Mendelian Genetics

Mendel Used a Model Experimental Approach to Study Patterns of Inheritance

- He chose the garden pea as his model system because it is:
  - easy to grow,
  - can be crossbred artificially,
  - and grows to maturity in one season.
- Using seven easily visible features, each with two contrasting traits, and true-breeding strains, Mendel determined that discrete units of inheritance "characters" exist and predicted their behavior during the formation of gametes.
- After many years of dismissal, Mendel's postulates were eventually accepted as the basis for Mendelian genetics.

Monohybrid Cross Reveals How One Trait Is Transmitted from Generation to Generation

- Monohybrid crosses involve one trait being followed.
- Original parents = P_1
- Their offspring = F_1
- F_1 offspring = F_2
- In the F_1 generation of a monohybrid cross, all of the plants have just one of the two contrasting traits.
- In the F_2 generation, 3/4 of the plants exhibit the same trait as the F_1 generation, and 1/4 exhibit the contrasting trait that disappeared in the F_1 generation.
- Mendel proposed the existence of "particulate unit factors" for each trait. He suggested that these "characters" serve as the basic units of heredity (now called genes) and are passed unchanged from generation to generation, determining various traits expressed by each individual plant.
- Mendel's monohybrid crosses were not sex dependent. It did not matter whether a tall male plant pollinated a dwarf female plant, or vice versa. The results were the same either way. This is called a reciprocal cross.
- An autosomal trait is one that is not on a sex chromosome.
- Mendel proposed three postulates of inheritance:
  - (1)unit factors exist in pairs;
  - (2)in the pair of unit factors for a single characteristic in an individual, one unit factor is dominant and the other is recessive; and
  - (3)the paired unit factors segregate (separate) independently during gamete formation. (Law of Segregation)
- The genotype is the genetic makeup of an individual.
- The phenotype is the physical expression of the genetic makeup.
- When the alleles (alternative forms of a single gene) for a trait in an individual are the same, the individual is homozygous. If the alleles differ, the individual is heterozygous.
- A phenotype is wild type if it is the most common expression of a particular gene in a population. It is often taken to mean standard or normal.
- An allele that came from a mutation (change) is a mutant.
- A Punnett square allows the genotypes and phenotypes resulting from a cross to be visualized easily.
- The genotype ratio is the ratio of different possibilities of genotypes.
- The phenotype ratio is the ratio of different possibilities of phenotypes.
- The patterns in which traits appear in families is termed Mode of Inheritance.
- A testcross is a way to determine whether an individual displaying the dominant phenotype is homozygous or heterozygous for that trait.

Mendel's Dihybrid Cross Revealed His Fourth Postulate: Independent Assortment

- A dihybrid cross involves two pairs of contrasting traits.

- The product law can be used to predict the frequency with which two independent events will occur simultaneously.
- Independent Assortment
    - Mendel's fourth postulate states that traits assort independently during gamete formation and that all possible combinations of gametes will form with equal frequency.
- A Punnett square of a dihybrid cross is will give you a 9:3:3:1 dihybrid ratio.
- Test crosses can also be used with two independent traits.
- Trihybrid crosses involving three independent traits show that Mendel's rules apply to any number of traits.
- The forked-line (branched diagram) method is easier to use than a Punnett square for analysis of inheritance of larger number of traits.

Mendel's Work Was Rediscovered in the Early Twentieth Century

- Mendel suggested that heredity resulted in discontinuous variation, as opposed to the existing continuous variation hypothesis of his time—in which offspring were thought to be a blend of the parental phenotypes.

The Correlation of Mendel's Postulates with the Behavior of Chromosomes Formed the Foundation of Modern Transmission Genetics

- The chromosomal theory of heredity proposed that the separation of chromosomes during meiosis could be the basis for Mendel's principles of segregation and independent assortment.

Independent Assortment Leads to Extensive Genetic Variation

- A major consequence of independent assortment is the production of genetically dissimilar gametes.
- Genetic variation results from independent assortment and is very important to the process of evolution.

Laws of Probability Help to Explain Genetic Events

- The probability of two independent events occurring at the same time can be calculated using the product law: the probability of both events occurring is the product of the probability of each individual event.

Pedigrees Reveal Patterns of Inheritance in Humans

- A pedigree shows a family tree with respect to a given trait. Pedigree analysis reveals patterns of inheritance.
- Pedigree analysis of human traits has been an extremely valuable tool in human genetic studies.