

Heredity

Heredity

- **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 his/her ancestors.
 - a) involves changes in DNA or reproductive tissues.
 - b) transmitted to progeny
- **Heredity**- transmission of characteristics or traits from parents to offsprings. • **Variations**- difference among individuals of a species and also among offsprings 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 is controlled by factors. Factors are now called genes. • Performed experiments on garden pea (*Pisum sativum*)
- Used seven contrasting pairs of characters or traits to study heredity. • **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 • **Dihybrid cross:** It is the cross between two parents that have two pairs of contrasting characters; for example, the cross between round yellow seed and wrinkled green seeds. • The phenotypic ratio obtained in dihybrid cross is 9:3:3:1.
- On the basis of observation of dihybrid cross, the law of independent assortment was proposed.

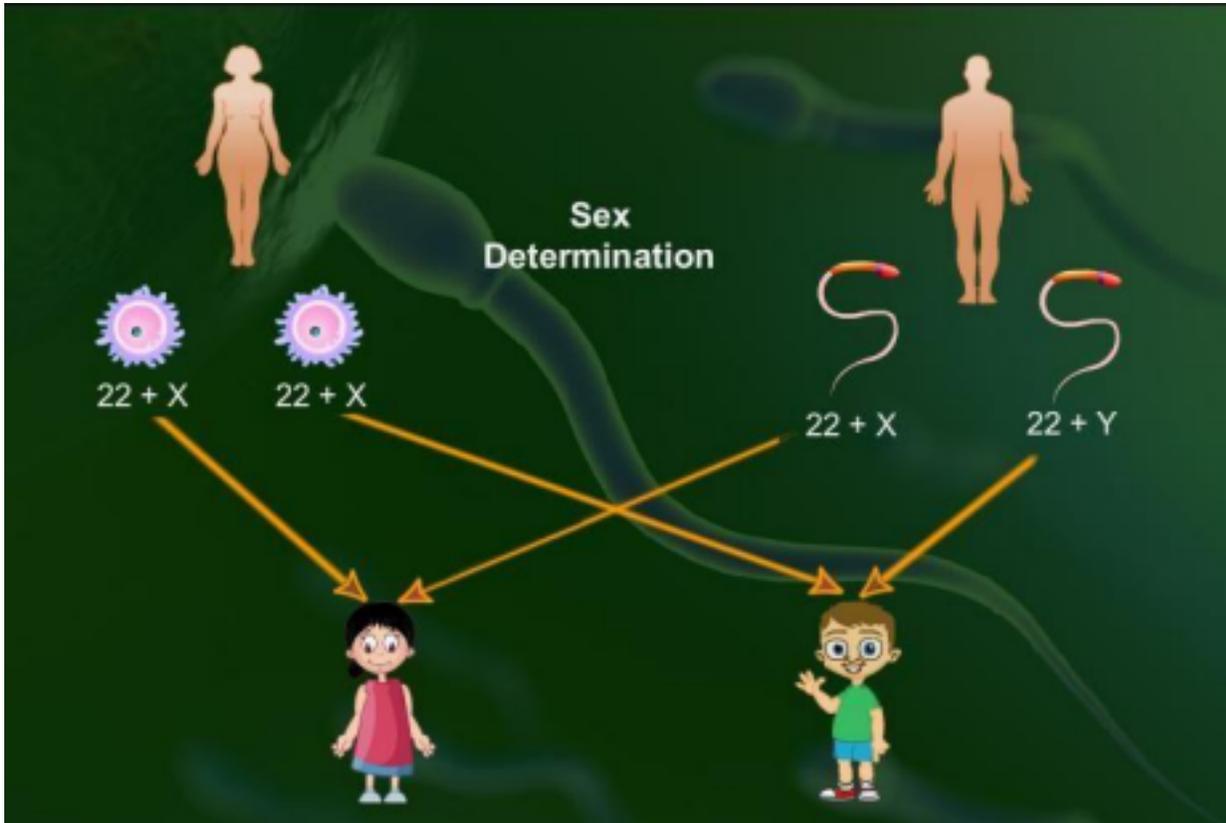
Principles of Mendel

- 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 occurs at cellular level
- Inside the nucleus of a cell, heredity material is present 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

- **Monohybrid cross:** It is a cross between two parents that have one pair of contrasting characters; for example, a cross between tall (TT or Tt) and dwarf (tt) plants. • The phenotypic ratio obtained in monohybrid cross is 3:1 while genotypic ratio is 1:2:1. • Based on observations on monohybrid crosses, two laws were proposed – 1. **First law or law of dominance:** It states that only one parental trait gets expressed in the F₁ generation while both the traits get expressed in the F₂ generation.
- 2. **Law of segregation:** It states that two alleles segregate from each other when characters are transferred from parents to offspring during reproduction.
- **Dihybrid cross:** It is the cross between two parents that have two pairs of contrasting characters; for example, the cross between round yellow seed and wrinkled green seeds. • The phenotypic ratio obtained in dihybrid cross is 9:3:3:1.
- On the basis of observation of dihybrid cross, the law of independent assortment was proposed.
- **Law of independent assortment:** It states that the members of different pairs of alleles assort independently into gametes.
- **Incomplete dominance**
- It is the phenomenon where one allele is incompletely dominant over the other member of the allelic pair.
- Both phenotypic and genotypic ratios are the same in the case of incomplete dominance, i.e., 1:2:1.
- **Co-dominance**
- It is the phenomenon where both the alleles of a gene are equally dominant and get expressed together in heterozygous condition; for example, ABO blood group in humans. • Blood group ABO is an example of multiple alleles.

Sex determination in humans

- 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,so can be represented as 44+XX. • Males have one X and one Y chromosome, so can be represented as 44+XY.



- Each gamete receives half of the chromosomes i.e. 22+X or 22+Y.
- 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.