INTRODUCTION TO GENETICS

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Introduction

- **Genetics:** is the science of heredity, its the study of the structure and function of genes.
- **Genetics** is branch of sciences that concerned primarily with understanding biological properties that are transmitted from parent to offspring.
- **Genetics** is central to biology because gene activity underlies all life processes, from cell structure and function to reproduction.
- **Genetics** is centered on the study of genes.

- The subject matter of genetics includes **heredity**, the molecular nature of the genetic material, the ways in which genes (which determine the characteristics of organisms) control life functions, and the distribution and behavior of genes in populations.

Terminology

- **Gene**: is the biological unit of hereditary.
- **Gene** hold the information to build and maintain their cells and passing genetics traits to offspring
- In cells, gene is portion of DNA
- **Gene** is a segment of DNA that produces a functional product. The functional product of most genes is a polypeptide.

Terminology

- **ALLELE:** is one members of pair or series different form of gene
- **Homozygous**: an organism in which to copies of genes are identical (have same **alleles**).
- **Heterozygous**: an organism in which has different **alleles** of genes.
- **Traits:** which are the characteristics of an organism.

In humans, for example, we speak of traits such as eye color, hair texture, and height.

- **Chromatin**: DNA,RNA & protein that make up the chromosome.
- **Chromatide:** one of the two identical pairs of the chromosome.
- **Nucleotides**: is group molecules that when linked together, form the building blocks of DNA and RNA.
- **Genetic variation: t**his term describes the differences in inherited traits among individuals

- Variations within the sequences of genes are a common source of genetic variation among members of the same species. In humans, familiar examples of variation involve genes for eye color, hair texture, and skin pigmentation. Chromosome variation—a change in chromosome structure or number (or both)—is also found, but this type of change is often detrimental. Many human genetic disorders are the result of chromosomal alterations. The most common example is Down syndrome, which is due to the presence of an extra chromosome.

- **Genetic code:**

Is the sequence of nucleotides in a DNA or RNA molecules that determines the amino acid sequence in the synthesis of proteins.

Congenital disease: disease which present at birth.

Hereditary/Familial disease: disease derived from one parents and transmitted to gametes through the generation.

- The characteristics of an individual are called **Traits**
- Some traits are heritable they are transmitted from generation to generation while others are not heritable.
- **Genotype:** is the genetic constitution of an organism.
- **Phenotype:** is an observable trait or set of traits (structural and functional) of an organism produced by the interaction between its genotype and the environment. phenotype may be visible .

- DNA's ability to store information is based on its structure. DNA is composed of a linear sequence of **nucleotides.**
- Each nucleotide contains one of four nitrogen-containing bases: Adenine (A), Thymine (T), Guanine (G), or Cytosine (C). The linear order of these bases along a DNA molecule contains information similar to the way that groups of letters of the alphabet represent words(A,T,G,C).
- In living cells, the DNA is found within large structures known as **chromosomes.**

- To synthesize its proteins, a cell must be able to access the **information** that is **stored within** its **DNA**. The process of using a gene sequence to affect the characteristics of cells and organisms is referred to as **gene expression.**
- Gene → Transcription (messenger RNA)

Translation (sequence of amino acids)

Functioning of proteins within living cells

- Humans recognized long ago that offspring tend to resemble their parents.
- the principles of heredity were not understood until the mid-nineteenth century, when **Gregor Mendel** analyzed quantitatively the results of crossing pea plants that varied in easily observable characteristics.

- Several years after his death, however, researchers realized that Mendel had discovered fundamental principles of heredity. We now **consider Mendel's** work to be the foundation of modern genetics.
- genetics has been an increasingly powerful tool for studying biological processes.

- An important approach used by many geneticists is to work with mutants of a cell or an organism affecting a particular biological process: by characterizing the differences between the mutants with normal cells or organisms, they develop an understanding of the process. Such research has gone in many directions, such as:

The Sub-disciplines of Genetics

- Geneticists often divide genetics into four major sub-disciplines:
- 1. **Transmission genetics** (sometimes called classical genetics) is the **dealing with how genes and genetic traits are transmitted from generation to generation and how genes recombine** (exchange between chromosomes). Analyzing the pattern of trait transmission in a human pedigree or in crosses of experimental organisms is an example of a transmission genetics study.

2. **Molecular genetics**

Is dealing with the molecular structure and function of genes.

Molecular geneticists often study mutant genes that have abnormal function. This is called a **genetic approach** to the study of a research question.

Analyzing the molecular events involved in the gene control of cell division.

3. **Population genetics :**

- is the subdiscipline that studies heredity in groups of individuals for traits that are determined by one or only a few genes.
- **Population Genetics is Concerned with Genetic Variation and Its Role in Evolution**
- Analyzing the frequency of a disease causing gene in the human population is an example of a population genetics study.