

## BIO 202 : GENETICS AND EVOLUTION

### INTRODUCTION

Genetics is the study of hereditary and expression of such traits or heredity. Genetics is the branch of biology that deals with heredity and expression of inherited trait.

The first significant insight into the mechanism involve in inheritance of biological traits occur about 150 years ago. 1866, Gregor Mendel published the results of series of experiment that laid foundation for the formal discipline of genetics.

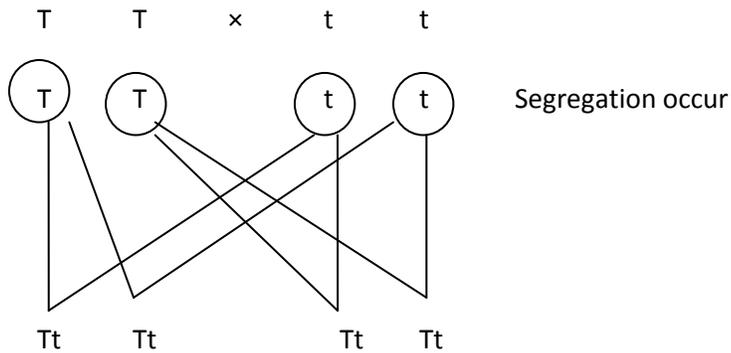
Mendel first reported result of some simple genetic crossing between certain strains of garden pea *Pisum sativum* in 1865. He shows remarkable insight into the methodology necessary for good experimental biology. He choose an organism that is easily grow and hybridized artificially .The pea plant is self fertilizing in nature but easily to cross breed experimentally. It reproduces well and grows to maturity in a single season .Mendel followed seven visible characteristics or features each represented by contrasting forms or traits like stem height, seed shape and colour, pod shape and colour of pod and flower arrangement.

The original parent constitutes the P1 or parental generation. Their offspring are the F1 or first filial generation and individual resulting from the selved F1 generation are the F2 or second filial generation. Mendel first hybridization experiment was to cross the so called true breeding short plants with true breeding tall plants. The result of this cross was that all the offspring in the first filial generation are tall resembling one parent. When the experiment was repeated for the other traits, all the first generation plant resembles only one of the parental type. In the colour of the pod, for example of a true breeding green plant with true breeding yellow podded plant produce first filial generation offspring that were all green podded.

When Mendel crossed the F1 generation plant with each other both parent types were represented in the F2 generation. This indicated that the factor determining yellowness was still present in the F1 plant but that their expression was somehow masked. From this result Mendel concluded that of the two contrasting alternative of certain traits such as height, one appear to be dominant over the other. This concept is known as dominant and recessiveness.

With regard to the height, tallest is dominant to shortest and with regard to pod colour green is dominant to yellow. By this experiment, we establish that there is indeed a pattern to the transmission of traits.

Monohybrid cross is the cross between two parent differing in a single pair of contrasting characters.



### MENDEL'S FIRST THREE POSTULATES/ LAWS

1. **UNIT FACTORS IN PAIRS:** Genetic characters are controlled by unit factors that exist in pairs in individual organisms.
2. **DOMINANT AND RECESSIVENESS:** When two unlike unit factors responsible for a single character are present in a single individual, one unit factor is dominant to the other which is said to be recessive.
3. **SEGREGATION:** During formation of gamete a pair of unit factor separates or segregates randomly so that each gamete receive one or the other with equal likelihood.

### MODERN GENETIC TERMINOLOGY

1. **PHENOTYPE:** Physical appearance of a trait. Traits such as tall or dwarf are visible expression of the information contained in unit factors.
2. **GENE:** Is the unit of inheritance. For any given character such as plant height. The phenotype is determinate by alternative form of a single gene called allele e.g. the unit factor representing tall and dwarf are allele determining the height of the pea plant.

3. **GENOTYPE:** this reflects the genetic makeup of the individual which is haploid or diploid. By reading the genotype we know the phenotype of individual. e. g. DD, Dd are tall and dd is dwarf. When both alleles are same as in DD then the individual is homozygous. On the other hand when the allele is different as in Dd the individual is heterozygous.
4. **PUNNETT SQUARE:** The genotype and phenotype resulting from the recombination of gamete during fertilization can be easily visualized by constructing a punnett square named after the person who first devised this approach Reginald C. Punnett.

#### **TEST CROSS:**

5. Mendel devised a simple method that is still useful in breeding plants and animals i.e. the test cross. The organism expresses the dominant phenotype but unknown genotype is crossed to a known homozygous recessive individual. For example if DD is test crossed to a dwarf plant which has dd genotype, all the offspring will be tall phenotypically and Dd genotypically. However if a tall plant heterozygous Dd is test cross to a dwarf (dd) then the offspring will be tall Dd and the other will be dwarf dd. Therefore a tall dwarf ratio demonstrates the heterozygous trait of the tall plant unknown genotype. The test cross reinforce the Mendel's conclusion that separate unit factors control traits.

#### 6. **DI HYBRID:**

Here, two characters are considered simultaneously. Such a cross involving two pairs of contrasting trait is a dihybrid cross or a two factor cross e.g. if pea plant having yellow seed that are round in shape are breed or crossed with those having green seeds that are wrinkle the result will be as follows F1 offspring would be yellow and round . This yellow is dominant to green and round is dominant to wrinkle. When F1 individuals are selved approximately 9/16 of the F2 express yellow and round, 3/16 express yellow and wrinkle, 3/16 express green and round and 1/16 express green and wrinkle. The ratio is constant for any dihybrid trait (9:3:3:1)

## PUNNETT SQUARE

	YR	Yr	yR	yr
YR	YYRR	YYRr	YyRR	YYRr
Yr	YYRr	YYrr	YyRr	Yyrr
yR	YyRR	YyRr	YyRR	yyRr
Yr	YyRr	Yyrr	yyRr	yyrr

Y-R ==YELLOW AND ROUND (9)

yy – R- =green and round (3)

Y- rr = yellow and wrinkle (3)

yy – rr = green and wrinkle (1)

## EVOLUTION

During the long voyage of Charles Darwin to Galapagos island in Pacific Ocean in 1832, many flora and fauna from different part of the world were gathered. He concluded that animals and plants have arisen by a process of slow and gradual change over successive generation. This been brought about by natural selection. For two decades after this voyage, Darwin consulted his data and filled in the details of his theory seeking support for his idea from geology, embryology and other branches of biology.

First, Darwin marshaled powerful evidence supporting the proposition that species have not remained unaltered through time but have changed. Much of the evidence was based on the geographical distribution of the animals and plants he has observed during his voyage.

Secondly, Darwin hypothesized that mechanism by which species have changed. He explained that individual of the species differ from each other in the degree to which they are suited to their environment.

The poorly adapted ones perish whereas the well adapted ones survive and pass on their beneficial characteristics or traits to their offspring. This is what is meant by natural selection i.e. nature select the fit and reject the unfit. The surviving individuals will produce offspring which will inherit the favourable

variation. This in turn will reproduce thus causing the frequency of this variation to increase in the population. Eventually, the characteristics that are initially rare or scarce when it appeared will become so common as to be a trait by which the population is identified e.g. Giraffe.

Eventually, the differences become so great that they are no longer able to mate with each other. They are considered separate species. Thus, species are form slowly and randomly.

#### **LINES OF EVIDENCE OF DARWIN EVOLUTION**

1. **Geology and paleontology:**
2. **Embryology:**
3. **Comparative Anatomy:**
4. **Cell Biology:**
5. **Distribution.**
6. **Molecular Evolution: DNA.**