Lecture 1
Introduction to Genetics

What is Genetics

- Genetics is the study of **heredity**
- **Hereditary** is the transmission of characteristics from one generation to the next…

Genetics branches:

- Medical genetics refers to the application of genetics to medical care.
- Cytogenetics:
- Molecular genetics:
- Microbial genetics:
- Plant genetics
- Animal genetics
- Genomics
- Proteomics

The Cell

- The cell is the basic unit of organization of Life.
- All living organisms are composed of **one** or **more** cells

Components of the cell:

1. **Cell membrane:**

- Composed of lipid bilayer
- **Protects** the interior of the cell but remains selectively permeable
- Has embedded proteins that serve different functions

2.Cytoplasm

Cytoplasm is substance of a cell other than that nucleus. It`s environment of cellular activities, it`s made up of:

- Cytosol: Homogenous& Semi fluid which is include Cytoskeleton, organic and inorganic materials (water, salts… etc)
- Organelles
  - **Ribosomes**: Ribosomes are the site of protein synthesis
  - **Endoplasmic reticulum:** (rough and smooth)
  - **Mitochondria**: Involved in energy production
  - **Golgi apparatus:** Responsible for the secretion of cellular products.
  - **Lysosomes**: involved in the degradation and disposal of cellular waste material.

3.Nucleus:

- Containing the **hereditary material** in the form of **chromosomes**

- **Nuclear envelope**: Separates the nucleus from the cytoplasm but still allows communication through nuclear **pores**
- **Nucleolus**: Darkly staining area in the nucleus.

Components of the cell:

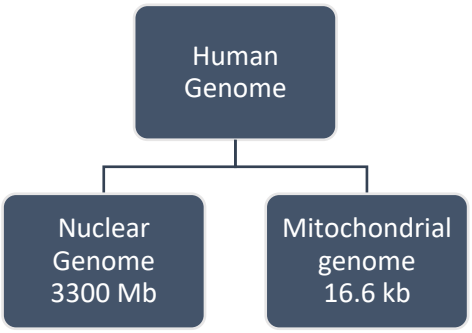
1. Nucleolus
2. Nucleus
3. Ribosome
4. Vesicle
5. Rough endoplasmic reticulum
6. Golgi apparatus
7. Cytoskeleton
8. Smooth endoplasmic reticulum
9. Mitochondrion
10. Vacuole
11. Cytosol
12. Lysosome
13. Centriole
14. Cell membrane

Genome

- A **genome** is all the genetic information of an individual.
- Each cell in the body contains the complete genome.
- **Human genome:**
  - Consists of approximately three billion DNA base pairs
  - Organized IN 23 PAIRS OF CHROMOSMES:
    - 22 autosomes pairs
    - One sex chromosomes pair

Human genome

- Nuclear genome:
  - 23 pair of chromosomes
- Mitochondrial genome
  - Single circular double-stranded DNA



Proteins:

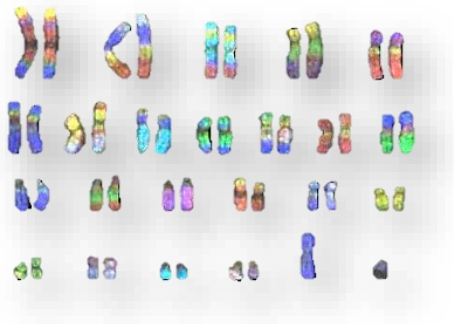
- Proteins are large biological molecules consisting of one or more polypeptides.
- A polypeptide is a single linear polymer chain of amino acids bonded together by peptide bonds.
- Proteins differ from one another primarily in their sequence of amino acids, which is dictated by the nucleotide sequence of their genes

DNA

- **D**eoxyribo **N**ucleic **A**cid
- The genetic information is stored in DNA
- DNA is a long linear **polymer** made of simpler units called **nucleotides**.

Chromosomes

- DNA is **packaged** in the cells in the form of chromosomes.
- Each chromosome is Made of a **single** DNA double helix molecule and associated proteins.
- The packaging of DNA into chromosomes involves several orders of DNA coiling and folding. This allows the very long DNA molecules to fit into the cell nucleus.
- Human somatic cells has 23 chromosome pairs per cell
- 22 pair of autosomes
- 2 sex chromosomes
- In males XY
- In females XX



GENE:

- The basic unit of inheritance.
- A section of DNA that occupies a specific location on a chromosome and codes for a protein product.
- Each gene codes for one protein.

Allele

- **Allele**: Different versions of the same gene are called alleles.
- A gene may have many possible alleles, but any one person will have only **two alleles** for each gene (one from each parent).
- **Homozygous**: When an individual's two alleles for a gene are the same, he or she is said to be homozygous for that gene.
- **Heterozygous** : When an individual's two alleles for a gene are different, he or she is said to be heterozygous for that gene.

Central Dogma of Genetics

- **DNA→ RNA→ Proteins**

Traits:

- **In genetics, a feature of a living thing is called a "trait".**
  - **Examples**
    - **person's eye-color, height or weight.**
    - **Blood group**

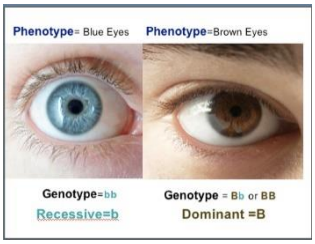
Genotype

- Genotype is the genetic make-up of an individual organism.
- All of the alleles found in an individual

Phenotype

Phenotype is the observable physical or biochemical characteristics of an individual organism.

Example



- Gene for eye color has two alleles:
  - B = brown eyes
  - b = blue eyes
- Each individual has two alleles from two parents

Genetic Terms:

Use library resources to define the following words and write their definitions using your own words.

- **allele:**
- **genes:**
- **dominant :**
- **recessive:**
- **homozygous:**
- **heterozygous:**
- **genotype:**
- **phenotype:**
- **Mendelian Inheritance:**

Mendelian Inheritance:

1. The inherited traits are determined by genes that are passed from parents to children.
2. A child inherits two sets of genes—one from each parent.
3. A trait may not be observable, but its gene can be passed to the next generation.
4. Each person has 2 copies of every gene—one copy from mom and a second copy from dad. These copies may come in different variations, known as **alleles**, that express different traits.
   - For example, 2 alleles in the gene for freckles are inherited from mom and dad:
   - allele from mom = has **freckles** (F)
   - allele from dad = no freckles (f)
   - child has the inherited gene pair of alleles, **Ff** **(**F allele from mom and f allele from dad).