Lecture 39

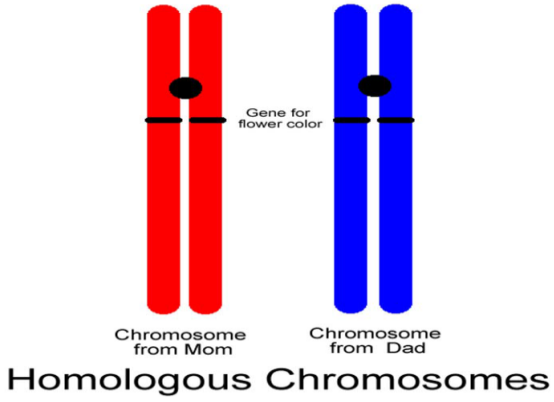
Genetics

Introduction

Humans, like every other organism, are made up of cells. We all start off as just one cell at the time of fertilization. This cell contains two sets of genes, one from our mother and one from our father. For ease of storage and access, the genes are packaged up into 46 protein parcels called chromosomes. As the single cell divides, the genes are copied so that every new cell possesses the full complement of genetic material. This mechanism of copying the genes is quite remarkable considering that the human body contains approximately 10 trillion cells. Genes are made of a chemical called DNA. Information of organism development is contained in its DNA.

Genes as a Functional heredity Unit

Chromosomes occur in pairs called homologous chromosomes. Chromosomes are made up of genes that control traits. Some traits are influenced by many genes are called as polygenic Eg height in humans. A gene is found at a specific location or locus on a chromosome.



Homozygous & Heterozygous

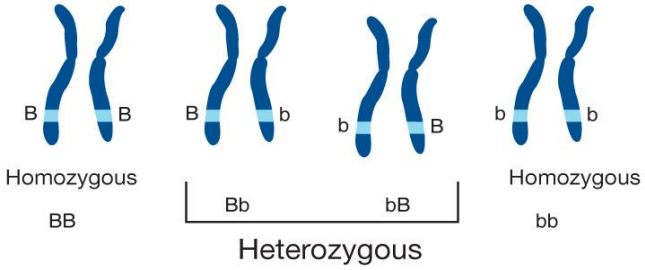
Human has two sets of chromosomes; it will have two copies of each gene. These two copies may be the same allele, or they may be different.

1) Homozygous

A cell is said to be homozygous for a particular gene when identical alleles of the gene are present on both homologous chromosomes.

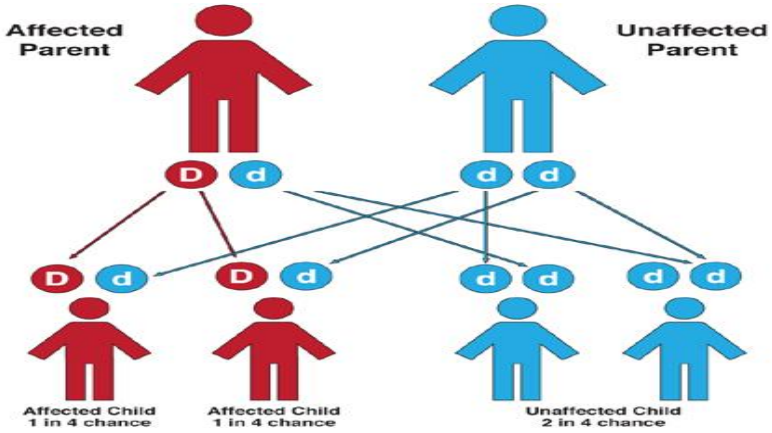
2) Heterozygous

A diploid organism is heterozygous at a gene locus when its cells contain two different alleles of a gene.



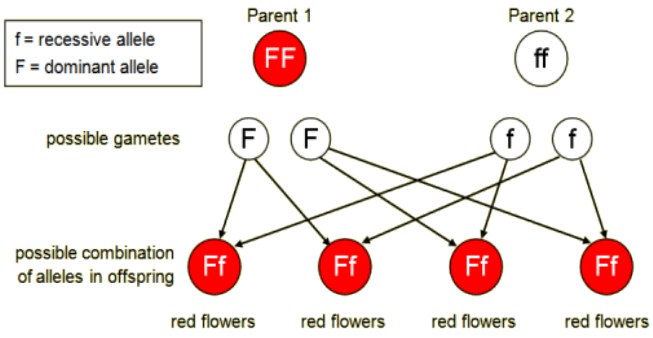
Dominant Inheritance

When a trait is dominant, only one allele is required for the trait to be observed. A dominant allele will mask a recessive allele, if present. A dominant allele is denoted by a capital letter (A versus a). Since each parent provides one allele, the possible combinations are: AA, Aa, and aa.



Recessive **Inheritance**

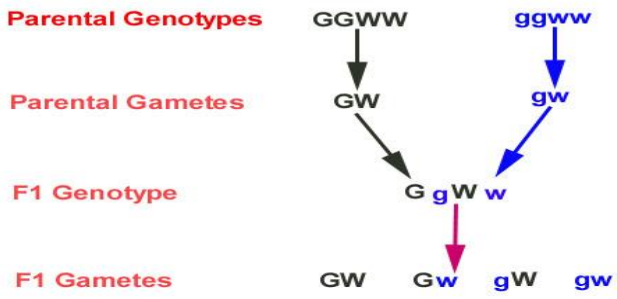
Recessive if it is masked by dominant allele in heterozygous condition. If two parents are both carriers of a genetic condition with a recessive inheritance pattern, there is a one-in-four chance that each child will be affected. So on average, one-quarter of their children will be affected. Pp Two white flower alleles (homozygous).



Genotype & Phenotype

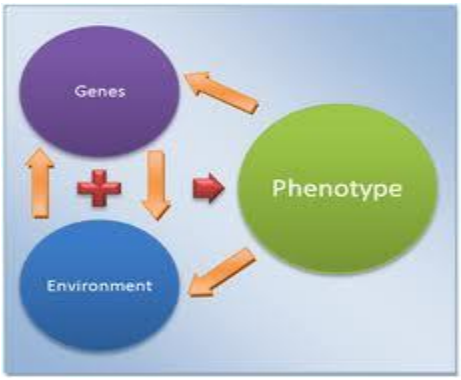
Genotype

The genotype is the genetic makeup of a cell, an organism, or an individual usually with reference to a specific characteristic under consideration.



Phenotype

The observable physical or biochemical characteristics of an organism, as determined by both genetic makeup and environmental influences. The expression of a specific trait, such as stature or blood type, based on genetic and environmental influences. An individual or group of organisms exhibiting a particular phenotype.



Heredity

One or two traits are passed from one generation to another. A rule *Punnett square* explains this transfer efficiently.

1. Albino

• A simple recessive trait

2. Pinstripe

• A dominant pattern mutation

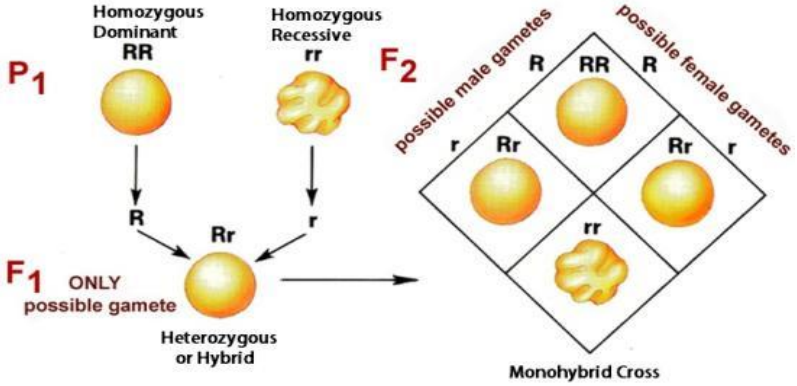
Albino Trait

Albino Trait is an inherited condition present at birth, characterized by a lack of pigment that normally gives color to the skin, hair, and eyes. Many types of albinism exist, all of which

involve lack of pigment in varying degrees. The condition, which is found in all races, may be accompanied by eye problems and may lead to skin cancer later in life.

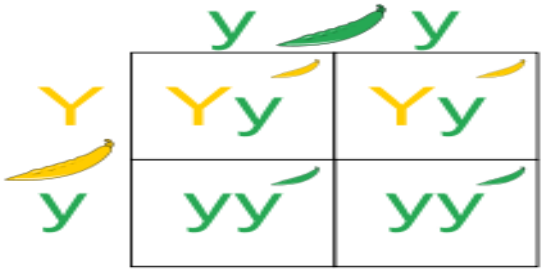
Monohybrid Cross

A monohybrid cross is a mating between two individuals with different alleles at one genetic locus of interest. The character(s) being studied in a monohybrid cross are governed by two or multiple alleles for a single locus.



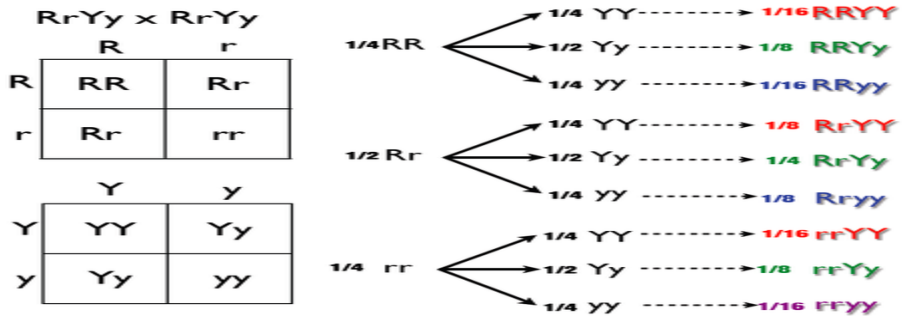
Punnett Square with one Trait

The Punnett square is a useful tool for predicting the genotypes and phenotypes of offspring in a genetic cross involving Mendelian traits. To draw a square, write all possible allele combinations one parent can contribute to its gametes across the top of a box and all possible allele combinations from the other parent down the left side. The allele combinations along the top and sides become labels for rows and columns within the square. Complete the genotypes in the square by filling it in with the alleles from each parent. Since all allele combinations are equally likely to occur, a Punnett Square predicts the probability of a cross producing each genotype.



Dihybrid Cross Genotypes

Dihybrid cross is a cross between two different lines (varieties, strains) that differ in two observed traits. In the Mendelian sense, between the alleles of both these loci there is a relationship of complete dominance - recessive. In the example pictured to the right, RRYY/rryy parents result in F_1 offspring that are heterozygous for both R and Y (RrYy). The Dihybrid cross is easy to visualize using a Punnett square of dimensions 4 x 4. The Punnett square gives us the *genotypes* that result from the cross.



Dihybrid Cross Phenotypes

In a cross, each parent plant contributes one allele for each gene, and every parental allele has an equal chance of being given to the offspring. The *phenotypes* would be:

– 9 Pinstripe (*A_P_*)
– 3 Normal (*A_pp*)
– 3 Albino pinstripe (aaP_)
– 1 Albino (*aapp*)

• Albino is a recessive trait, while pinstripe is a dominant trait.
• The 9:3:3:1 phenotypic ratio is characteristic of a dihybrid cross.

AaPp x AaPp

	AP	Ap	aP	ap
AP	AAPP	AAPp	AaPP	AaPp
Ap	AAPp	AApp	AaPp	Aapp
aP	AaPp	AaPp	aaPP	aaPp
ap	AaPp	Aapp	aaPp	aapp

References

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