# Introduction

Genetics – term was given by W. Bateson

## Heredity

Transfer of genetic characters from parents to offspring

## Variation

(Individual of same species have some diff →

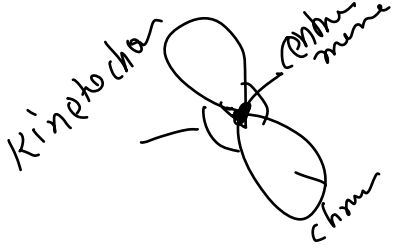
## HISTORY :-

G. J. Mendel – Father of genetics

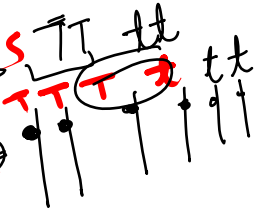
W. Bateson – Father of Modern genetics

Morgan :- Experimental gen → Drosophila

A. Garrod → Human genetics alkaptonuria (Black urine disease)




- Factor's
- Allele




- Homozygous
- Heterozygous
- Hemizygous

phenotype  Genotype

## Factor's

Unit of heredity

- Johannsen (1909)

⇒ element factor

Morgan

Dominant → TT

Recessive – tt

| | T | t |
|---|---|---|
| T | TT | Tt |
| t | Tt | tt |

1 : 2 : 1 → Genotypic = 3 : 1

phenotype

Tall : dwarf

3 : 1

## Allele

Alternative form of gene

T t

The term of allele was coined by Bateson

## Homozygous

n sperm → F

n ovum → Zygote (2n)

Ex- TT

RR

tt

TT tt

t t

TT tt

(it)

## Hetero zygous

(Tt, Rr)

zygote (formed) by fusion of two different types of gametes

Genotype

TT Tt tt

1 : 2 : 1

## Hemizygous

One gene of a pair

↓

eg- SEX linked gene

ABLES KOTA

Have you ever wondered why an elephant always gives birth only to a baby elephant and not some other animal? Or why a mango seed forms only a mango plant and not any other plant?

Given that they do, are the offspring identical to their parents? Or do they show differences in some of their characteristics? Have you ever wondered why siblings sometimes look so similar to each other? Or sometimes even so different?

These and several related questions are dealt with, scientifically, in a branch of biology known as Genetics. This subject deals with the inheritance, as well as the variation of characters from parents to offspring. Inheritance is the process by which characters are passed on from parent to progeny; it is the basis of heredity. Variation is the degree by which progeny differ from their parents.

Humans knew from as early as 8000-1000 B.C. that one of the causes of variation was hidden in sexual reproduction. They exploited the variations that were naturally present in the wild populations of plants and animals to selectively breed and select for organisms that possessed desirable characters. For example, through artificial selection and domestication from ancestral

| Character | Dominant trait | Recessive trait |
|---|---|---|
| Seed shape |  Round |  Wrinkled |
| Seed colour |  Yellow |  Green |
| Flower colour |  Violet |  White |
| Pod shape |  Full |  Constricted |
| Pod colour |  Green |  Yellow |

wild cows, we have well-known Indian breeds, e.g., Sahiwal cows in Punjab. We must, however, recognise that though our ancestors knew about the inheritance of characters and variation, they had very little idea about the scientific basis of these phenomena.

## 5.1 Mendel's Laws of Inheritance

It was during the mid-nineteenth century that headway was made in the understanding of inheritance. Gregor Mendel, conducted hybridisation experiments on garden peas for seven years (1856-1863) and proposed the laws of inheritance in living organisms. During Mendel's investigations into inheritance patterns it was for the first time that statistical analysis and mathematical logic were applied

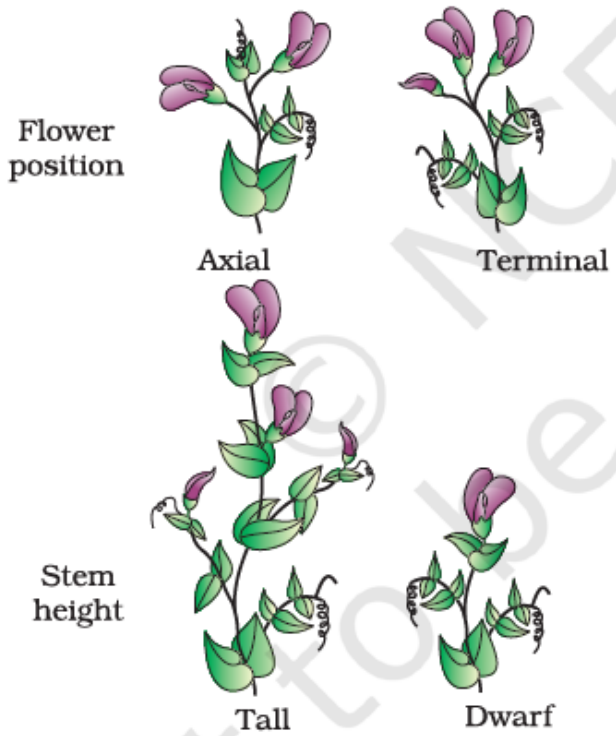



**Figure 5.1** Seven pairs of contrasting traits in pea plant studied by Mendel

to problems in biology. His experiments had a large sampling size, which gave greater credibility to the data that he collected. Also, the confirmation of his inferences from experiments on successive generations of his test plants, proved that his results pointed to general rules of inheritance rather than being unsubstantiated ideas. Mendel investigated characters in the garden pea plant that were manifested as two opposing traits, e.g., tall or dwarf plants, yellow or green seeds. This allowed him to set up a basic framework of rules governing inheritance, which was expanded on by later scientists to account for all the diverse natural observations and the complexity inherent in them.

Mendel conducted such artificial pollination/cross pollination experiments using several true-breeding pea lines. A true-

breeding line is one that, having undergone continuous self-pollination, shows the stable trait inheritance and expression for several generations. Mendel selected 14 true-breeding pea plant varieties, as pairs which were similar except for one character with contrasting traits. Some of the contrasting traits selected were smooth or wrinkled seeds, yellow or green seeds, inflated (full) or constricted green or yellow pods and tall or dwarf plants (Figure 5.1, Table 5.1).

**Table 5.1: Contrasting Traits Studied by Mendel in Pea**

| S.No. | Characters | Contrasting Traits |
|---|---|---|
| *1.* | *Stem height* | *Tall/dwarf* |
| *2.* | *Flower colour* | *Violet/white* |
| *3.* | *Flower position* | *Axial/terminal* |
| *4.* | *Pod shape* | *Inflated/constricted* |
| *5.* | *Pod colour* | *Green/yellow* |
| *6.* | *Seed shape* | *Round/wrinkled* |
| *7.* | *Seed colour* | *Yellow/green* |

## 5.2 Inheritance of One Gene

Let us take the example of one such hybridisation experiment carried out by Mendel where he crossed tall and dwarf pea plants to study the inheritance of one gene (Figure 5.2). He collected the seeds produced as a result of this cross and grew them to generate plants of the first hybrid generation. This generation is also called the **Filial$_1$ progeny** or the **F$_1$**. Mendel observed that all the F$_1$ progeny plants were tall, like one of its parents; none were dwarf (Figure 5.3). He made similar observations for the other pairs of traits – he found that the F$_1$ always resembled either one of the parents, and that the trait of the other parent was not seen in them.

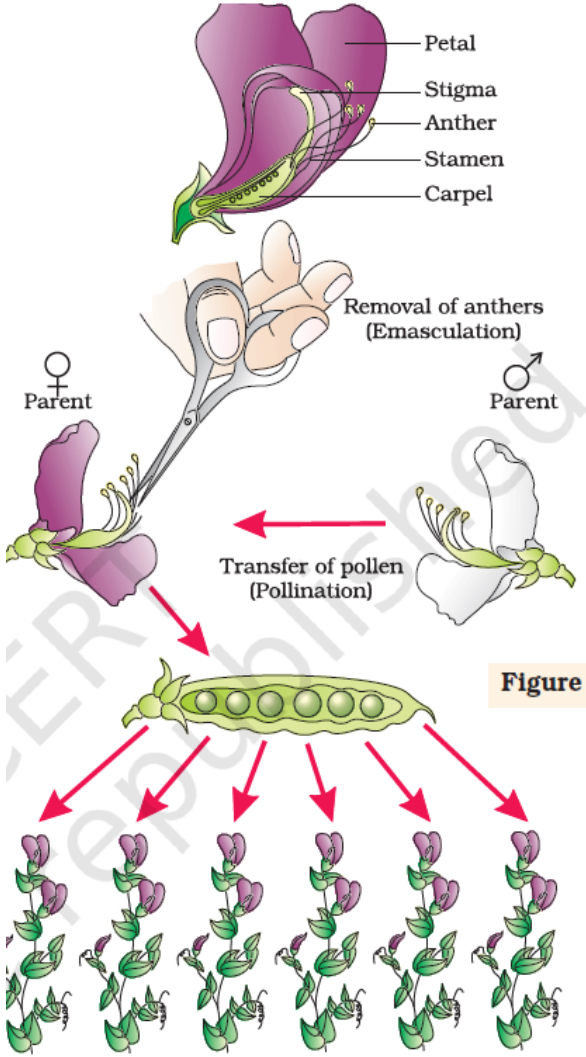



**Figure 5.2** Steps in making a cross in pea

Mendel then self-pollinated the tall $F_1$ plants and to his surprise found that in the Filial$_2$ generation some of the offspring were 'dwarf'; the character that was not seen in the $F_1$ generation was now expressed. The proportion of plants that were dwarf were $1/4^{th}$ of the $F_2$ plants while $3/4^{th}$ of the $F_2$ plants were tall. The tall and dwarf traits were identical to their parental type and did not show any blending, that is all the offspring were either tall or dwarf, none were of in-between height (Figure 5.3).

Similar results were obtained with the other traits that he studied: only one of the parental traits was expressed in the $F_1$ generation while at the $F_2$ stage both the traits were expressed in the proportion 3:1. The contrasting traits did not show any blending at either $F_1$ or $F_2$ stage.