Unit 1 : Mendelian Genetics & its extension

Principles of inheritance, Chromosomal Theory of inheritance

I. Introduction : Our understanding of how inherited traits are passed b/w generations comes from principles first proposed by Gregor Mendel in 1866. Mendel worked on pea plants, but his principles apply to traits in plants & animals — They can explain how we inherit our eye colour, hair colour & even tongue-rolling ability.

II. Inheritance in Pea plants : Mendel followed the inheritance of 7 traits in Pea plants (Pisum sativum). He chose traits that had 2 forms:

- Pea shape (round or wrinkled), Pea colour (yellow or green), Flower colour (Purple or white), Flower position (Terminal or Axial), Plant height (tall or short), Pod shape (inflated or constricted), Pod Colour (yellow or green).

Mendel began with pure-breeding pea plants because they always produced Progeny with the same characteristics as the parent plant. Mendel cross-bred these pea plant & recorded the traits of their progeny over several generations.

✓ Fundamental theory of heredity : Mendel found that pea traits were either dominant or recessive. When pure-bred parent-plants were cross-bred, dominant traits were always seen in the progeny, whereas recessive traits were hidden until the first-generation (F_1) hybrid plants were left to self-pollinate. Mendel counted the number of second generation (F_2) progeny with dominant or recessive traits & found a 3:1 ratio of dominant to recessive traits. He concluded that traits were not blended but remained distinct in subsequent generations, which was contrary to scientific opinion at the time.

Mendel didn't know about genes or linkage genes, but he did speculate that there were 2 factors for each basic trait & that 1 factor was inherited from each parent. [Now, it is known as genes/alleles].

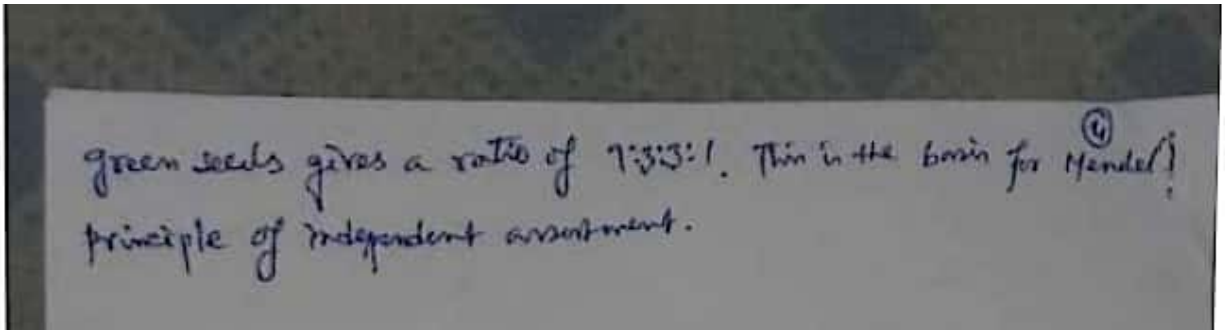
□ Inheritance of a single trait in Peas : Mendel followed the inheritance of 7 pea traits. Dominant traits, like round peas, appeared in the F_1 hybrids. Whereas, recessive traits reappeared in the second generation (F_2). Each individual carries a pair of factors for each trait & they separate from each other during fertilization. This is the basis of Mendel's principle of Segregation.

Principle of Segregation: Mendel proposed that, during reproduction the inherited factors must separate into reproductive cells. He had observed that allowing hybrid pea plants to self-pollinate resulted in progeny that looked different from their parents. Separation occurs during meiosis when the alleles of each gene segregate into individual reproductive cells (eggs & sperm in animals or pollen & ova in plants).

3) Principle of independent assortment :

Mendel observed that, when peas with more than one trait were crossed, the progeny did not always match the parents. This is because different traits are inherited independently — this is the principle of independent assortment. For eg. he cross-bred pea plants with Round, yellow seeds & plants with wrinkled, green seeds. Only the dominant traits (yellow & round) appeared in the F_1 progeny, but all combinations of trait were seen in the self-pollinated F_2 progeny. The traits were present in a 9:3:3:1 ratio (Round, yellow : Round, green : Wrinkled, yellow : Wrinkled, green).

- Inheritance of multiple traits in peas : Mendel cross-bred plants with 2 or more traits & found that each trait was inherited independently of the other & produced its own 3:1 ratio. For eg, a plant with round, yellow seeds crossed with a plant wrinkled


green seeds gives a ratio of 9:3:3:1. This is the basis for Mendel's principle of independent assortment.