6. UNRAVELLING GENETIC MYSTERIES

CONTENT

* Genetics -Heredity and Variations
* Experiments and inferences of Gregor Johann Mendel
* Nucleic acids - DNA, RNA -structure
* Nucleotides, Genes and Alleles
* Gene action (protein synthesis)
* Autosomes & Sex chromosomes
* Sex determination
* Variations – Crossing over, fertilization & Mutation.

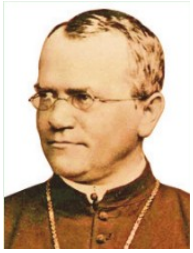
1. What is genetics (Hereditary science) ?

Genetics is the branch of science which deals with heredity and variations.

2. What do you mean by Heredity and Variations ?

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

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



3. Who is known as 'the Father of Genetics' ? Why is he known as so ?

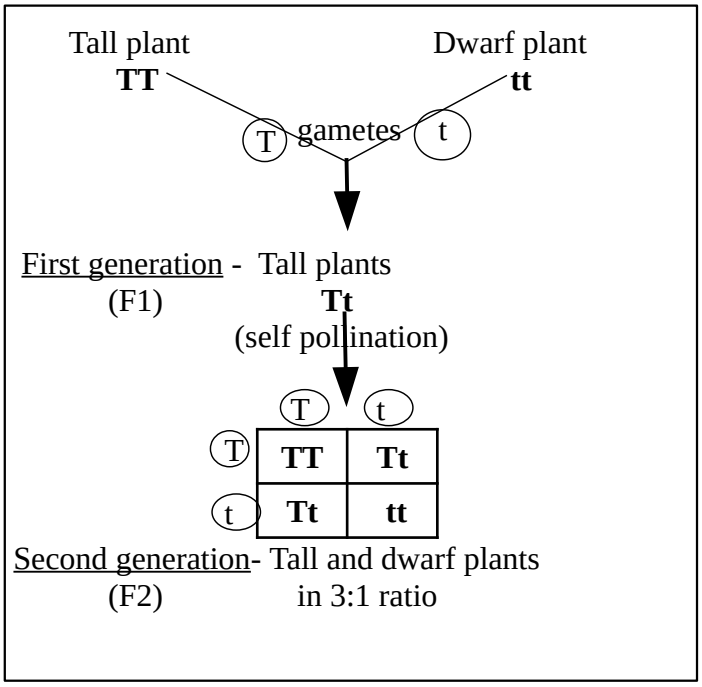
Gregor Johann Mendel.

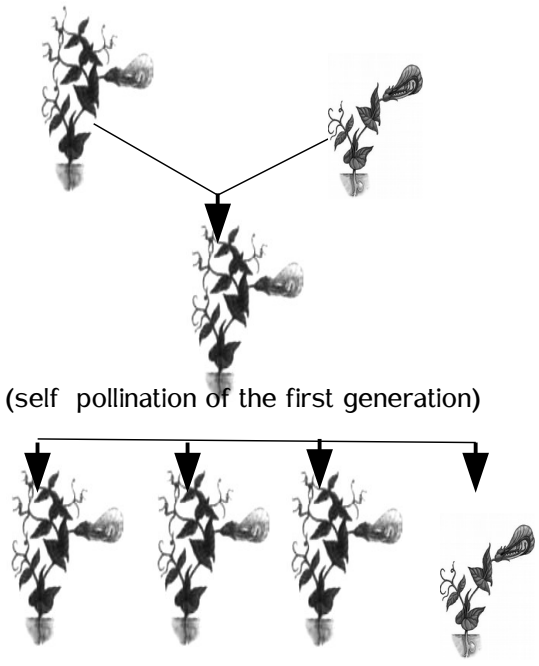
The inferences from his hybridization experiments in pea plants (*Pisum sativum*) from 1856 to 1863 led to the foundation of Hereditary science or Genetics.

4. What were the traits considered by Gregor Mendel for his hybridization experiments in pea plants ?

- 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
- Shape of fruit.

5. Mendel's experiment on pea plants considering one pair of contrasting traits: (tallness-dwarfness)





6. What, according to Mendel, the terms dominant trait and recessive trait are referred to ?

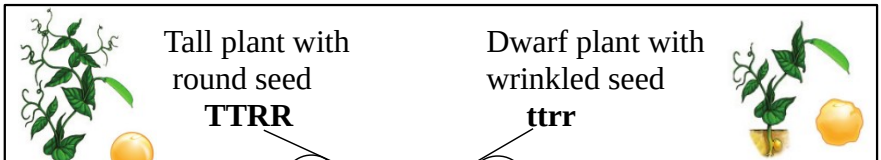
The expressed character, out of the two factors of a particular trait, is known as **dominant trait** and the other factor which remains hidden, is known as **recessive trait**.

For example, if 'Tt' are the two factors of the trait 'height', the "T' is dominant trait and 't' is recessive trait.

7. When Gregor Mendel conducted experiments considering one pair of contrasting traits, the plants obtained in the second generation were always in ---------- ratio.
3:1 [Out of 1064 plants got in F2, 787 were tall and 277 were dwarf. Approximate ratio is 3:1]

8. The main <u>inferences of Gregor Mendel</u> that paved the way for the emergence of Genetics ?
- 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 .

9. Illustration of Mendel's experiment considering two pair of contrasting traits:
(tallness-dwarfness and round-wrinkled seeds)



<u>First generation</u> - (F1) Tall plants with round seed **TtRr** (self pollination)

	TR	Tr	tR	tr
TR	**TTRR**	**TTRr**	**TtRR**	**TtRr**
Tr	**TTRr**	**TTrr**	**TtRr**	**Ttrr**
tR	**TtRR**	**TtRr**	**ttRR**	**ttRr**
tr	**TtRr**	**Ttrr**	**ttRr**	**ttrr**

<u>Second generation</u> (F2)
- tall with round seed : **9**
- tall with wrinkled seed : **3**
- dwarf with round seed : **3**
- dwarf with wrinkled seed : **1**

When considering two pair of contrasting traits, the ratio in the F2 will be 9:3:3:1

10. The hereditary factors, first described by Gregor Mendel, are now known as ------ ?
Genes.

11. Define the term 'genes'.
Genes are the specific parts of DNA that control metabolic activities and responsible for specific characteristic feature of any organism.

12. What is the meaning of term 'allele' ?
Alleles are the different forms of a gene that controls a trait.
Eg:- Suppose 'Tt' is the factors responsible for the trait, 'height', the allele 'T' determines tallness and the allele 't' determines dwarfness.

13. Offsprings of the same parents may show differences among themselves. Why ?
Fertilization causes change in the allele combination in the chromosomes and it causes slight difference among the offsprings.
(According to Mendel, the difference is due to the <u>independent assortment</u> of each character or trait)

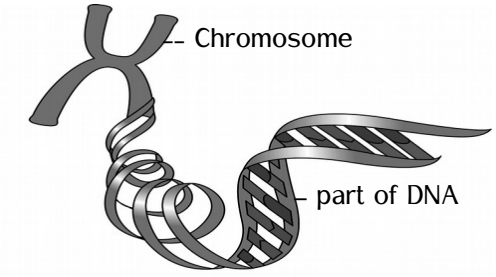
14. Name the 2 types of nucleic acids.
DNA (deoxyribo nucleic acid) and **RNA** (ribo nucleic acid)

15. Who proposed the double helical model of DNA ?
James Watson and Francis Crick (in 1953)

16. Comparison between the two types of nucleic acids, DNA and RNA.

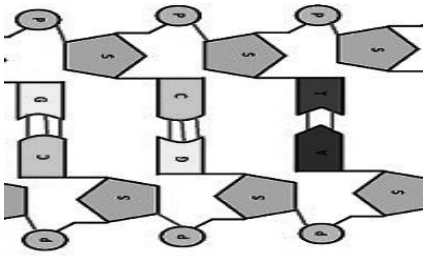
	DNA	**RNA**
Number of strand	2	1
Type of sugar	deoxyribose	ribose
Nitrogen bases	Adenine, **thymine**, cytosine, guanine	Adenine, **uracil**, cytosine, guanine

Rasheed Odakkal,9846626323 GVHSSKondotty



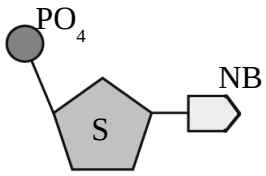
17. Explain the Watson-Crick model of DNA.
Each chromosome contains a DNA , which is made up of several **nucleotides**. DNA is a double helical structured molecule. The two long strands of DNA contain deoxyribose sugar and phosphate groups and its steps are made of pairs of **nitrogen bases**. The nitrogen base, adenine pairs with thymine and the nitrogen base, 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.



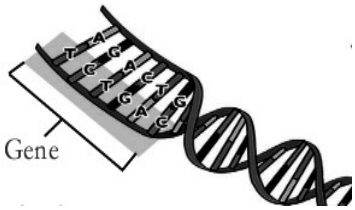
Nucleotides

18. Define a nucleotide.
Nucleotides are the basic units of nucleic acids, (DNA, RNA).
A nucleotide is made up of a nitrogen base, a sugar molecule and a phosphate group.



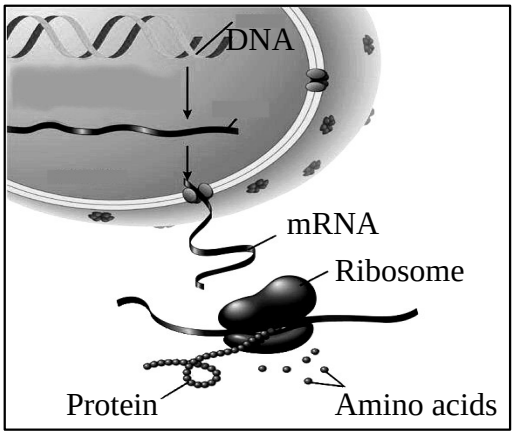
19. Molecules seen in the nucleic acids that contain nitrogen and are alkaline in nature ?
Nitrogen bases.

20. Adenine : Thymine;
Guanine : ---------- ?
Cytosine.



21. How do genes act ?
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.

22. DNA unwinds and ---------- is synthesized which carries the information from DNA to the ribosomes.
mRNA.



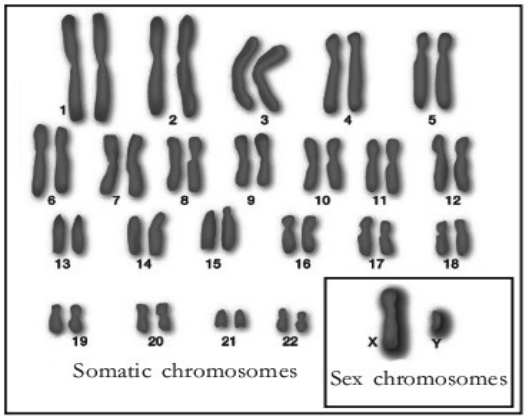
23. The stages of protein synthesis of DNA (The action of genes) ?
- DNA unwinds and mRNA forms.
- mRNA reaches outside the nucleus.
- mRNA reaches ribosomes.
- Based on the information in mRN, amino acids are transferred to ribosomes by tRNA.
- Ribosomes bind amino acids to form protein molecule.

24. Name different types of RNA.
mRNA (messenger RNA), **tRNA** (transfer RNA), **rRNA** (ribosomal RNA).

25. The cell organelles where protein synthesis occur ?
Ribosomes.

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

44+XX is female and **44+XY** is male



27. The two types of sex chromosomes ?
X and Y chromosomes.
[XY in males and XX in females]

28. Y chromosome of male gamete : Male child ;
X chromosome of male gamete : ---------- ?
Female child

29. What are the reasons for variations in organisms ?
Crossing over, combination of allele during fertilization and mutation occur in chromosomes.

30. Define the term 'crossing over'. How does crossing over cause variations ?
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.

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

32. Define mutation.
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.

33. The protein which gives colour to our skin ?
Melanin.

Rasheed Odakkal, 9846626323 GVHSS Kondotty

34. What may be the reason in the colour difference of skin in people living in various parts of the world ?
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 for this chapter:

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