

HEREDITY

Heredity: Tendency of the offsprings to resemble their parents is called Heredity

Variation: Tendency of the offsprings to differ from their parents is called Variation.

Genetics: The branch of biology which deals with the study of heredity and variation is called Genetics

Father of Genetics: Gregor Johann Mendel (An Austrian Monk)

TERMS USED IN GENETICS

Chromosome: thread like structures present in nucleus which carry genes, which carry genetic material from one generation to the next

Genes: units of heredity which are transferred from parents to offspring.

Genes exist in pairs. For a given characteristic, we have two genes , one received from father (paternal gene) and the other received from the mother (maternal gene)

Offspring: New individuals formed from the same parent are called offspring.

Inherited Traits : means characters received from parents.

Phenotype: The external , physical appearance of an organism(character) is called phenotype. Each character may be controlled by a pair of genes received from the parents.

Genotype: Genetic make up of an organism responsible for a given character is called Genotype. For each genotype there is an external expression, called phenotype. Each phenotype is controlled by a genotype.

Hybrid: If an organism carry two different kinds of genes for a particular character it is said to be Hybrid for that character.

Pure line breeding/ True breeding: If an organism carry same kind of gene for a particular character it is said be Pureline breeding / True breeding.

Symbols Used in Genetics: Genes are represented by suitable English alphabets.
P – represents parental generation, selected for experimental study.

F₁/ First Filial- represents the Offsprings of the first generation usually formed by crossing of the selected parents for the experimental study

Crossing: Means cross pollination/ hybridisation

F₂- Second Filial : represents the offsprings of the second generation usually formed by the selfing of the F1 individuals.

Selfing: means self pollination

Symbol of gene in a circle: represents gamete with gene

A circle with upward arrow : represents male gamete

A circle with plus sign below: represents female gamete

MonoHybrid Cross: If transfer of only one character is studied at a time , during a genetic experimental study , it is called Monohybrid cross.

Dihybrid cross: If transfer of two characters is studied at time during a genetic experimental study, it is called Dihybrid cross.

Phenotypic ratio: The ratio of phenotype among the offsprings obtained in a generation

Genotypic ratio: The ratio of genotype among the offsprings obtained in a generation

Dominant and Recessive gene: When two different kinds of genes for a given character come together in an offspring, only one character will be expressed, and the other gene will remain suppressed. The expressed gene is called Dominant gene. The suppressed gene is called recessive gene

Dominant gene is represented by the symbol of Capital letter.

Recessive Gene is represented by the symbol of small letter.

Homozygous : If both the genes of a pair are of the same kind it is said to be Homozygous.

Homozygous Dominant: If both the genes of a pair are dominant and same kind it is said to be Homozygous dominant

Homozygous Recessive: If both the genes of pair are recessive , it is said to be homozygous recessive.

Heterozygous : If both the genes of a pair are different (one dominant and the other recessive) it is said to be heterozygous

Punnet's Square: a method of representing genetic experimental study results using squares for genotype and phenotype of offspring and circles for male and female genes involved in the cross

Mendel's MONOHYBRID EXPERIMENT

Plant Selected: Garden Pea or *Pisum sativum*

Studied one character at a time.

Identified Seven different characters with contrasting features

Height of the plant	Tall (TT) x Dwarf(tt)
Flower color	Purple(PP) x White(pp)
Pod color	Yellow (YY) x Green (yy)
Pod shape	Inflated x constricted
Flower position	Axial x Terminal
Seed color	Yellow x Green
Seed Shape	Round (RR) X Wrinkled (rr)

Reason for selecting Garden Pea

1) Annual ,

- 2) Have variety of characters with contrasting features
- 3) Can be raised easily
- 4) Self pollinating

Reason for Mendel's Success:

- 1) Selected an annual plant – garden pea
- 2) Studied one character at a time
- 3) Recorded the observation mathematically and analyzed statistically

Emasculation: is the process of removing the anther of a bisexual flower in the bud stage to prevent the chance of self pollination during an experimental genetic study. Emasculated flowers are covered with polythene bags. After emasculation the flowers are pollinated by using pollen grains collected from the selected plant.

Steps followed by Mendel In Monohybrid Experiment

Selected true breeding varieties of parents with contrasting features in one Trait i.e Tall (TT) and Dwarf (tt).

Conducted the crossing of the selected parents.

Raised the F1 generation from the seeds collected and recorded the Phenotype

Conducted the selfing of the plants in F1 generation to raise F2.

Collected the seeds and grown to observe the phenotype of F2.

Observation : All the F1 generation plants were Tall and heterozygous dominant.

In F2 generation nearly 75% plants were tall and remaining 25%

Were dwarf, indicating a 3:1 phenotypic ratio. (Monohybrid Ratio). During crossing the two different genes T and t come together in one

offspring, but only one expressed. Mendel said that genes never blend and proposed the Law of Dominance and Law of Segregation.

Law of Dominance: states that when two different genes of a trait come together, one will be expressed and the other will be suppressed. The expressed gene is called Dominant gene and the suppressed gene is called Recessive gene.

Law of segregation/ Law of Purity of Gametes: states that genes (PATERAL AND MATERNAL GENES) always exist pair in an organism. At the time of gamete formation the two genes are separated and enter into the gametes. Therefore a gamete will carry only one gene for a particular character. Or a gamete is said to be pure for a character.

Inherited Traits: Traits that are transferred from one generation to the next through genes are called inherited traits.

Ear lobes character in humans: may be Free Ear lobe or Attached Ear lobe

Explain the Monohybrid cross between purple flowered plants and white flowered plants (P and p)

Mendel's Dihybrid cross Experiments

Studied the inheritance of two characters at a time

Characters studied: Shape of the seed, Color of the seed

Shape of the seed: Round (RR) and Wrinkled (rr)

Color of the seed: Yellow (YY) and Green (yy)

Plants with Round, green (RRyy) characters were crossed with Wrinkled, yellow plants (rrYY).

Observation: All F1 plants were found to be Round, Yellow character (RrYy)

F1 plants were self pollinated. Each plant can produce four types of gametes

With the following genetic make up, RY,Ry, rY,ry.

All the possible crossings were carried out.

F2 generation showed two new genetic combinations which were not seen in F1.

The parental characters which were not expressed in F1, reappeared in F2.

The phenotypic ratio was found 9 Round Yellow: 3 Round green: 3 Wrinkle yellow: 1 wrinkled green (Dihybrid phenotypic ratio, 9:3:3:1).

Conclusion: Genes never blend

Genes are segregated independent to each other during gamete formation.

Genes are combined or assorted independent to each other during zygote formation.

Because of segregation and assortment taking place independently, always there is chance for new combination leading to variations.

Observations led to the proposal of Law of Independent Assortment.

Law of Independent Assortment: states that when more than one characters are transmitted at a time, the genes are segregated and assorted independent of each other. The Law of Independent Assortment, also known as "Inheritance Law", states that separate genes for separate traits are passed independently of one another from parents to offspring.

SEX DETERMINATION IN MAN

Mechanism: XX female –XY male mechanism

Chromosomes: Chromosomes that carry genes that control somatic characters are called Autosomes.

Human beings have 46 (23 pairs) chromosomes. 22 pairs of chromosomes are autosomes. The remaining one pair of chromosome is called Sex chromosomes.

Therefore the genetic makeup of human female is 22 pair Autosomes + XX

Genetic make up of human male is 22 pair of autosomes + XY

At the time of gamete formation gene pairs are separated.

So the human sperm has X or Y chromosome (Human male is heterogametic)

Human egg/ ovum has only X chromosome.(Human female is homogametic)

If the egg(X) fertilizes with a sperm carrying X chromosome child will be a baby girl (XX)

If the egg(X) fertilizes with a sperm carrying Y chromosome child will be a baby boy(XY)

Home work

Explain sex determination in man

Name the mechanism that determine the sex of a human child

Human females are homogametic . Why?

Human males are heterogametic. Why?

What Will the sex of the child if it inherits X chromosome from the father.

What will be the sex of the child if it inherits Y chromosome from the father.

Which chromosome regarding sex do all humans inherits from mother.