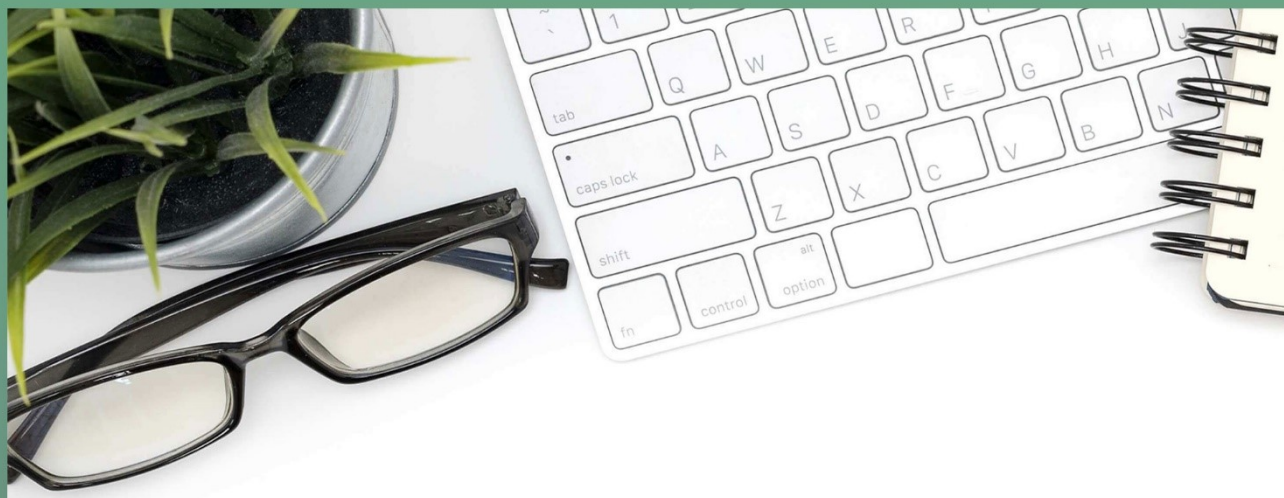

# NEET Biology
## Short Notes

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Check Notes for Principles Of Inheritance and Variation Part-02 NEET 2019 exam! Every year about 3-4 questions have been asked in NEET, AIIMS, JIPMER and various Medical Exams. This is one of the important and Conceptual Unit. In this article, we are providing Short notes on Principles Of Inheritance and Variation for NEET 2019. This is one of the easiest and scoring chapters from the Unit Genetic and Evolution. So, let's begin with a brief introduction of Principles Of Inheritance and Variation.

## Inheritance and Variation

Genetics is a branch of biology which deals with the principle and mechanisms of organisms' genetic variation and heredity. Gregor Mendel, referred to as 'Father of Genetics', postulated the fundamental laws of inheritance. Inheritance is the process of passing down characters from parents to progeny. It is considered as the basis of heredity. Genetic variation is a term used to describe the degree by which progenies vary in their DNA (deoxyribonucleic acid) sequence from their parents. Variations among individuals could be in terms of their morphological, physiological, and cytological characteristics. Mutation, a biological process which brings about a permanent change in the chromosomes' chemical structure, fundamentally causes genetic variation.

### Mendel's Experiment

He studied the genetics of pea plants and tried to trace the inheritance of a variety of traits. For this, he crossed parent plants of pure breed with different forms of traits.
He considered the following traits for his study:

| Trait | Dominant | Recessive |
|---|---|---|
| **Height of plant** | Tall | Dwarf |
| **Position of flower or pod** | Axillary | Terminal |
| **Colour of fruit or pod** | Green | Yellow |
| **Seed shape** | Round | Wrinkled |
| **Seed colour** | Yellow | Green |
| **Flower colour** | Violet | White |
| **Pod shape** | Inflated | Constricted |

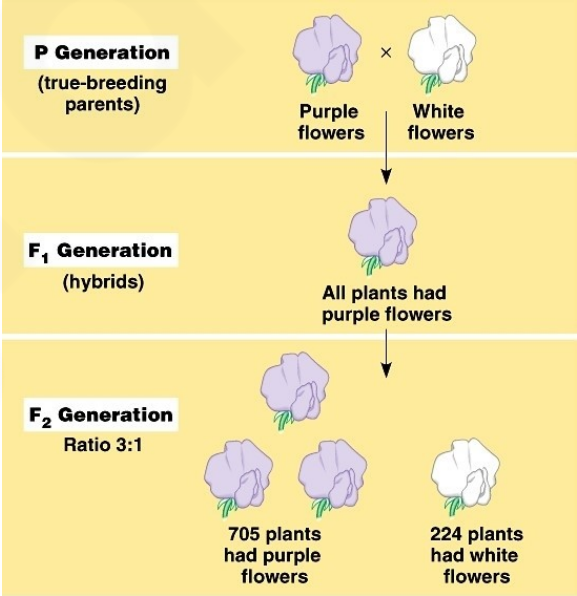
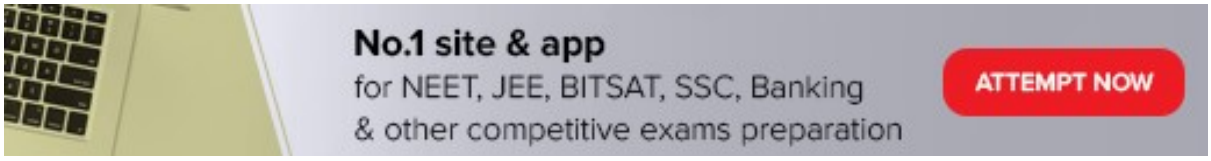



**Figure: Inheritance of one gene in a monohybrid cross**



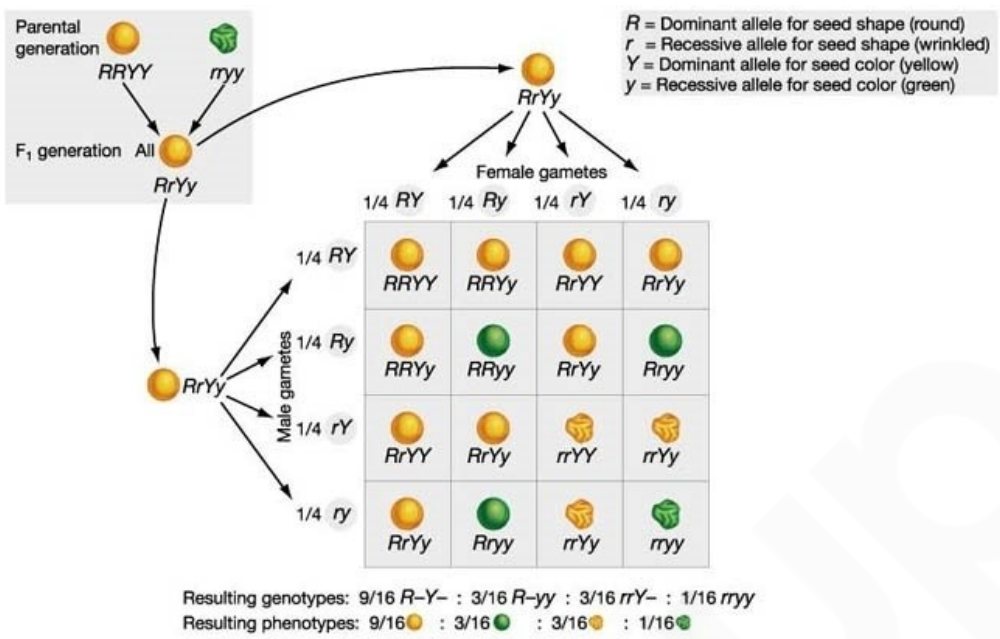



**Figure: Inheritance of two genes in dihybrid cross**

**Table: Difference between monohybrid and dihybrid cross**

| Monohybrid Cross | Dihybrid Cross |
|---|---|
| It involves a single parent. | It involves two parents. |
| It produces single progeny. | It produces two progeny. |
| It involves organisms that are heterozygous for a character. | It involves organisms that are heterozygous for two characters. |
| Crossing is done only once. | Crossing is done twice. |
| It gives a 3:1 ratio. | It gives a 9:3:3:1 ratio. |

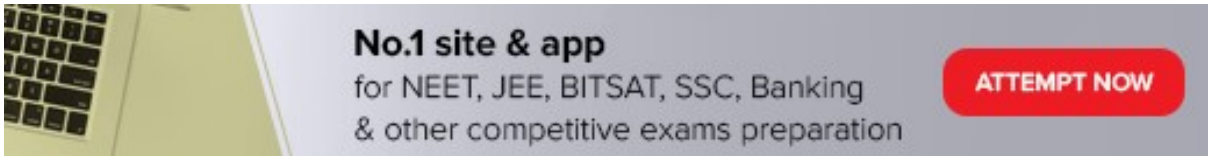
**Mendel's Law of Heredity consists of the following laws.**

- **Law of Segregation:** Each trait inherited by a progeny is characterized by a gene pair that comes from the parent. Sex cells of parents contain only one gene of the pair. So, during fertilization, sex cells of parents unite and thus offspring inherit one genetic allele from each parent.
- **Law of Independent Assortment:** According to this law, inheritance of a trait is independent of inheritance of other traits as a gene that defines a trait gets sorted separately.
- **Law of Dominance:** The law states that an organism with alternate gene forms express the form which is dominant.

**Post-Mendelian Concept of Heredity**

The basic principles of heredity postulated by Mendel in 1866 were redefined by de Vries, Correns, and Tschermak in the year 1900. These concepts do not go along with Mendel's findings and hence are often referred to as "Mendelian deviations". These include:

- **Incomplete dominance.** In this case one allele does not show complete dominance over the other. For instance, monohybrid cross of a red and white flower *Mirabilis jalapa* produced plants with pink flower.



- **Co-dominance.** In this case, both alleles of a gene express their phenotype in a heterozygote. ABO blood group of human shows co-dominance.
- **Multiple alleles.** It deals with the existence of more than two alleles of a particular gene. ABO blood group of humans has multiple alleles.
- **Linkage.** The tendency of two or more genes to remain together in a chromosome and pass down together during inheritance is termed as linkage. This is against Mendel's law of Independent assortment.
- **Polygenes.** Mendel observed that each character is governed by a single gene. However, there were instances that showed some characters being governed by several genes with each gene having additive effect on the expression of the character.
- **Gene interaction.** Gene interaction occurs as genes of individual do not operate in isolation. At times, two or more genes interact with one another to govern a single phenotype. When gene interaction occurs, the ratio of $F_2$ progeny deviates from the general ratio predicted by Mendel.

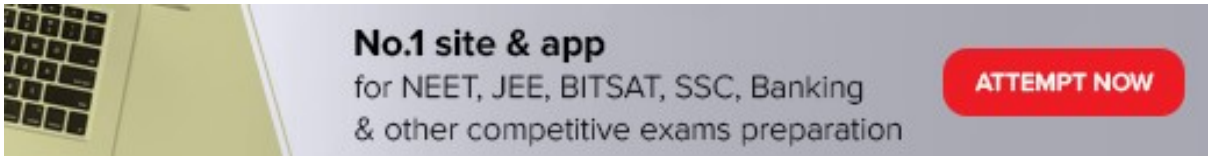
Following are different forms of gene interaction observed:

- **Duplicate gene interaction;** It gives the ratio of 15:1. It is observed in kernel color of wheat. Two dominant factors that govern a trait can give the same phenotype when they are present either in pairs or in single.
- **Complementary gene interaction;** It gives the ratio of 9:7 and is observed in flower color of sweet pea. In this case, for the production of a particular phenotype, complementation of two non-allelic genes is required.
- **Supplementary gene interaction;** it gives the ratio of 9:3:4 and is observed in color of grain in maize. In this type of interaction, two independent dominant genes interact to produce a phenotype that is different from the phenotype produced by either gene individually.
- **Dominant epistasis;** It is observed in fruit color of squash and gives the ratio of 12:3:1. In the case of epistasis, the expression of one gene is masked by another non-allelic gene. This type og gene interaction is also referred to as masking gene action.
- **Dominant suppression epistasis or Inhibitory interaction;** It gives the ratio of 13:3. It is observed in malvidin production of *Primula.* In this case, two pairs of genes take part in the interaction and the expression of one non-allelic dominant gene is inhibited by the other non-allelic dominant gene.

**Polygenic inheritance:** It is the phenomenon of controlling the expression of a particular character by polygenes (many genes), in which case, each individual genes have a small effect on expression of the character. Such characters show continuous variation. Skin color or height of human shows polygenic inheritance.

**Chromosomal theory of inheritance**

- Sutton and Boveri correlated Mendel's conclusion of theory of inheritance to chromosomal behavior during meiosis and mitosis.
- According to this theory, chromosomes as well genes are present in diploid cells as pairs. Alleles of a gene pair are present on homologous sites of homologous chromosomes.
- Homologous chromosomes separate during meiosis and fertilization restores chromosome number to diploid condition.
- Thus, chromosomal theory of inheritance states that it is the chromosome that segregates and assorts independently.



**Linkage and Recombination**

- In a dihybrid cross, when two genes are located on same chromosome, the chances of parental gene combination was higher than the non-parental type.
- Morgan explained this situation to physical association of genes on same chromosome and termed it as linkage.
- Recombination is the process of generation of non-parental gene combination in a dihybrid cross.
- Genes located on same chromosome and are tightly linked show very low rate of recombination.

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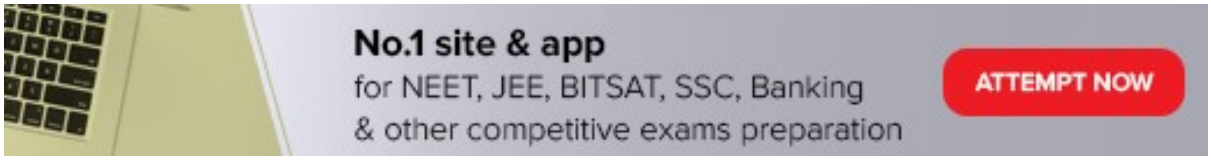

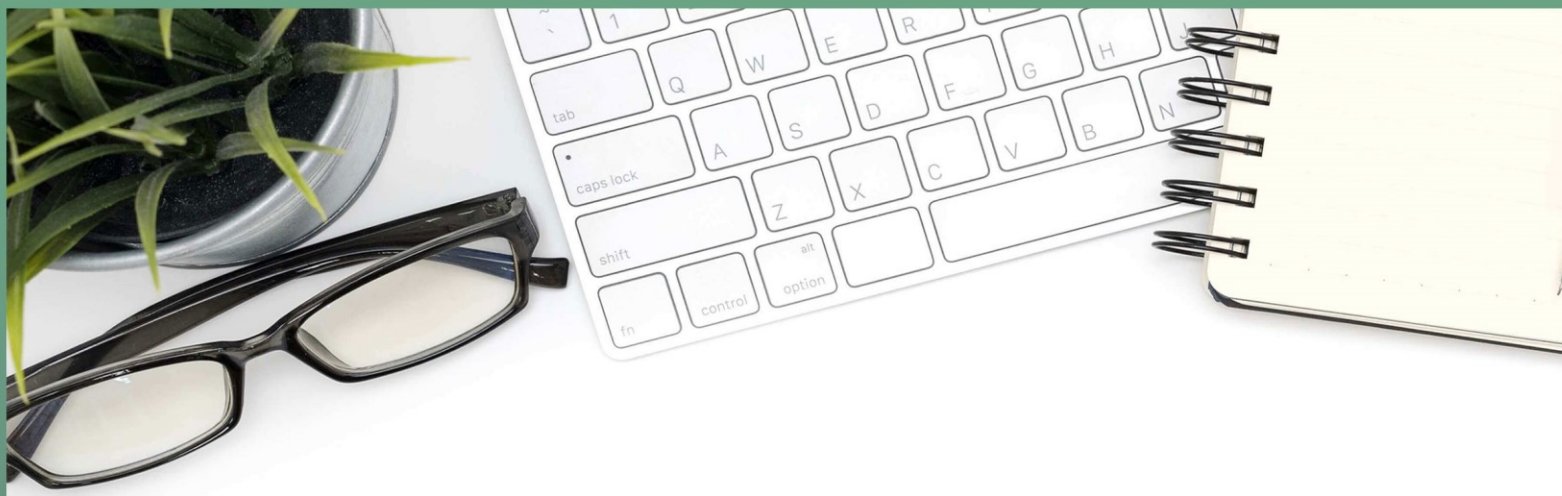

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