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Principles of Inheritance and Variation –

Mendel's Laws of Inheritance:

1. Genetics is the branch of biology, which deals with inheritance and variation of characters from parents to offspring.

2. Inheritance is the process by which characters or traits are transferred from one generation to the next.

3. Variation is the degree by which progeny differs from each other and with their parents. Humans knew from as early as 8000-1000 BC, that one of the causes of variation was hidden in sexual reproduction.

4. Gregor Johann Mendel, for the first time conducted experiments to understand the pattern of inheritance of variation in living beings.

5. Mendel's Experimental Material

(i) He conducted experiments on garden pea plant (*Pisum sativum*) for seven years (1856-1863) and proposed the laws of inheritance in living organisms.

(ii) He selected garden pea plant as a sample for experiment because of:

(a) Easy availability on a large scale.

(b) Many varieties are available with distinct characteristics.

(c) They are self-pollinated and can be cross-pollinated easily in case self-pollination does not occur.

(iii) Mendel selected 14 true-breeding (a breeding line which has undergone continuous self-pollination shows stable trait inheritance and expression for several generations) pea plant varieties, as pairs, which were similar except for one character with contrasting traits.

Seven contrasting characters and their traits as taken by Mendel are listed in the table given below:

Contrasting Characters Studied by Mendel in Pea

Character	Contrasting character (Dominant/Recessive)
Stem height	Tall/Dwarf
Flower colour	Violet/White
Flower position	Axial/Terminal
Pod shape	Inflated/Constricted
Pod colour	Green/Yellow
Seed shape	Round/Wrinkled
Seed colour	Yellow/Green

6. Mendel's Experimental Procedure

- (i) He observed one trait or character at a time. For example, he crossed tall and dwarf pea plants to study the inheritance of one gene.
- (ii) Mendel hybridised plants with alternate forms of a single trait (monohybrid cross). The seeds produced by these crosses were grown to develop into plants of Filial₁ progeny or F₁-generation.
- (iii) He then self-pollinated the tall F₁ plants to produce plants of Filial₂ progeny or F₂-generation.
- (iv) In later experiments, Mendel also crossed pea plants with two contrasting characters known as dihybrid cross.
- (v) Mendel self-pollinated the F₂ plants also.

7. Mendel's Observation in his Experiment

- (i) In F₁ generation, Mendel found that all pea plants were tall and none were dwarf.
- (ii) He also observed other pair of traits and found that F₁ always resembled either one of its parents and the traits of the other parent was not found in them.
- (iii) In F₂-generation, he found that some of the off springs were dwarf, i.e. the character which were not seen in F₁-generation were expressed in F₂-generation.
- (iv) These contrasting traits (tall/dwarf) did not show any mixing either in F₁ or in F₂-generation.
- (v) Similar results were obtained with the other traits that he studied. Only one of the parental traits was expressed in F₁-generation, while at F₂-generation stage, both the traits were expressed in the ratio of 3:1.
- (vi) Mendel also found identical results in dihybrid cross as in monohybrid cross.
- (vii) On self-pollinating F₂ plants, he found that dwarf F₂ plants continued to generate dwarf plants in F₃ and F₄-generations.

