Introduction to genetics

Human Biology Lab / 4ᵗʰ Lab

1ˢᵗ Grade / Fall Semester

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Instructor: Adam Jalal Mohammed

Email: adam.jalal@tiu.edu.iq

A brief description of genetics

- Genetics is the study of genes, genetic variation, and heredity in living organisms.
- Genes are the basic physical and functional unit of heredity. Genes, which are made up of DNA, act as instructions to make molecules called proteins.

- **HEREDITY:** transmission of traits from parent to offspring.

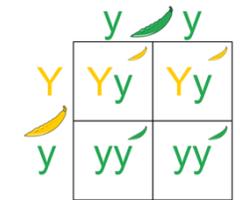- **VARIATION:** similarities and differences
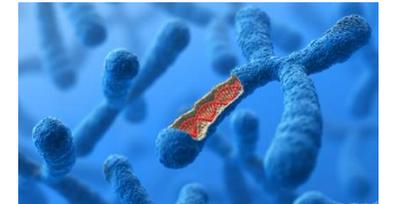
Levels of Genetic Analysis

1. Classical genetics:

In classical genetic analysis, genes are studied by following the inheritance of traits in crosses between different strains of an organism.

2. Molecular genetics:

In molecular genetic analysis, genes are studied by isolating, sequencing, and manipulating DNA and by examining the products of gene expression.

3. Population genetics:

In population genetic analysis, genes are studied by assessing the variability among individuals in a group of organisms.

Applications of Genetics

- Medicine

- Agriculture

- Society

Genetic Information:

- **DNA** - is a nucleic acid that contains the genetic instructions specifying the biological development of all cellular forms of life.

- **Gene** – basic unit of genetic information. Genes determine the inherited characters.

- **Genome** – the collection of genetic information.

- **Chromosomes** – storage units of genes. Chromosomes vary in size; have different numbers of genes.
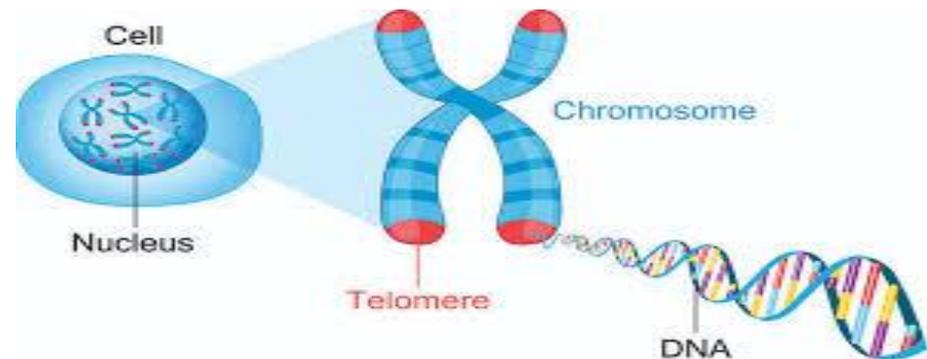
- **Alleles**: are forms of the same gene with small differences in their sequence of DNA bases. These small differences contribute to each person's unique physical features.

- **Chromatid**: Generally refers to a strand of a replicated chromosome;
- consists of DNA and protein.

P- arm

Centromere

q- arm

Same Allele

Centromere

Sister Chromatids

I≡ PEDIAA
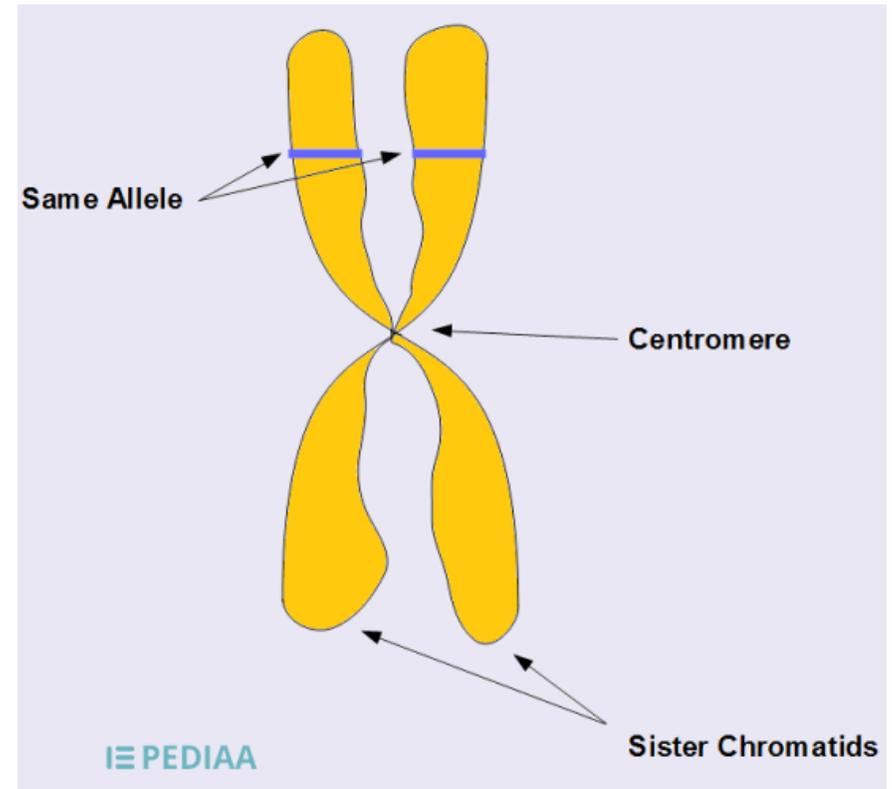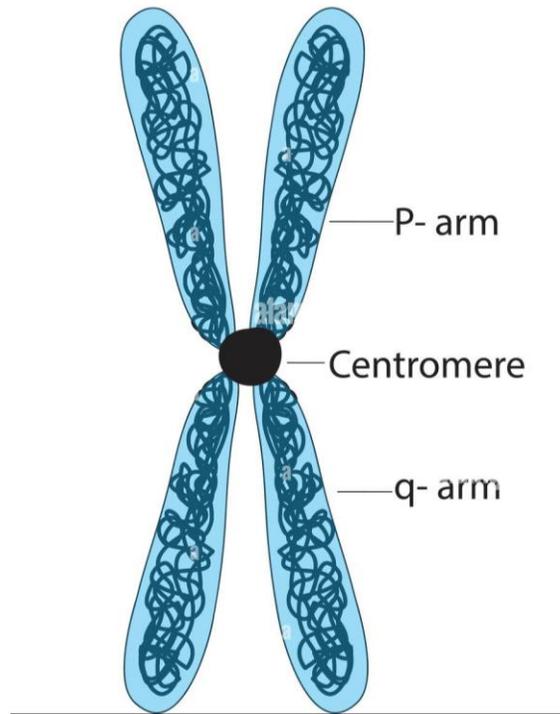
- **Heterozygote:** An individual organism possessing two different alleles at a locus .

- **Homozygote:** An individual organism possessing two of the same alleles at a locus .

- **Autosome:** Except for sex chromosomes, other chromosomes are called autosomes.

- **Crossing over:** It is the exchange of segments between chromatids of a chromosome.
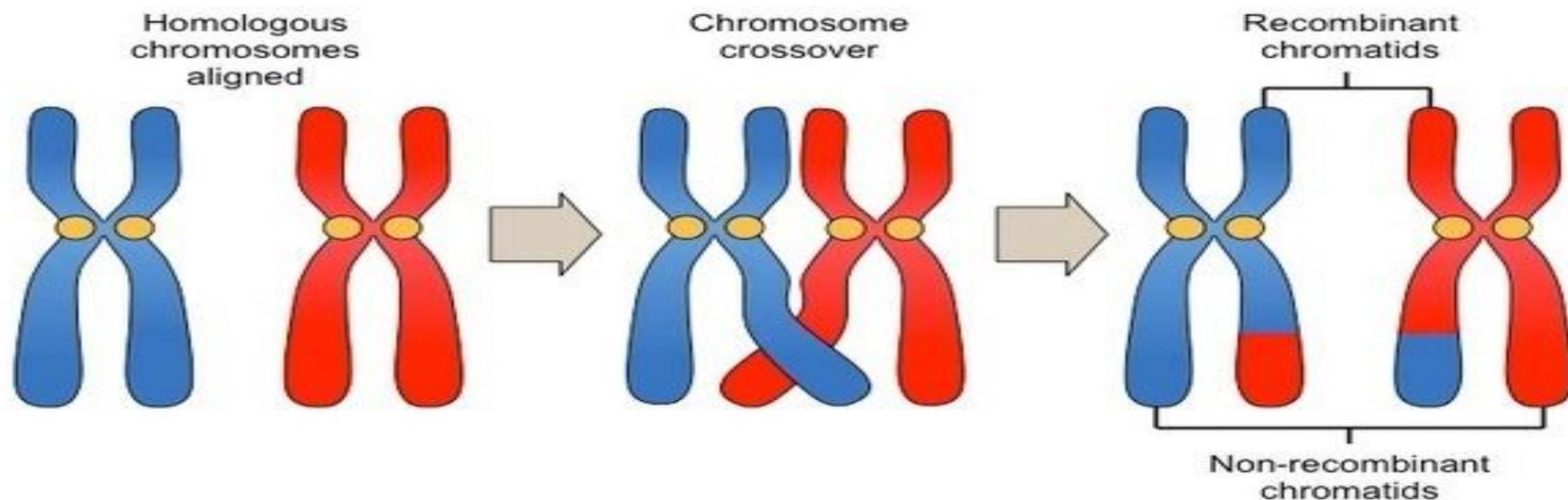
Genotypes ⟷ Phenotypes

➤ At each locus (except for sex chromosomes) there are 2 genes these constitute the individual's **genotype** at the locus.

➤The expression of a genotype is termed a **phenotype**.

For example, hair color, weight, or the presence or absence of a disease.
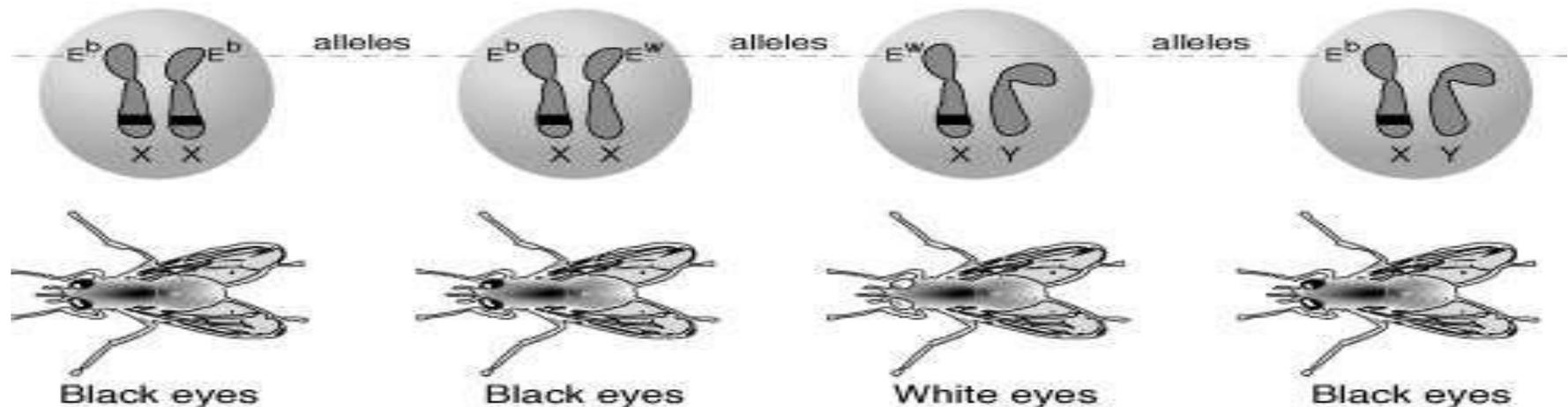
Three Great Milestones in Genetics

1. Mendel: genes and the rules of inheritance.
2. Watson and crick: the structure of DNA.
3. The human genome project: sequencing DNA and cataloguing genes.

Gregor Mendel: The father of genetics

- **Lived 1822 – 1884.**
- **plant breeder, trained in both physics and plant physiology.**
- **Discovered basic principles of genetics.**
- **Mendelian rule of inheritance.**

REVOLUTIONARY DISCOVERIES OF SCIENTIFIC PIONEERS

THE LAWS OF GENETICS AND GREGOR MENDEL

FRED BORTZ
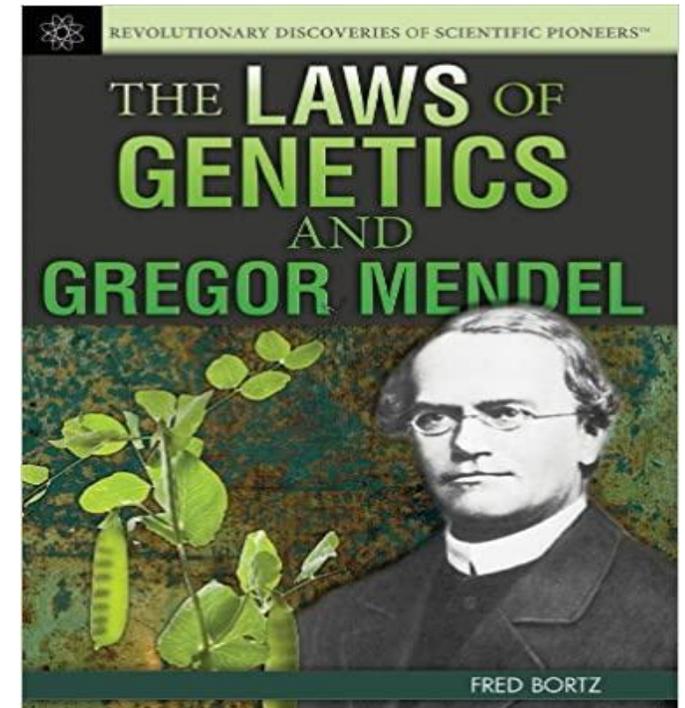
Gregor Mendel: The father of genetics

- He chose the pea plant (*Pisum sativum*) for three main reasons:

- **It is easy to grow and grows quickly**, so results can be seen in a short time.
- **It has clear and easily noticeable traits**, such as flower color and the shape of the peas.
- **Pollination is easy to control**. The plant can self-pollinate, and cross-pollination can be done by hand while keeping unwanted pollen out.

Probabilities and statistics

- An easy way to predict the outcome of simple genetic crosses is to use a **Punnett square,** a method originally proposed by Reginald Punnett.
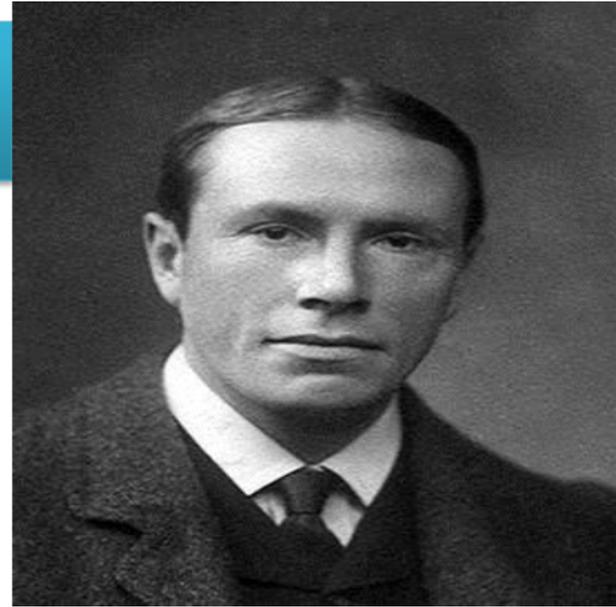
Example: A heterozygous tall plant is crossed to another heterozygous tall plant.
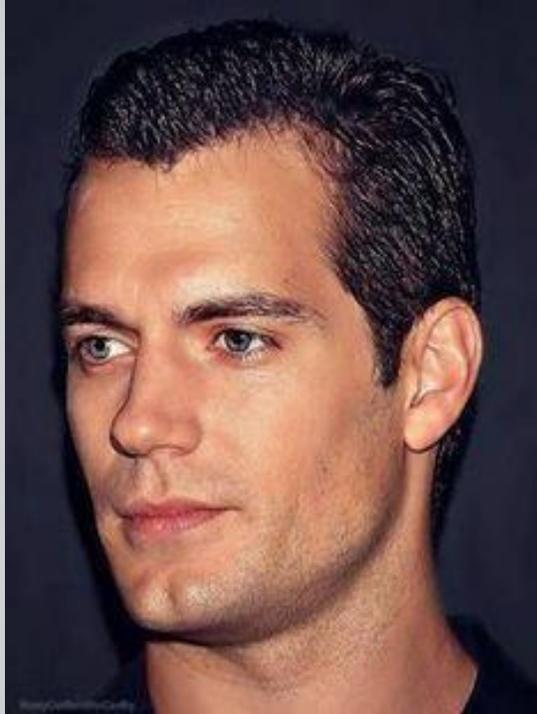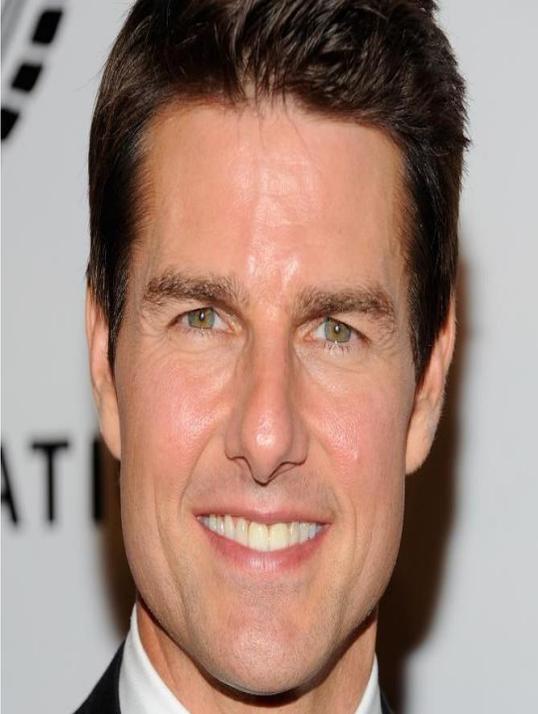
1. *Write down the possible gametes that each parent can Make?*

2. *Determine the relative proportions of genotypes and phenotypes of the offspring?*
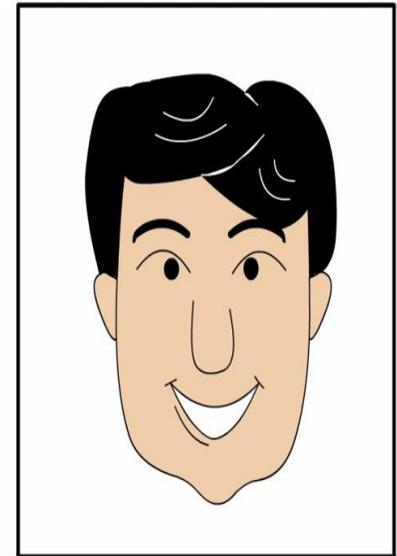
Determination of Human Phenotypes and Genotypes

Hairline: Widow's peak (D)
straight hairline (r)

Cleft Chin: Dimples (D)
Non-dimpled (r)

Cleft chin present   Cleft chin absent
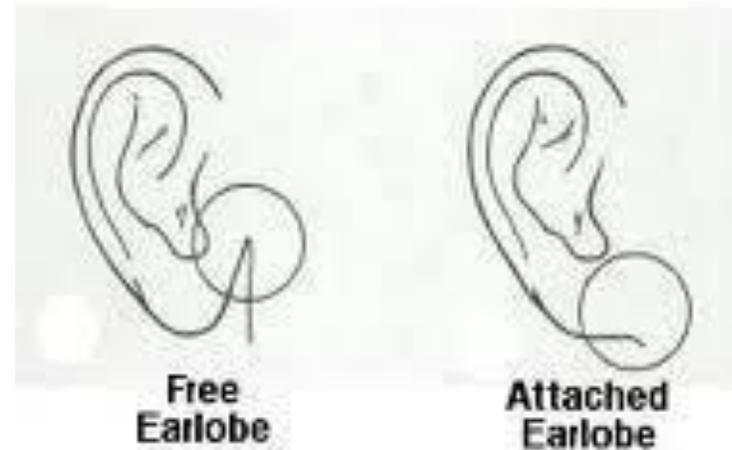
Ear-lobes:

Unattached   (D)

Attached   (r)

Attached earlobe   Free earlobe   Free Earlobe   Attached Earlobe
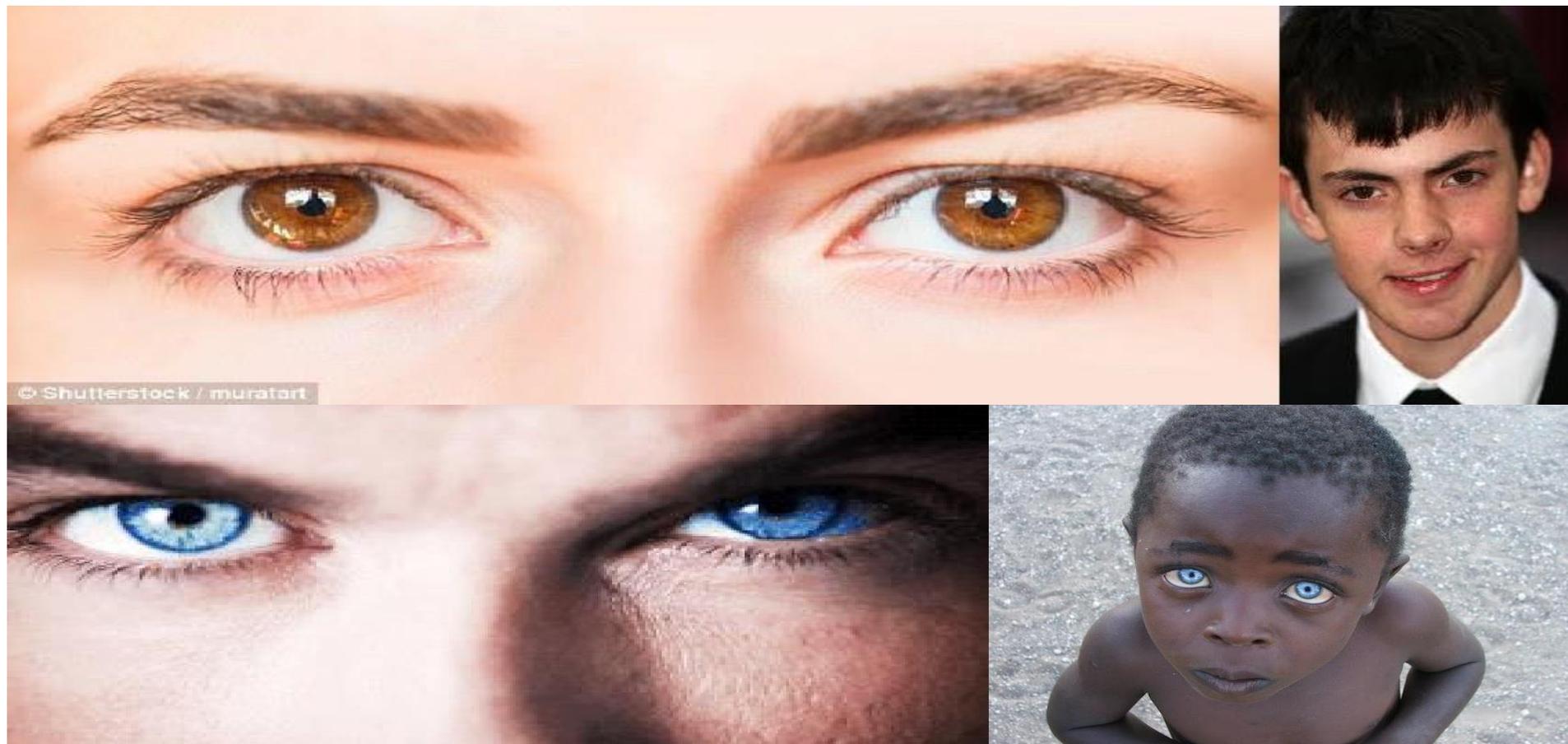
Skin pigmentation: Freckles (D)
No freckles (r)

Eye color: Brown (D)
            Blue   (r)

Tongue :Rolling (D)
Non-rolling (r)

Thumb hyperextension

The last segment cannot
be bend backward
(D)

The last segment can be
bend backward
(r)

Nose-length: **Long (D)**
Short(r)

Dimples: Dimples (D)
          Non-dimpled (r)

Hair on the middle finger segment → Dominant
No hair → Recessive