

UNIT-III : GENETICS

9. PRINCIPLES OF INHERITANCE AND VARIATION

 $(1 \times 2) + (1 \times 4) = 6 \text{ Marks}$

ROOT POINTS

1. **Inheritance** is the basis of heredity by which characters are passed on from parent to progeny.
2. **Variation** is the degree by which progeny differ from their parents as well as among themselves.
3. **Genetics** is a branch of biology which deals with the principles of inheritance and its practices.
4. **Mendel** proposed the principles of inheritance, which are called '**Mendel's laws of inheritance**'
5. **Law of dominance**: Some characters are dominant over others and these characters are expressed when factors are either in homozygous or in heterozygous condition.
6. A **recessive character** that was not expressed in heterozygous condition may be expressed again when it becomes homozygous.
7. **Law of segregation**: Characters segregate during the formation of gametes.
8. Later it was found that Mendel's Laws of Inheritance did not hold true for the genes that were located on the same chromosome. These genes are called '**Linked genes**'.
9. It was proved that closely located genes assort together and distantly located genes, due to recombination, assort independently.
10. **Mutations** involve changes in chromosomes and genes. [IPE]
11. Mutations help to increase variability which are useful in crop improvement. [IPE]
12. A mutation that occurs due to a change in a single base pair of DNA is called **point mutation**.
13. The physical appearance of a character is called **Phenotype**. [IPE]
14. The genetic makeup of an individual is called **Genotype**. [IPE]
15. **Monohybrid cross**: The cross made between two individuals differing in one character is called Monohybrid cross. [IPE]
16. **Test cross**: Crossing between F_1 individuals with the recessive parent is called test cross. [IPE]
17. **Incomplete Dominance**: It is the phenomenon in which neither of the genes is completely dominant or completely recessive. [IPE]

FRUITY Qs OF IPE

 $(1 \times 2) + (1 \times 4) = 6 \text{ Marks}$

1. What is the cross between the F_1 progeny and the homozygous recessive parent called? How is it useful?
2. Who proposed the Chromosome theory of Inheritance?
3. Define true breeding. Mention its significance.
4. Explain the terms phenotype and genotype.
5. What is the genetic nature of wrinkled phenotype of pea seeds?
6. Mention the advantages of selecting pea plant for experiment by Mendel.
7. Explain the law of Dominance using a monohybrid cross.
8. Define and design a test-cross.
9. Explain the following terms with examples. (a) Co-dominance (b) Incomplete dominance

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FOR SELECTIVE QUESTIONS

31. Mention the advantages of selecting pea plant for experiment by Mendel.

[TS 19,20,22][AP 17,18,23]

A: Mendel selected garden pea for his experiments due to following advantages:

- 1) It has many contrasting characters.
- 2) It can be grown and crossed easily.
- 3) It has bisexual flowers containing both female and male flowers
- 4) It can be self pollinated conveniently.
- 5) It has a short life cycle and produces large number of off springs.
- 6) It has less number of chromosomes
- 7) It may be conducted in simple laboratory conditions.

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Do you Know?

Mendel has chosen
Pea Plant for having
7 contrast characters &
7 advantages

32. Differentiate between the following:

[AP 20]

a) Dominant and Recessive b) Homozygous and Heterozygous

A: a) The character which is **expressed** in F_1 generation is called

dominant character and which is **unexpressed** is called
recessive character.

b) An individual having two **similar alleles** for a single character
is called **homozygous**.

An individual having two **dissimilar alleles** for a single
character is called **heterozygous**.

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F_1 Generation is like a
judge to decide
Dominant & Recessive.
Homo- similar,
Hetero - dissimilar

33. Explain the law of Dominance using a monohybrid cross.

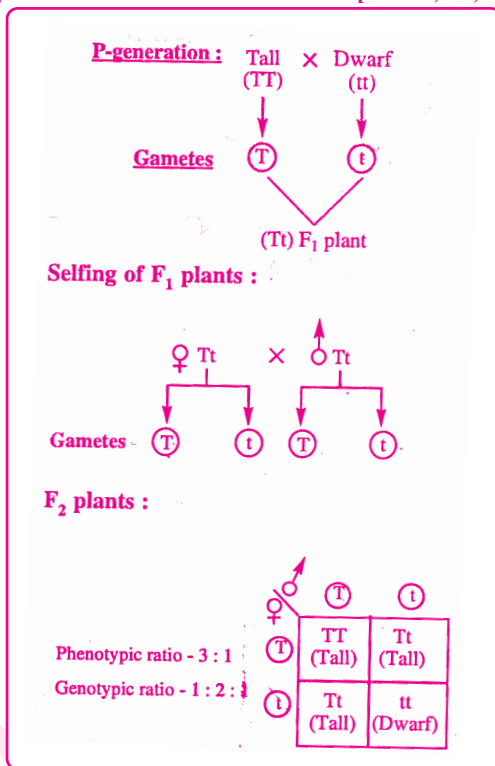
[AP 15, 17, 19]

A: Monohybrid cross: The cross made between two individuals differing in one character is called Monohybrid cross.

In the hybridization experiment Mendel crossed tall and dwarf pea plants to study the inheritance of one gene. Based on his observation on monohybrid crosses, Mendel proposed Law of Dominance.

Law of Dominance:

- 1) Characters are controlled by discrete units called factors.
- 2) Factors occur in pairs.
- 3) In a dissimilar pair of factors, one member dominates the other member of the pair.
- 4) The law of dominance is used to explain the expression of only one of the parental characters in a 'monohybrid cross' in the F_1 generation and the expression of both in the F_2 generation.
- 5) It also explains the proportion of 3:1 ratio obtained at the F_2 generation.



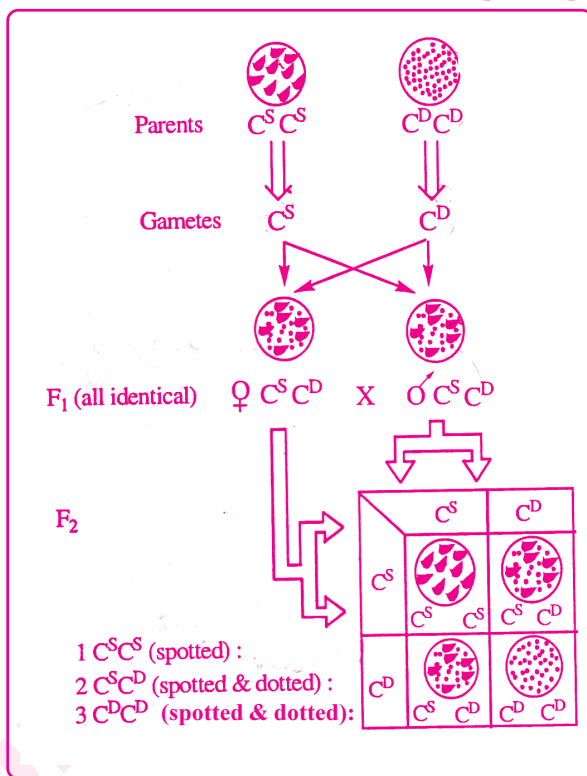
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F1 likes her Father while
F2 likes both Father & Mother
in 3:1 ratio
F1 likes Dairy Milk
F2 likes both Dairy Milk & 5-star
in 3:1 ratio

35. Explain the Co-dominance with example.

[TS 23]

- A:**
- 1) **Co-dominance:** It is the phenomenon in which **both the genes are equally dominant**.
 - 2) The character of both genes is well expressed in the next generation.
 - 3) So, in F_1 generation, regeneration resemble both parents.
 - 4) **Ex 1:** Different types of red blood cells that determine ABO blood grouping in human beings.
 - 5) **Ex 2:** Seed coat pattern and size in Lentil plants in North America.
 - 6) A cross is made between pure - breeding spotted lentils and pure breeding dotted lentils.
 - 7) It produced heterozygotes that are both spotted and dotted.
 - 8) The F_1 hybrids show the phenotypic features of both parents.
 - 9) It shows that neither the spotted nor the dotted allele is dominant or recessive to the other.



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No Compromise

Only equal dominance
says RBC of ABO
in Co-dominance

36. Explain the Incomplete dominance with example.

[TS 15,17,18,19]

- A:**
- 1) **Incomplete Dominance:** It is the phenomenon in which neither of the genes is completely dominant or completely recessive.
 - 2) **Ex:** The inheritance of flower colour in the dog flower (Snapdragon).

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While I am Painting
as I don't have pink colour.
I used to mix Red & White
colours in 1:2:1 ratio
just like dog flower does
for its ID

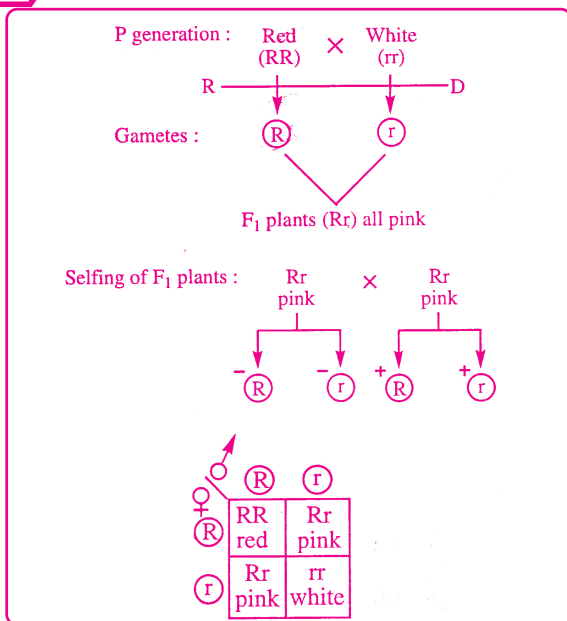
3) In a cross between homozygous red flowered (RR) and white flowered plants (rr), the F_1 (Rr) was Pink.

4) When the F_1 was self pollinated, the F_2 resulted in 1 (RR) Red: 2 (Rr) Pink: 1 (rr) white.

5) Here genotypic ratios were exactly as in Mendelian monohybrid cross, but phenotypic ratio had changed from 3:1 to 1:2:1.

6) It was because of the incomplete dominance of 'R' over 'r' and this made it possible to distinguish Rr as Pink from RR (red) and rr (white).

7) Thus the Phenotypic and genotypic ratios in F_2 progeny are the same, that is 1:2:1.



37. Write a brief note on chromosomal mutations and gene mutations.

[TS 22]

A. 1) Chromosomal mutation: A change in the number or structure of chromosome is called chromosomal mutation.

- (i) Loss or gain of a segment of DNA results in alteration in chromosomes
- (ii) Alteration in chromosomes results in abnormalities (or) aberrations.

Ex: It is commonly observed in Cancer cells

2) Gene Mutation: (i) A change in a single base pair of DNA is called gene mutation.

(ii) It is also called as point mutation. **Ex:** Sickle cell anaemia in humans.

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Cancer cells CM
while Sickle Cell anaemia
is PM (or) GM

84. Who proposed the Chromosome Theory of Inheritance?

[TS 20,22] [AP 17, 19,22]

A: Sutton and Boveri.

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SuBo is new joiner
in CTI Company