

Topic: Law of independent Assortment

Definition:

The principle, originated by George Mendel, stating that when two or more characteristics are inherited, individual hereditary factor assort independently during gamete production, giving different traits on equal opportunity of occurring to gather.

Independent Assortment:

Mendel's law of independent Assortment states that gene don't influence each other with regard to the sorting of allele into gametes every possible combination of allele for every gene is equally likely to occur. The independent Assortment of gene can be illustrated by dihybrid cross: a cross between two true breeding parents that express different traits for two characteristics.

Experiment:

Consider the characteristics of **seed color** and **seed texture** for two pea plants. One that has **green, wrinkled** seed (yyrr) and other has **yellow, round** seed (YYRR). Because each parent is homozygous the law of segregation indicates that the gametes, for the **green/wrinkled** plants all are yr, while the gametes for **yellow/round** plant are all YR. Thus, for F1 generation of offspring all are YyRr. For F2 generation the law of segregation requires that each gamete receives either **R** allele or **r** allele along with either **Y** or **y** allele. The law of independent Assortment states that a gamete into which allele sorted would be equally like to contain either **Y** or **y** allele. Thus, these are four equally liked gamete that can be formed when the **YyRr** heterozygote is self-crossed as follow

YR, Yr, yR, yr

Arranging these along top and left of Punnett square gives us 16 equally liked genotypic combination. From these genotypes we infer a phenotypic ratio of

9 Round / Yellow: 3 Round / Green: 3 Wrinkled / Yellow: 1 Wrinkled / Green

These are offspring ratio we would, expect, assuming we performed the crossing with a large enough size.

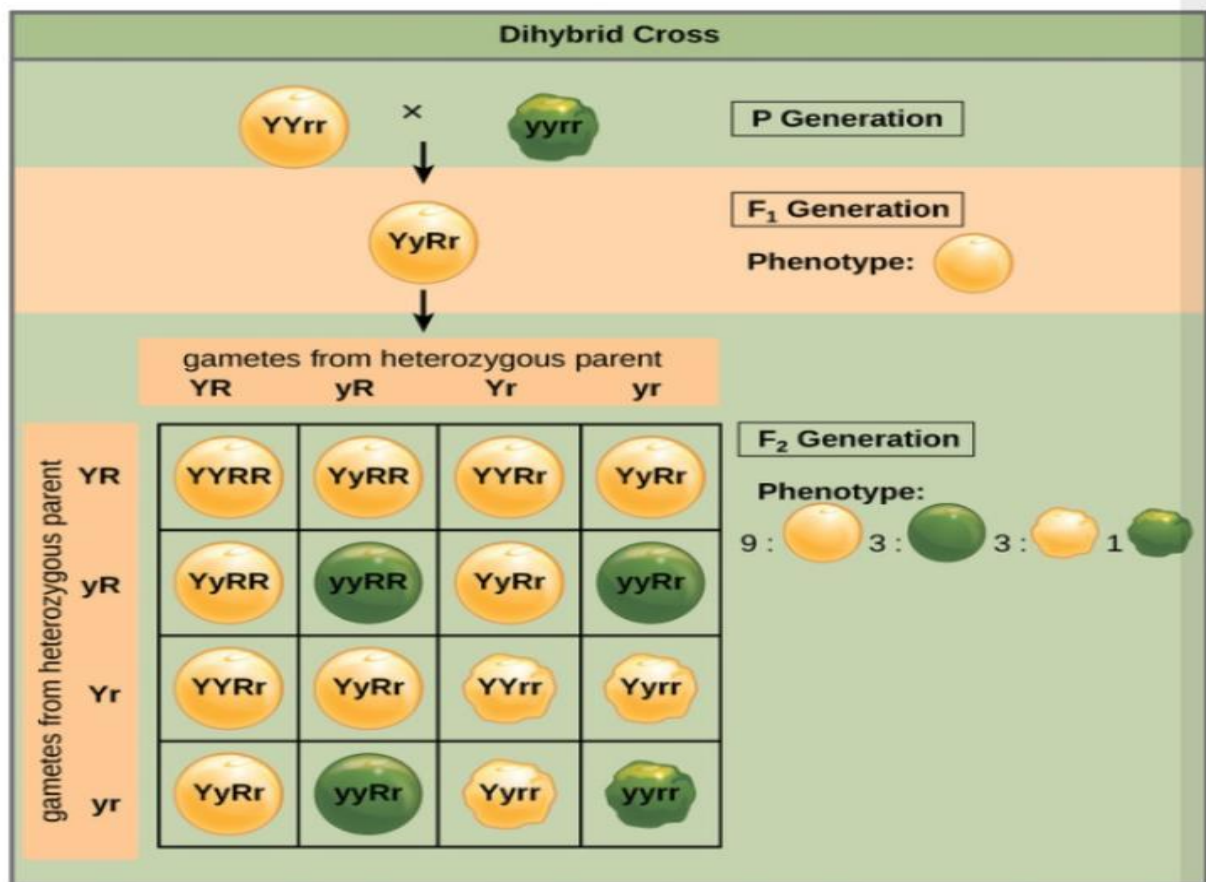


Figure 12.3D. 1: Independent assortment of 2 genes: This dihybrid cross of pea plants involves the genes for seed color and texture.

Because of independent Assortment and dominance, the ratio **9:3:3:1** dihybrid phenotype ratio can be collapsed into two **3:1** ratio, characteristics of any monohybrid cross that follows a dominant and recessive pattern ignoring seed color and considering only **seed texture** in the above dihybrid cross , we would expect that **three** quarters of F₂ generation offspring would be **round** and **one** quarter would be **wrinkled**, similarly isolating only **seed color** we would assume that **three** quarters of F₂ generation offspring would be **yellow** and one quarter would be **green**. The sorting of allele for texture and color are independent events, so we can apply the product rule. Therefore, the proportion of **round** and **yellow** F₂ offspring is expected to be:

$$(3/4) \times (3/4) = 9/16$$

And the proportion of **wrinkled** and **green** is expected to be

$$(1/4) \times (1/4) = 1/16$$

The proportion are identical to those obtained using a Punnett square.

When does independent Assortment occurs?

Independent assortment occurs during the process of meiosis. Meiosis is similar to mitosis, only the final product is gamete cell. Gamete cells have half the DNA of regular, diploid cells and we considered haploid

This is necessary part of sexual reproduction which allow two gametes cell to then fuse together to create a diploid zygote, containing all the DNA necessary to create a new organism.

To understand when independent Assortment occur you must also understand the law of segregation. This law states that during meiosis, the two different gamete cells. This law of independent Assortment, on the other hand, deals with the maternal and parental sources of DNA being separated at random.

We know that this independent Assortment of gene occur during meiosis in eukaryotes. Meiosis is a type of the cell division that reduce the number of the chromosome on a parent cell by half to produce four reproductive cells called gametes.

In humans diploid cell contain 46 chromosomes with 23 chromosomes inherited from the mother and the second similar set of 23 chromosome from father pairs of similar chromosomes are called homologous chromosome. During meiosis, the pair of homologous chromosomes are divided in half to form haploid cell, and this separation or Assortment of homologous chromosome is random. This means that all of the maternal chromosome will not be separated in one cell while the all the parents' chromosome are separated into another. Instead of the meiosis occur, each haploid cell contains a mixture of gene from the organism mother and father.

Independent assortment in meiosis:

As a basic example, let us consider a hypothetical population of bunny rabbit that only have two visible **traits**. **Fur color** (black or white) **eye color** (green or red)

The black color fur allele (**B**) is dominant over white (**b**) while the green eye (**G**) is dominant over red (**g**).in this hypothetical example, two hybrid rabbits are mixed.

What does it's mean is that both rabbits look black with green eyes, but are really they have a heterozygous genotype. Both rabbits have genotype **BbGg**. In this

population of two rabbits all the individual has same mixture of characteristics. In other words, they are all black with green eyes.

Before breeding, each rabbit will have to produce gamete. During this process, not only all the alleles are separated but each copy of each chromosome is randomly assigned to a different gamete. This means regardless of the parental phenotype (black with green eyes) the babies can inherit different combinations of these traits. For instance, one baby would receive the **bbgg** genotype, giving it white fur and red eyes. Alternatively, a baby rabbit could also receive the genotype, **Bbgg**, giving it black fur and red eyes. This is the law of independent Assortment.

Explanation:

Mendel's law of independent Assortment explains the inheritance of two traits of a plants to gather. It can be explained by taking the example of inheritance of height and color of flower together in pea plants. This type of cross is termed as dihybrid Cross.

A pure tall plants bearing red flower is crossed with pure dwarf plant bearing white flower. The plant produce as a result of this cross are all tall plants bearing red flower constituting the first filial generation or F1 generation of the offspring.

Plants of F1 generation are allowed to interbreded freely among themselves to get F2 generation. The plants of F2 generation have 4 different phenotypes tall red, tall white, dwarf red, dwarf white in the ratio of 9:3:3:1. This is termed as dihybrid phenotypic ratio.

This result obtained in dihybrid cross could be explained by assuming that segregation of the gene of two traits height and color of flower occur independently of each other. In other words, the segregation of the gene of one trait don't affect the segregation of the other trait.

A homozygous tall and homozygous red plants (**TRTR**) is crossed to homozygous dwarf and homozygous white plant (**trtr**). The plants of F1 generation are heterozygous tall and heterozygous red (**TRtr**).

On crossing plants D1 the gametes produced by two plants will have 4 genotypes, if we assume that the segregation of gene of two traits is independent of each other. 4 type of gamete formed will have genotype, **TR, TR, tR, tr**. Each of four types of gametes formed by one plant has equally chances of fusing with each other 4 types of gametes formed by other plants.

The possible permutation and combination of these gametes will produce red, tall white, dwarf red and dwarf white plants in ratio of 9:3:3:1 as is actually observed that the actual result observed in dihybrid cross were the same as calculated results, on the basis of assumption that the segregation of gene of 2 trait is independent of each other's. He thus proposed the law of independent Assortment, which states that the segregation of gene of trait is independent of each other.