

Mendelian Genetics

Presented by
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Key Terms

- Heredity – The passing of traits from parents to offspring
- Genetics – the branch of science that studies heredity
- Gene – the unit of heredity – codes for a specific trait
- Gregor Mendel – the father of modern genetics
- Gametes – male and female sex cells
- Zygote – forms when the sperm and egg meet

Gregor Johann Mendel (1822 - 1884)

- **1865: Mendel published the results of his experiments with garden peas in which he crossed parents and examined offspring, became the "father" of genetics.**
- **Concluded that each parent contributes "particles" or genetic units to their offspring**
- **The *particulate nature of inheritance* and the *laws of inheritance* = final pieces in the puzzle that fulfilled Darwin's vision of evolution by natural selection**
- **Mendel's contribution DID NOT become known until early in the 20th century**



Why Pea (*Pisum sativum*) plant?

Mendel selected garden pea plant for his experiments because of the following characteristics:















- (i) The flowers of this plant are bisexual (hermaphrodite).
- (ii) They are self-pollinating, and thus, self and cross pollination can easily be performed.
- (iii) The different physical contrasting characteristics were easy to recognise and study.
- (iv) They have a shorter life span, limited visible characters and are easier to maintain.



Seven Traits of *Pisum Sativum*

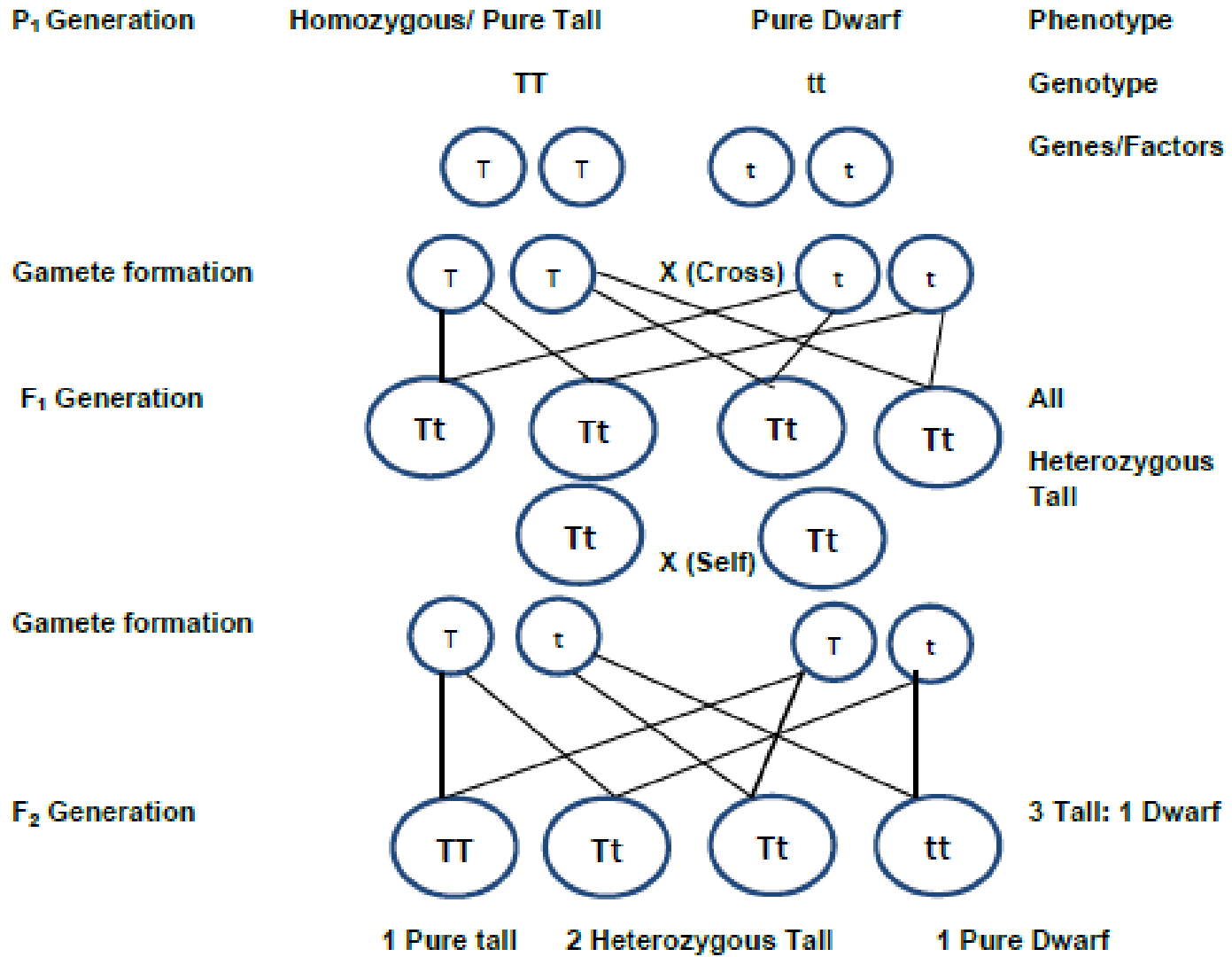
The seven pairs of contrasting characters of *Pisum sativum* chosen by Mendel for his experiment :

Characters	Dominant Traits	Recessive Traits
Height	Tall	Dwarf
Seed shape	Round	Wrinkled
Seed color	Yellow	Green
Flower color	Violet	White
Pod shape	Inflated	Constricted
Pod color	Green	Yellow
Flower position	Axial	Terminal

	Stem height	Seed shape	Seed color	Flower color	Pod shape	Pod color	Flower position
Dominant traits	 Tall	 Round	 Yellow	 Violet	 Inflated (full)	 Green	 Axial
Recessive traits	 Dwarf	 Wrinkled	 Green	 White	 Constricted (flat)	 Yellow	 Terminal

Trait studied	Dominant	Recessive
1. Plant height	Tall (T)	Dwarf (t)
2. Flower position	Axial (A)	Terminal (a)
3. Pod colour	Green (G)	Yellow (g)
4. Pod shape	Full or Inflated (I)	Constricted (i)
5. Flower colour	Violet (V)	White (v)
6. Seed shape	Round (R)	Wrinkled (r)
7. Seed colour	Yellow (Y)	Green (y)

Mendel's Monohybrid Test



Monohybrid Ratio or Phenotypic ratio: 3:1

Genotypic ratio: 1:2:1

Parents : (Pure tall) TT \times tt (Dwarf)

Gametes :



F_1 generation :

Tt Heterozygous tall

selfing

$Tt \times Tt$

F_2 generation :

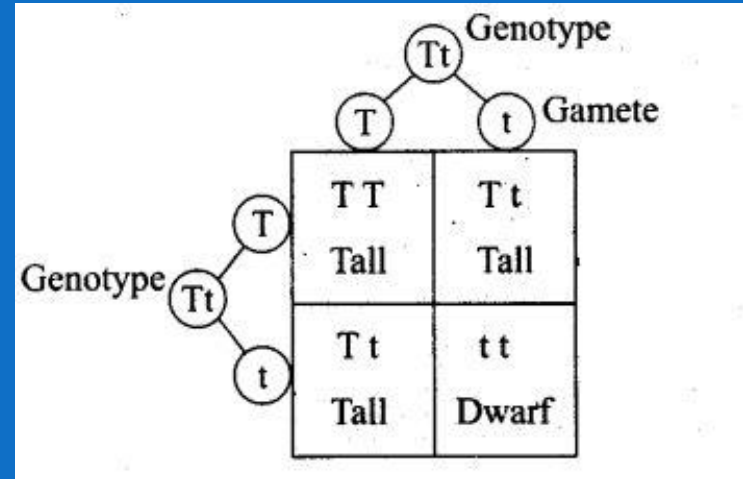
$\begin{matrix} \text{♀} & \text{♂} \\ \text{♀} & \text{♂} \end{matrix}$	T	t
T	TT	Tt
t	Tt	tt

Phenotypic ratio : 3 Tall : 1 Dwarf

Genotypic ratio : Pure tall : Hybrid tall : Dwarf

1 : 2 : 1

Fig.: Monohybrid cross



Punnet's Square

Basic Terms in Genetics

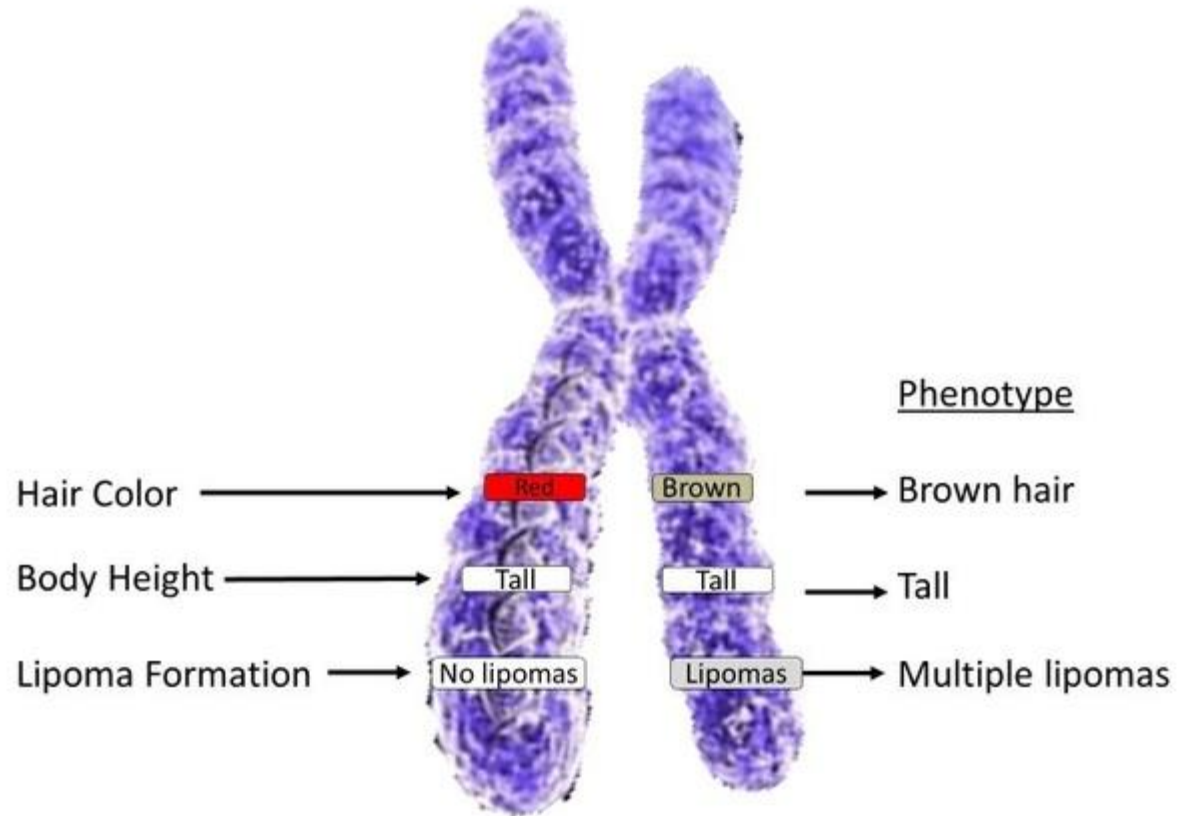
Term	Definition
Allele	One of two or more alternative versions of a gene.
Dominant allele	An allele that determines the phenotype of an organism even when paired with a different (recessive) allele.
F ₁ generation	The first generation of offspring in a genetic cross.
F ₂ generation	The second generation of offspring in a genetic cross.
Gene	An individual unit of genetic information for a specific trait. Genes are located on chromosomes and are the basic unit of inheritance.
Genetic cross	A controlled mating experiment, usually performed to examine the inheritance of a particular trait.
Genotype	The genetic makeup of an organism.
Heterozygote	An individual that carries one copy of each of two different alleles (for example, an <i>Aa</i> individual or a C^{WC^R} individual).
Homozygote	An individual that carries two copies of the same allele (for example, an <i>AA</i> , <i>aa</i> , or C^WC^W individual).
P generation	The parent generation of a genetic cross.
Phenotype	The observable characteristics of an organism.
Recessive allele	An allele that does not have a phenotypic effect when paired with a dominant allele.
Trait	A feature of an organism, such as height, flower color, or the chemical structure of a protein.

Terms you should know:

- **GENOTYPE**: genetic makeup of an organism in term of the alleles present (e.g. **Tt** or **GG**).
- **PHENOTYPE**: physical or other features of an organism due to both its genotype and its environment (e.g. **tall plant** or **green seed**)
- **HOMOZYGOUS**: having two identical alleles of a particular gene (e.g. **TT** or **gg**).Two identical homozygous individuals that breed together will be pure-breeding.
- **HETEROZYGOUS**: having two different alleles of a particular gene (e.g. **Tt** or **Gg**), not pure- breeding.
- **DOMINANT**: an allele that is expressed if it is present (e.g. **T** or **G**)
- **RECESSIVE**: an allele that is only expresses when there is no dominant allele of the gene present. (e.g **t** or **g**)

Allele

- You may know about chromosomes and genes, and alleles are also a part of chromosomes.
- Alleles are *different forms of the same gene* which are located on the same part of the chromosome.



Allele

- Genes are made up of information needed to produce different proteins, so alleles carry information to *produce different versions of the same protein*.
- We have 22 pairs of 'autosomal' or non-sex chromosomes and 1 pair of sex chromosomes (x and y). In each pair one copy comes from the mother and one from the father.
- A particular allele will be in the equivalent place on each copy in the pair. So like the chromosome, we have one allele from the mother and one from the father for each gene.
- The alleles may be the *same* (e.g. for the gene responsible for eye colour, both may be for brown eyes) - these alleles are called **homozygous**.
- They may also be *different* (one allele e.g. from the mother may be for blue eyes and the other from the father for brown eyes) - these alleles are called **heterozygous**.



Thank you