Introduction to Genetics

Genetics BIO-310

Lecture .1

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Objectives:

By the end of this chapter you should be able to:

- Understand the concept of genetics in brief
- History of genetics
- Define chromosomes and genes
- To figure ou the different branches of genetics

What Is Genetics?

- Genetics is the field of science that examines how traits are passed from one generation to the next; Blueprint of life.
- Genetics is centered on the study of genes.

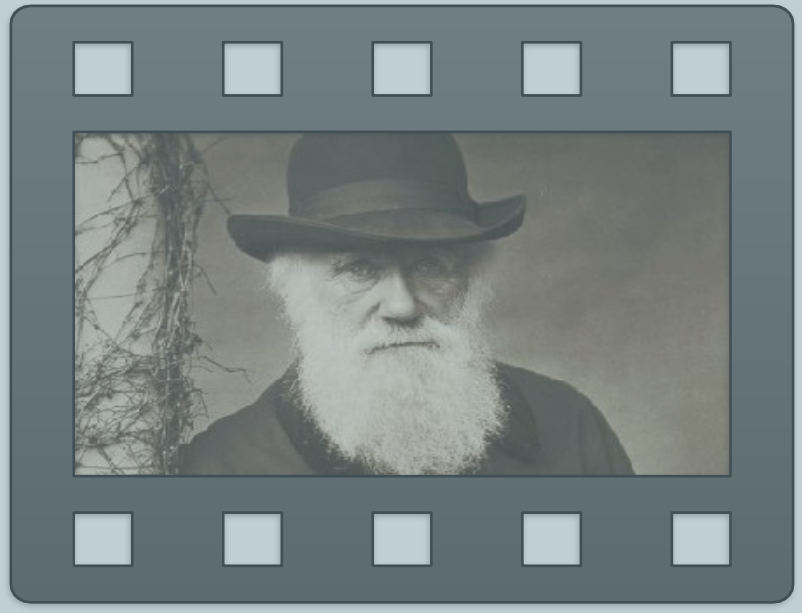
Why Genetic study?

- Technically it's a requirement of Biology degree!!! Why?!
- Genetics has became the backbone of all biomedical fields.
  - Molecular Biology.
  - Neurosciences
  - Pharmaceutical
  - Medicine
  - Cellular and developmental Biology.

- Who we are (although debatable)!
- Why we are doing, what we are doing!
- Social changes and policies will be reveled by genetics!
- How life sciences impacts on social change.

History of Genetics

ARISTOTLE



1859

Charles Darwin

- Idea of natural evolution
- Pangenesis Theory

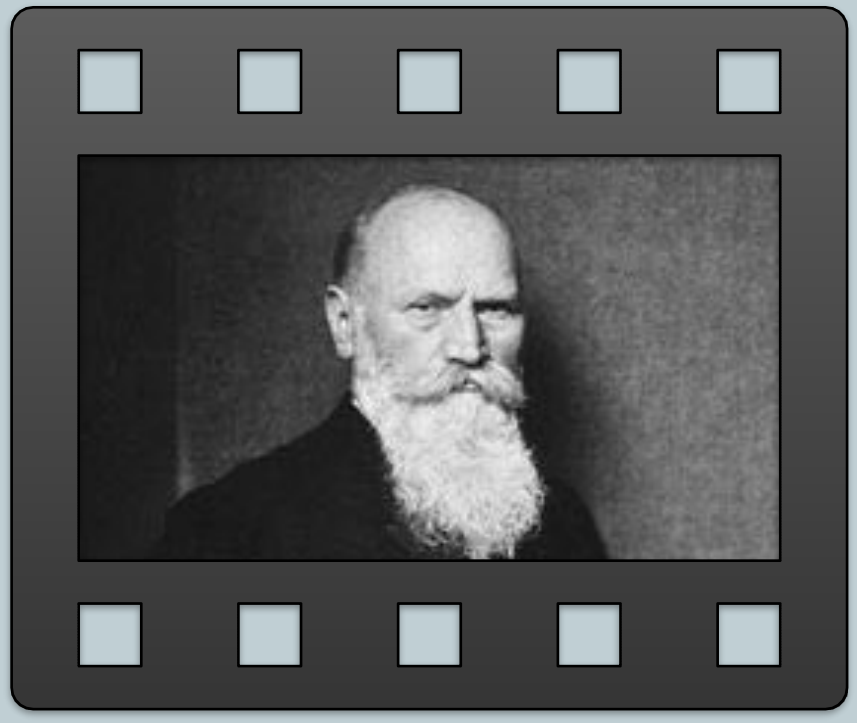
Timeline of Genetics

1865

Gregor Mendel and Laws of Inheritance

- Father of modern Genetics
- He used Pisum Sativum (Garden Pea) in his study.
- There are 7 characteristics of pea in his study
- LAW: Mendelian Laws of Inheritance (Law of Segregation and Independent Assortment)

Timeline of Genetics



1888

Heinrich Wilhelm Gottfried Waldeyer discovered the chromosome

1909

Wilhelm Johannsen- The term **gene** was introduced

Timeline of Genetics

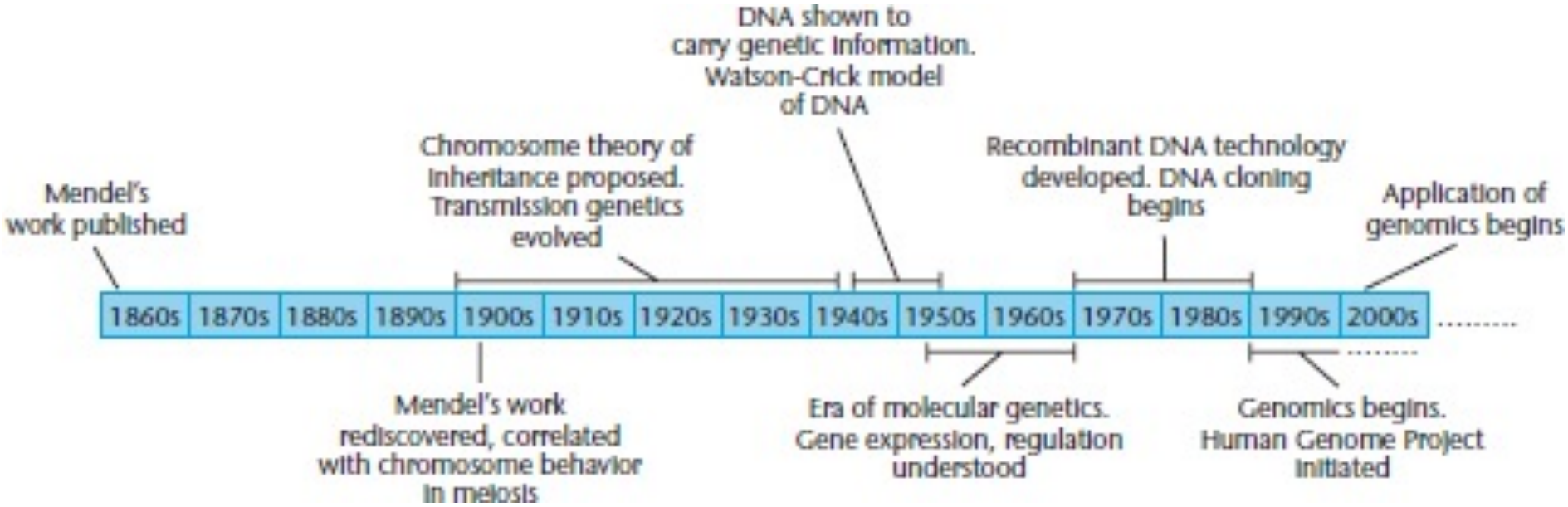
1927

Herman Muller - radiation causes defects in chromosomes

1944

Oswald Avery, Colin MacLeod and Maclyn McCarty proved that the DNA carries the genetic information

Timeline of Modern genetics



timeline showing the development of genetics from Gregor Mendel's work on pea plants to the current era of genomics and its many applications in research, medicine, andsociety.

Adapted from Concepts of Genetics, Klug, Cummings, Spencer, Palladino, 2012

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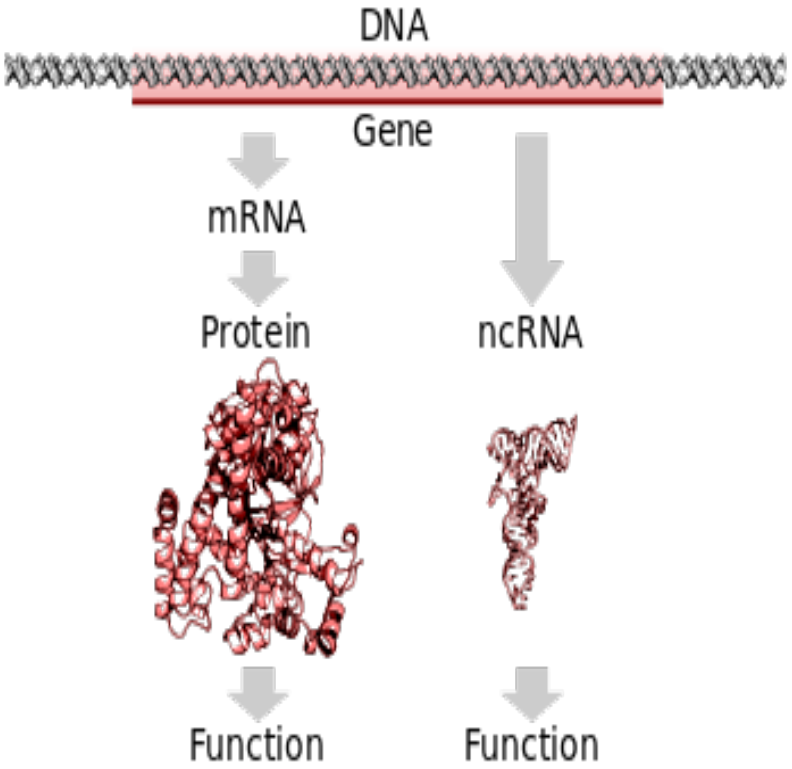
Gene

- A gene is classically defined as a unit of heredity. At the molecular level, a **gene** is a segment of DNA that produces a functional product.

- An organism's **genes**, snippets of DNA that are the fundamental units of heredity, control how it looks, behaves, and reproduces.

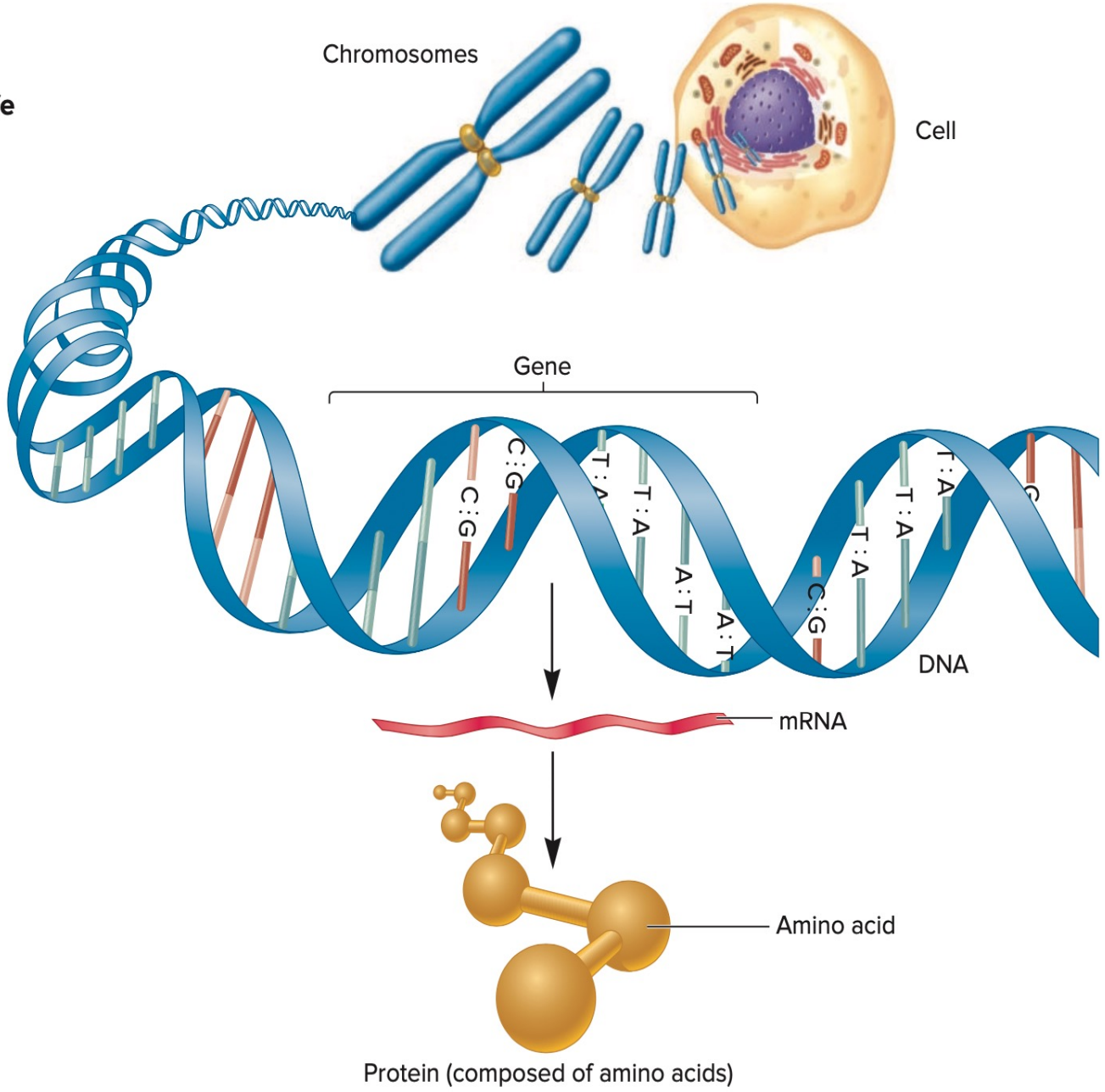


DNA, the molecule of life

The adult human body is composed of trillions of cells.

Most human cells contain the following:

- 46 human chromosomes, found in 23 pairs
- 2 meters of DNA
- Approximately 22,000 genes coding for proteins that perform most life functions
- Approximately 3 billion DNA base pairs per set of chromosomes, containing the bases A, T, G, and C



The major subdivision Genetics

➢ CLASSICAL GENETICS

- Study of analysis of offspring to mating (parents to offspring).
- Describes how traits (physical characteristics) are passed along from one generation to another.

➢ POPULATION GENETICS

- Deals with the transmission of trait with a large group of individual through a passage of time.
- Takes Mendelian genetics (that is, the genetics of individual families) and ramps it up to look at the genetic makeup of larger groups.

The major subdivision Genetics

➢ Quantitative genetics

- A highly mathematical field that examines the statistical relationships between genes and the traits they encode

➢ BEHAVIORAL GENETICS

- Study of behavior of an organism.

The major subdivision Genetics

- **CYTOGENETICS**

Science that deals with the physical basic of heredity (cell)

- **MOLECULARGENETICS**

Chemical basis of heredity

Newest and most advanced field of Genetics

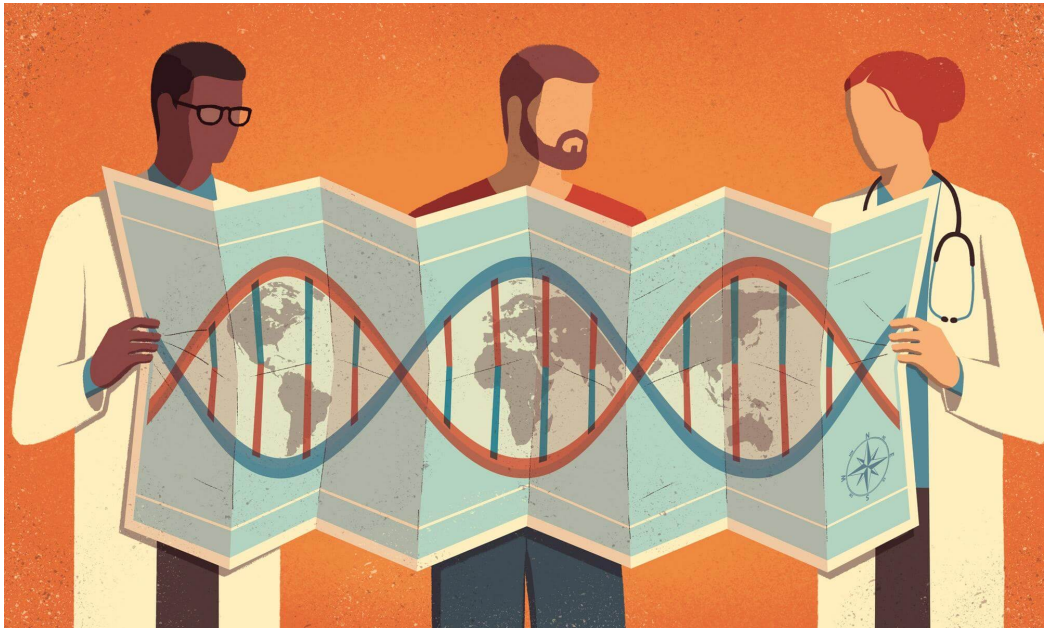
- Genomics
- Proteomics

Methods of Genetic studies

1. Planned Experimental Breeding

2. Pedigree Analysis

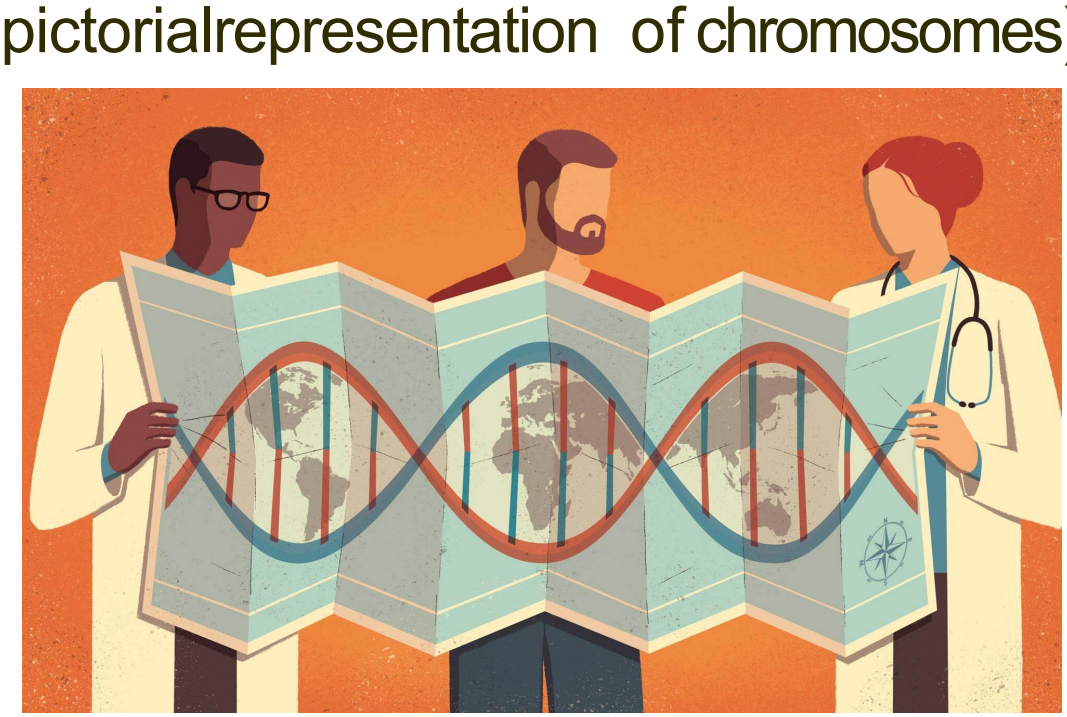
- Transmission of trait through the use of pedigree.
- Pictorial representation



Methods of Genetic studies

3. . Karyotyping

- Detect chromosomalabnormality
- karyogram/ karyotype (pictorialrepresentation of chromosomes)



4. TwinStudy

- Study oftwins

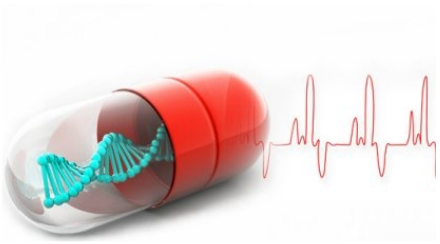
5. StatisticalAnalysis

- Make use ofseveral data
- Use for populationdata

Genetics Applications

- Genetics and agriculture
- Genetics and legality

- Genetics and eugenics
- Genetics and medical science
- Genetics in removing false concepts about heredity



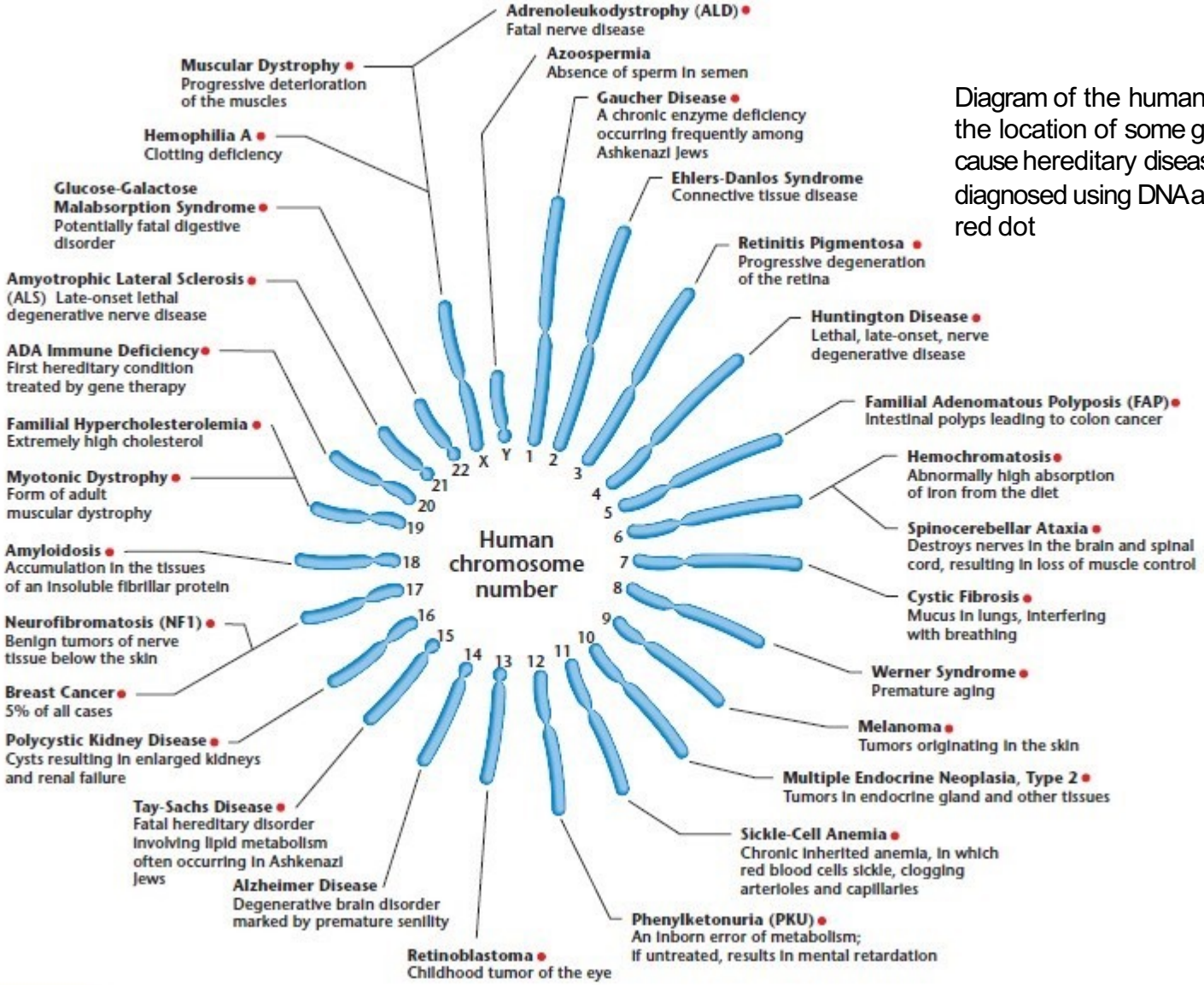


Diagram of the human chromosome set, showing the location of some genes whose mutant forms cause hereditary diseases. Conditions that can be diagnosed using DNA analysis are indicated by a red dot

Adapted from Concepts of Genetics, Klug, Cummings, Spencer, Palladino, 2012

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Some Genetic Terms

- Trait – Any feature or quantifiable measurement of an organism
- Gene – Functional unit of heredity (we will usually mean a segment of DNA)
- Alleles – are various molecular forms of a gene encoding for the same trait (i.e. flower color)
- Locus – Site on a chromosome where a gene is located

Some Genetic Terms

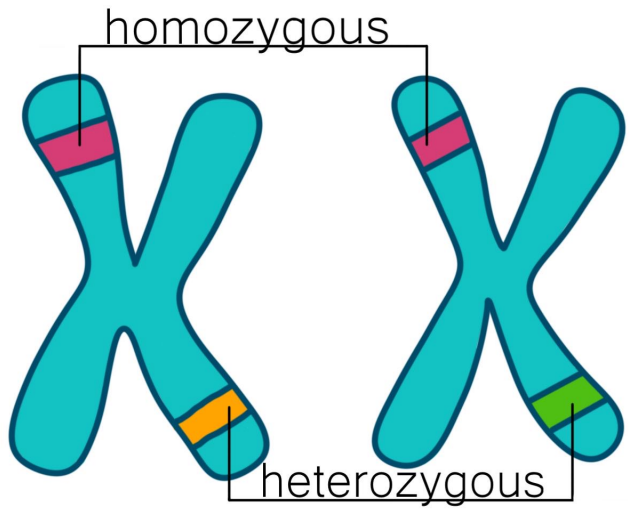
- **Genotype**: the states of the two alleles at one or more locus associated with a trait

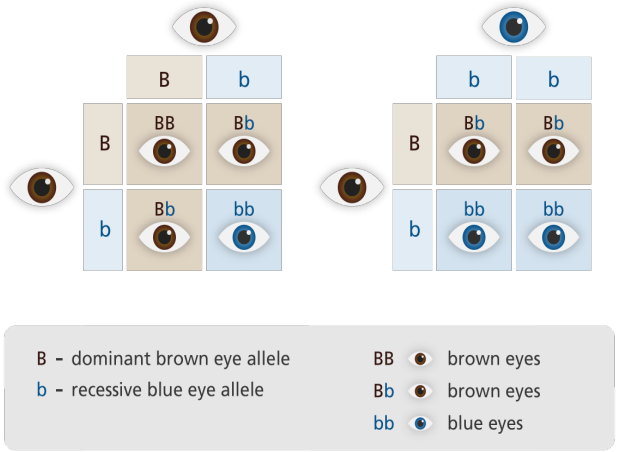
- **Phenotype**: the state of the observable trait

Genotype	Phenotype
BB (homozygous)	Brown eyes
Bb (heterozygous)	Brown eyes
bb (homozygous)	Blue eyes

Some Genetic Terms

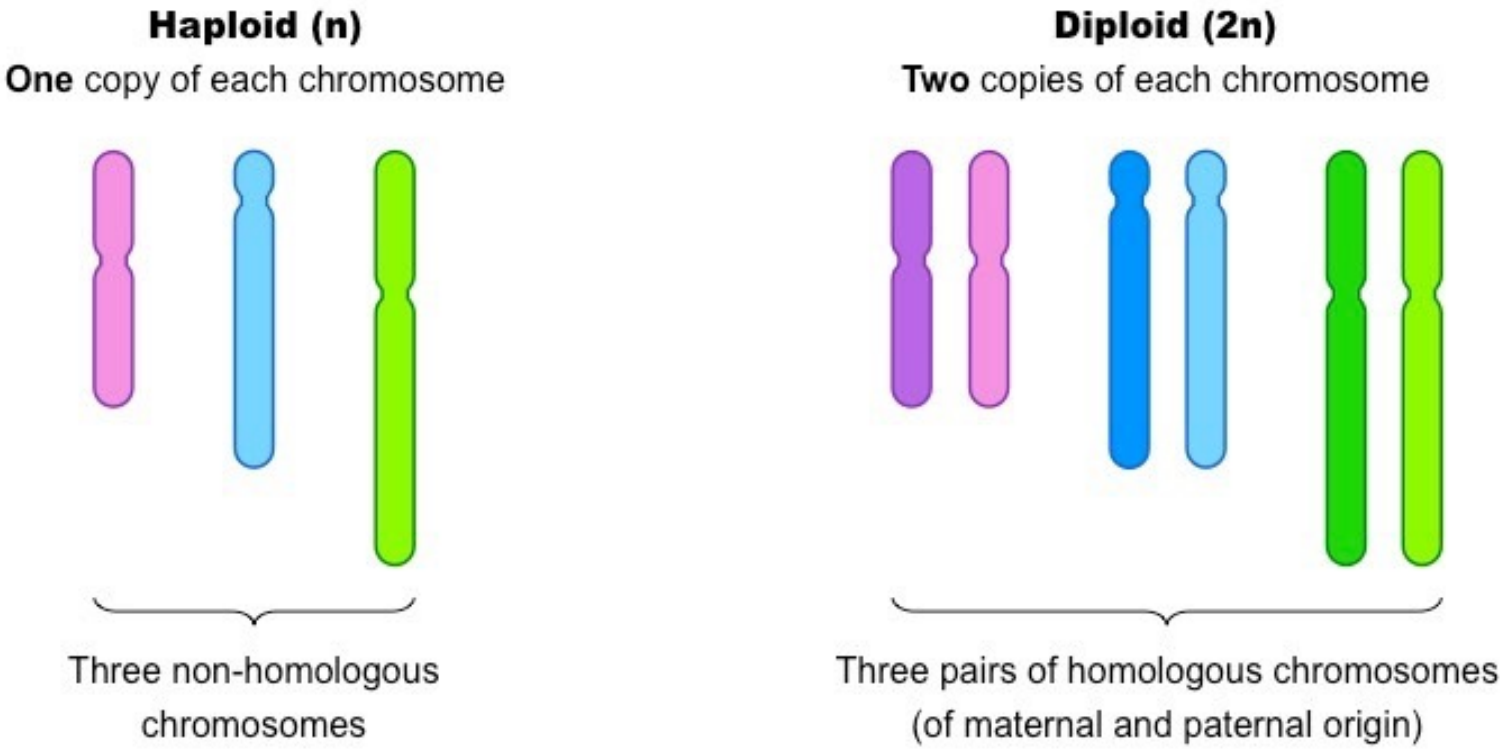
- Homozygous – Having two of the same allele
- Heterozygous – Having two different alleles
- Dominant – allele that expresses phenotype in heterozygous state
- Recessive – allele whose phenotype is not visible in a heterozygote





Some Genetic Terms

- **Haploid**: containing one copy of each chromosome (n=23).
- **Diploid**: containing two copies of each chromosome (2n=46)



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