups and 4 types of nitrogen bases.

	DNA	RNA
Number of strand	2	1
Type of sugar	Deoxyribos	Ribos
Nitrogen bases	Adenine, **thymine**, cytosine, guanine	Adenine, **uracil**, cytosine, guanine

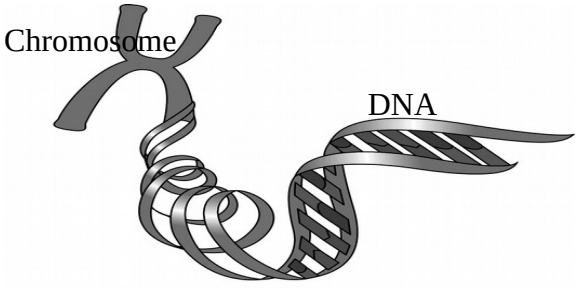
Nucleotides are the basic units of nucleic acids.

A nucleotide is made up of a nitrogen base, a sugar molecule and a phosphate group.



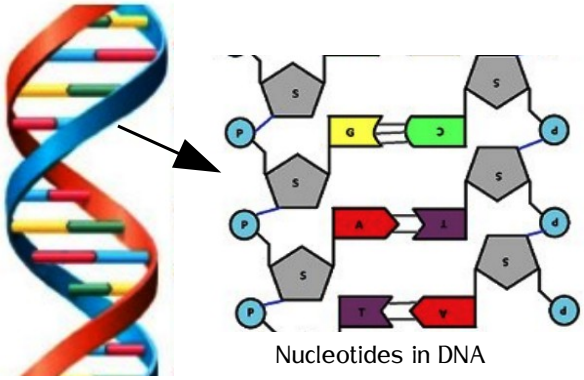
(**Nitrogen bases** are molecules that contain nitrogen and are alkaline in nature)

DNA is a double helical structured molecule. In 1953, James Watson and Francis Crick proposed this model.



The two long strands of DNA contain deoxyribose sugar and phosphate groups and its steps are made of pairs of nitrogen bases. The nitrogen base, adenine pairs with thymine and cytosine pairs with guanine.

In other words, DNA molecule is made up of four kinds of nucleotides, namely adenine nucleotide, thymine nucleotide, cytosine nucleotide and guanine nucleotide.


Nucleotides in DNA

The single stranded nucleic acid, RNA, is made of 4 different types of nucleotides that contain ribose sugar, phosphate and nitrogen bases (adenine, uracil, guanine and cytosine).

RNA involve in the protein synthesis as directed by the DNA.

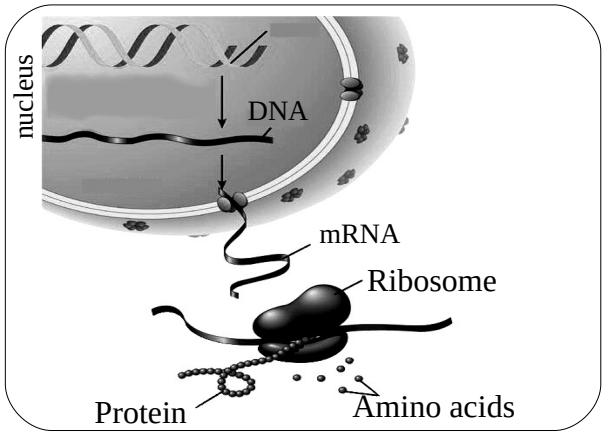
Gene action (protein synthesis)

Genes, which are the specific parts of DNA, act through synthesizing proteins.

Proteins are formed in the ribosomes. Different types of RNA involve in this process.

The stages of protein synthesis of DNA:

- DNA unwinds and mRNA forms.
- mRNA reaches outside the nucleus.
- mRNA reaches ribosomes.
- Based on the information in mRN, amino acids are transferred to ribosomes by tRNA.
- Ribosomes bind amino acids to form protein.



Different kinds of RNAs involved in this are :

mRNA (messenger RNA),
tRNA (transfer RNA),
rRNA (ribosomal RNA).

Sex determination in man

There are 46 (23 pairs) chromosomes seen in each cell of human being. Out of which, 44 (22 pairs) are **somatic chromosomes** and 2 (one pair) are **sex chromosomes**.

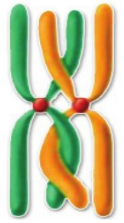
Sex chromosomes are two types: X and Y. [XY in males and XX in females]

The total chromosomes can be represented as **44+XX** in female and **44+XY** is male.

Reasons for variations in offsprings

Crossing over, combination of allele during fertilization and mutation occur in chromosomes etc. may cause variation.

*** Crossing over**



The process of pairing of chromosome and exchanging their parts, during the initial phase of meiosis, is called **crossing over**. As a result of this, part of one DNA becomes the part of another DNA, causing a difference in the normal distribution of genes. This may causes expression of new characters (variations) in the offsprings. .

*** Fertilization**

When gametes undergo fusion (fertilization), the combination of allele changes. This causes the expression of characteristics in offsprings that are different from parents.

*** Mutations**

Mutation is a sudden inheritable change in the genetic constitution of an organism. It may occur due to the defects in the duplication of DNA, certain chemicals, radiations etc.

Mutation causes changes in genes, that lead to variations in characters.

Melanin, a pigment protein,imparts colour to the skin. The difference in gene function is the reason for colour differences of skin. The differences in skin colour is mere an adaptation to live under sun.

Youtube video links:

Part 1 : https://youtu.be/Tu8Ztn9vQWk
Part 2 : https://youtu.be/qivKb8Oc6Aw
Part 3 : https://youtu.be/yCWoqzsFTo4