

Principles of Genetics

Genetics

- Genetics is a branch of the biology involved with the study heredity, its biological process, the study of genes, genome, cell cycle, heredity, inherits genes, etc.

Genotype

- The genotype is a set of genes in DNA responsible for unique trait or characteristics.
- The genotype refers to the genetic material passed between generations

Phenotype

- The phenotype is the physical appearance or characteristic of an organism.
- The sum of an organism's observable characteristics is their phenotype.

Inheritance

- Inheritance is the process by which genetic information is passed on from parent to child.
- Inheritance Patterns are four:
 - Autosomal Dominant Inheritance.
 - Autosomal Recessive Inheritance.
 - X-linked Inheritance.
 - Complex Inheritance.

Punnett square

- The Punnett square is a square diagram that is used to predict the genotypes of a particular cross or breeding experiment.
- It is named after Reginald C. Punnett
- The Punnett square is a tabular summary of possible combinations of maternal alleles with paternal alleles.
- The diagram is used to determine the probability of an offspring having a particular genotype.
- The Punnett square is a visual representation of Mendelian inheritance.

Test cross

- A test cross is a way to explore the genotype of an organism.
- Testcross is a cross between F1 hybrid and homozygous recessive parent.
- Test cross is so named as it determines whether the individual with dominant phenotype is homozygous dominant or heterozygous dominant.

Backcross

- Backcrossing is a crossing of a hybrid with one of its parents or an individual genetically similar to its parent, to achieve offspring with a genetic identity closer to that of the parent.
- Cross between F1 generation plant to any of the parent plants is known as back cross.

Mendel's experiments

- Johan Gregor Mendel, also known as the “father of genetics”, started a decade-long research project in 1856 to study the patterns of inheritance.
- He carried out his experiments on inheritance with the common pea plant taking 7 features of the plant.
- He started the experiment by breeding plants with two different features, such as tall vs short height, till they were pure breeding.
- He carried out breeding experiments with all the features and noted down similar observations in inheritance.

Mendel's Laws of inheritance

- When Mendel observed the monohybrid cross he proposed three laws of inheritance-
 - Law of Dominance
 - Law of Segregation
 - Law of independent assortment

Chromosomal Theory of Inheritance

- Chromosomal Theory of Inheritance was proposed by Walter Sutton and Theodor Boveri in 1902 and 1903, respectively.
- Observed that similar appearing chromosomes paired and then were pulled apart during meiosis.
- Diploid cells have two copies of each heritable gene, and gametes each have one.
- Segregation and independent assortment were observed.

Morgan's experiment

- T. H. Morgan was the first to associate a specific gene with a specific chromosome.
- Morgan chose the fruit fly, *Drosophila melanogaster*, for his genetic studies.
- Morgan chose fruit flies due to their short generation time, only had 4 chromosomes and they were easy to rear and harmless.
- A mutation in a gene affecting fly eye color makes a fly's eyes white, rather than their normal red.

Sex-Linked Inheritance

- Sex Linkage proves the chromosomal theory.
- Morgan found that the eye color gene was inherited in different patterns by male and female flies.
- Male flies have an X and a Y chromosome (XY), while female flies have two X chromosomes (XX).
- Eye color in this instance was sex-linked, which explained why males were white-eyed and females had red eyes.

Karyotyping

- A karyotype is the number and appearance of chromosomes, and includes their length, banding pattern, and centromere position.
- To obtain a view of an individual's karyotype, cytologists photograph the chromosomes and then cut and paste each chromosome into a chart, or karyogram, also known as an ideogram.