

Introduction to Genetics

Introduction to Genetics – Study Notes

1. What Is Genetics?

- **Definition:** The branch of biology that studies how traits are inherited from one generation to the next.
 - **Key Question:** How do organisms pass on characteristics such as eye color, blood type, or disease susceptibility?
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2. Historical Milestones

Year	Scientist	Contribution
1859	Charles Darwin	Theory of natural selection (variation & inheritance)
1865	Gregor Mendel	Laws of inheritance from pea?plant experiments
1902	Walter Sutton & Theodor Boveri	Chromosome theory of inheritance
1953	James Watson & Francis Crick	DNA double?helix structure
1970s	Frederick Sanger	DNA sequencing methods
1980s? 1990s	Human Genome Project	Mapping the entire human genome

3. Basic Terminology

Term	Meaning
Gene	Segment of DNA that codes for a functional product (protein or RNA)
Allele	Alternative form of a gene (e.g., A vs. a)
Locus	Physical location of a gene on a chromosome
Genotype	Genetic makeup of an individual (e.g., AA, Aa, aa)
Phenotype	Observable traits resulting from genotype + environment
Dominant	Allele that masks the effect of a recessive allele in heterozygotes

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Term	Meaning
Recessive	Allele whose effect is seen only when two copies are present
Homozygous	Same alleles at a locus (AA or aa)
Heterozygous	Different alleles at a locus (Aa)
Polygenic	Trait controlled by many genes (e.g., height)
Epistasis	Interaction where one gene masks the effect of another

4. Mendelian Inheritance

1. **Law of Segregation** – Each individual carries two alleles per gene; they separate during gamete formation.
2. **Law of Independent Assortment** – Genes for different traits assort independently when located on different chromosomes.
3. **Punnett Squares** – Diagrammatic tool to predict genotype and phenotype ratios in offspring.

Typical Monohybrid Cross (single trait)

Parental Genotypes	Gametes	F1 Generation	F2 Generation Ratio (Genotype)
AA × aa	A, a	All Aa (heterozygous) (uniform phenotype)	1 AA : 2 Aa : 1 aa 3 dominant : 1 recessive

Dihybrid Cross (two traits) – 9:3:3:1 phenotypic ratio when genes assort independently.

5. Chromosomal Basis of Inheritance

- **Chromosomes:** Linear DNA molecules packaged with proteins; humans have 23 pairs (46 total).
- **Meiosis:** Specialized cell division that reduces chromosome number by half, creating haploid gametes.
 - **Key stages:** Prophase I (crossing over), Metaphase I (homologous pairing), Anaphase I (segregation), followed by a second division.
- **Crossing over:** Exchange of genetic material between homologous chromosomes ? new allele combinations.

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6. Non-Mendelian Patterns

Pattern	Description	Example		
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