Terms - Alphabetical

Allele: Different form of the same gene

Continuous Variation: Occurs when a phenotype shows multiple variations in a population through multiple genes

Gene: Basic unit of DNA - hereditary material.
It occupies a specific location on a chromosome and determines a particular characteristic in an organism

Genotype: An organisim's genetic information

Heredity: Transfer of traits from parent to offspring

Phenotype: Set of observable traits

Polygenic: Multiple genes contributing to one trait eg. height or weight.

Gregor Mendel

Studied the phenotypes of generations of peas.
Some of the pea plant phenotypes are:
- Purple flowers or white flowers
- Yellow seeds or green seeds
- Wrinkled seeds or round seeds
- Tall or short plants

Alleles

Humans have 2 alleles for each gene
Dominant allele: Will mask a recessive gene – **TT or Tt**
Recessive allele: Is only expressed when a gene has two of this type of allele – **tt**

Genotypes

Homozygous dominant genotype: 2 dominant alleles (TT or AA)

Homozygous recessive genotype: 2 recessive alleles (tt or aa)

Heterozygous genotype: one dominant allele and one recessive allele (Tt or Aa)

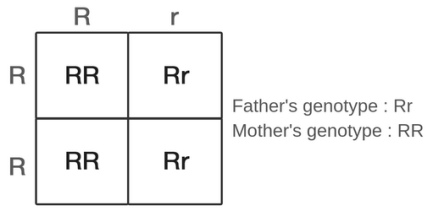
One-Trait Inheritance

The types of gametes that are produced depends on the genotype of the parent cell.
Examples of one-trait inheritance
👉 Cheek dimples
👉 Free or attached earlobes
👉 Freckles
One-trait crosses consider only one set of alleles -
e.g. HH x Hh
Remember that a gamete (egg or sperm) has only
one allele
👉 e.g. a 'H' or a 'h'

Punnet Squares

Can be used to predict genotypes and phenotypes of offspring from genetic crosses.
Steps for a Punnet Square (based on the picture below)
Step 1: Figure our the genotypes of the parents - **Rr x RR**
Step 2: Place one Parent on the top and one on the outside
Step 3: Cross them. **Always make sure to put the capital letter first**

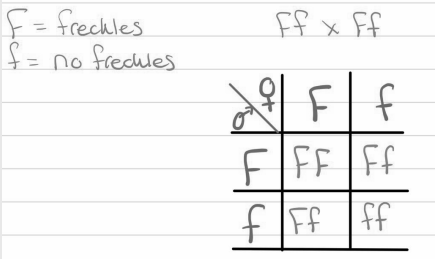
Punnet Squares



Monohybrid Cross

Both parents are heterozygous (or a hybrid) for a single (mono) trait.
Based on the picture below the trait is freckles.

Monohybrid Cross



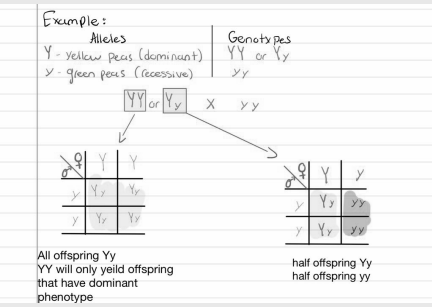
Ratios

Genotypic ratio: the number of offspring with the same genotype
Phenotypic ratio: the number of offspring with the same outward appearance
What is the genotypic ratio for the Monohybrid cross above?
1: 2: 1 (1 FF: 2 Ff: 1 ff)
What is the phenotypic ratio?
3: 1 (3 with freckles and 1 with no freckles)
For a monohybrid cross, 3:1 phenotypic ratio is always expeccted when one allele is completely dominant over the other.

Test Crossing

Determine whether an organism with a dominant phenotype is homozygous or heterozygous.
The genotype is unknown (Hh or Hh)
Rules of a test cross
1. If the cross yeilds 100% dominant phenotype offspring, the parent is homozygous dominant.
2. If the cross yeilds 50% dominant phenotype and 50% recessive phenotype offspring, the parent is heterozygous.
Example shown in picture below.

Test Crossing



Mendelian Laws

Law of Segregation

> During formation of gametes, the 2 traits carried by each parent will separate

Law of Independent Assortment

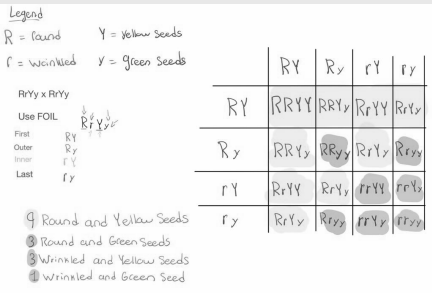
> The homologous pairs separate into gametes is completely random, so any possible combination can occur.

If the genes for two different traits are found on different chromosomes, we can use a dihybrid cross to look at the possible genotype and phenotype outcomes.

Dihybrid Cross

A cross between two individuals that carry two different traits that determines the probability of the traits being passed onto the offspring.
A dihybrid is heterozygous for 2 traits.
A dihybrid cross **always** gives a 9:3:3:1 phenotypic ratio

Dihybrid Cross



Non-Mendelian Inheritance

Polygenic Inheritance

> Multiple genes affect one trait (eg. hair colour, eye color, skin colour)

Incomplete Dominance

> Dominant allele is partially expressed, resulting in an intermediate phenotype (Eg. Red X White = Pink heterozygous).

Codominance

> both alleles are expressed in the heterozygote neither is dominant or recessive, but there is no blending

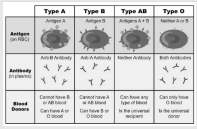
Sex-linked Inheritance

> Traits that are carried on by the sex chromosomes

Codominance - Blood Types

Different combinations of the three blood-type alleles produce four different possible phenotypes, or blood types (A, B, AB, and O)
I^A and I^B are completely dominant over i, and I^A is codominant with I^B
I^A -> dominant allele for blood type A
I^B -> dominant allele for blood type B
i -> recessive allele for blood type O
.

Blood Types Cont'



Type AB blood has no antibodies, any blood can be donated to them - universal acceptor

Type O - universal donor

X-linked Influences

Some inheritance patterns depend on which chromosomes the gene is located on. The X chromosome contains many genes that are not related to sex characteristics, and those genes are called X-linked (genes on the X chromosome unrelated to sex characteristics).
Human X-linked, recessive traits include hemophilia, which is a blood clotting disorder and red-green colour blindness. Each of these traits are much more common in males than females because males have only one X chromosome and females need to inherit two mutated alleles to have the disease

Genetic Disorders

Sickle-cell Anemia

> **Autosomal Recessive.** The hemoglobin gene is mutated, causing abnormal red blood cell formation and reduced capacity to carry oxygen.

Tay Sachs

> **Autosomal Recessive.** Lysosomal enzyme is mutated, causing brain deterioration leading to death

Cystic Fibrosis

> **Autosomal Recessive.** the chloride channel gene is mutated, causing altered water balance inside of cells, and this leads to excessive mucus production, which impacts the lungs, liver, pancreas, and sweat glands.

Huntington's Disease

> **Autosomal Dominant.** CAG nucleotide repeats are inserted into a gene that affects a protein in the brain.

Hemophilia

> **Recessive X-linked.** Affects a gene involved in blood clotting.