

9. Heredity and Evolution

Heredity

- **Heredity**- transmission of characteristics or traits from parents to offspring's
- **Variations**- difference among individuals of a species and also, among offspring's of same parents
- Variations are of two types- heritable and non-heritable
- **Basis of heredity**- each trait is influenced by both maternal and paternal DNA

Mendel's work

- Proposed- heredity controlled by genes
- Performed experiments on garden peas (*Pisum sativum*)
- Used seven contrasting pairs of characters or traits
- **Dominant trait**- able to express itself over another contrasting trait
- **Recessive trait**- unable to express its effect in the presence of a dominant trait
- Mendel represented- dominant trait as upper case (e.g., T for tallness) and recessive trait as lower case (e.g., t for shortness)
- **Homozygous**- when the factors or genes of a trait are similar e.g., TT or tt
- **Heterozygous**- when the factors or genes of a trait are different e.g., Tt
- **Genotype**- genetic constitution of an organism e.g., pure tall- TT
- **Phenotype**- observable traits or characteristics of an organism e.g., tallness, shortness etc.
- **Genotypic ratio**- expected ratio of genotypes produced by a particular cross
- **Phenotypic ratio**- expected ratio of phenotypes produced by a particular cross
- **Monohybrid cross**- involves only one pair of contrasting characters
- **Phenotypic ratio in monohybrid cross is 3:1**
- **Dihybrid cross**- involves two pairs of contrasting characters
- **Phenotypic ratio in dihybrid cross is 9:3:3:1**

Stages of Mendel's experiment

- **Selection of parents**- true breeding with contrasting pairs of traits e.g., pure tall (TT) and pure dwarf (tt) pea plants were selected
- **Obtaining F₁ plants**- F₁ generation is the first filial generation, formed after crossing desirable parents e.g., crossing pure tall (TT) and dwarf (tt) plants gives heterozygous tall (Tt) F₁ plants
- **Self-pollination of F₁ plants**- involves crossing F₁ plants to obtain F₂ plants

Conclusions of Mendel's experiment

- Each characteristic in an organism is represented by two factors
- Two factors are - dominant and recessive
- Two contrasting factors when present in an individual do not blend
- When more than two factors are involved, they are independently inherited

Heredity at cellular level

- Inside the nucleus of a cell, heredity material in the form of DNA
- DNA associates with proteins to form chromosomes
- Every somatic (body) cell of the human body has 23 pairs (46) of chromosomes
- Autosomes- first 22 pairs of chromosomes that do not determine the sex of an individual
- Sex chromosomes- last pair of chromosomes, represented as X and Y
- Females have two X chromosomes, XX
- Males have one X and one Y chromosome, XY

Sex determination in humans

- Gametes receive half of the chromosomes
- Male gametes have 22 autosomes and either X or Y sex chromosome
- Male gametes can be of two types, 22+X or 22+Y
- Female gametes can be of only one type, 22+X
- Sex of a baby is determined by the type of the male gamete (X or Y) that fuses with the female gamete

Evolution

- Changes in inherited traits from one generation to the next in a species
- Variations leads to evolution
- Speciation- formation of new species

Causes of evolution

- **Natural selection**- a process that results in an increased survival and reproductive success of individuals that are well adjusted to the environment
- **Genetic drift**- accidental change in the frequency of genes in a small population
- **Acquired traits**- a trait that an individual experiences during his lifetime a) involves changes in non-reproductive tissues b) cannot be passed on to the progeny

- **Inherited traits-** distinguishing qualities or characteristics that one acquires from ancestors a) involves changes in DNA b) transmitted to progeny

Evolutionary relationships

- **Homologous organs-** similar in origin, but perform different functions e.g., forelimbs of humans and wings of birds
- **Analogous organs-** different origins, but perform similar functions e.g., wings of birds and bats
- **Fossils-** remains of organisms that once existed on the Earth
- **Paleontology-** science dealing with the study of fossils
- **Vestigial organs-** organs present in the reduced form, having no function eg wisdom teeth, nictitating membrane.
- Human beings (*Homo sapiens*)- evolved from primates in Africa

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