## Introduce to Genetics:

- **Genetics,** (from Ancient Greek genetikos, "genitive" and that from ***genesis***, **"origin"),** a discipline of biology, is the science of ***heredity*** and ***variation*** in living organisms.
- **William Bateson**, a proponent of **Mendel's work**, coined the word ***genetics*** in 1905.
- Prior to Mendel, **Imre Festetics**, a Hungarian noble, w, was the first who used the word ***"genetics."*** He described several **rules of genetic inheritance** in his work (The genetic law of the Nature) (Die genetische Gesätze der Natur, 1819). Also his second law is the same as what Mendel published. In his third law, he developed the basic principles of mutation.
- The fact that **living things** inherit traits from their parents has been used since prehistoric times to improve crop plants and animals through selective breeding.

## Description of Genetics:

- **Genetics** is a discipline of **biology**, is the science of **Heredity** and **Variation** in living organisms.
- **Medical genetics** is the branch of medicine that involves the diagnosis and management of hereditary disorders.
- **Heredity:** *study of* ***transmission of genetic characteristics*** *from* ***parents*** *to* ***offspring***.
- **Variation:** ***Differences that are seen among the members of same species***.
- **Inheritance:** *Process by which genetic characteristics are transfer from parent to offspring.*
- **Genetics** is the science of **heredity** that involves the **structure** and **function of genes** and **the way genes** are **passed from generation to the next.**
- **So Genetics** is concerned primarily with understanding biological properties that are **transmitted from parent to offspring**.

## 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.
- The **distribution and behavior of genes** in populations.

**haploid** - the condition of having only one set of chromosomes per cell (n)
**diploid** - the condition of having two sets of chromosomes per cell (2n)

**gamete** - a haploid (n) sex cell in plants and animals (egg or sperm)

**zygote** - diploid (2n) cell resulting from the union of two gametes in sexual reproduction

**chromatin** - the complex of DNA, RNA and proteins that makes up uncondensed eukaryotic chromosomes.

**chromosome** - structures within the nucleus of eukaryotic cells composed of chromatin and visible at cell division (condensed chromatin).

**homologous chromosomes -** chromosomes that are similar in morphology (shape and form) and genetic constitution. In animals one set comes from the father and the other from the mother.

**chromatids** - one of the two halves of a duplicated chromosome

**centromeres** - specialized constricted region of a chromatid, that contains the kinetochore; sister chromatids are joined at the centromere during cell division **10. recombination** - exchange of genetic material between chromosomes

11. **crossover** - the breaking and rejoining of homologous (non-sister) chromatids during early prophase I of meiosis, resulting in recombination

12. **synapsis** - the pairing of homologous chromosomes during prophase I of meiosis.

13. **disjunction** - separation of homologous chromosomes (or sister chromatids) during anaphase.

14. **genotype** - the genetic make-up (the assemblage of alleles) of an individual.

15. **phenotype** - the physical or chemical expression of an organism's genes.

16. **gene** - a discrete unit of hereditary information that usually specifies a protein; a region of DNA (locus) located on a chromosome that specifies a trait (characteristic).

17. **alleles** - genes governing variations of the same characteristic (trait) that occupy corresponding positions (loci) on homologous chromosomes; alternative forms of a gene.

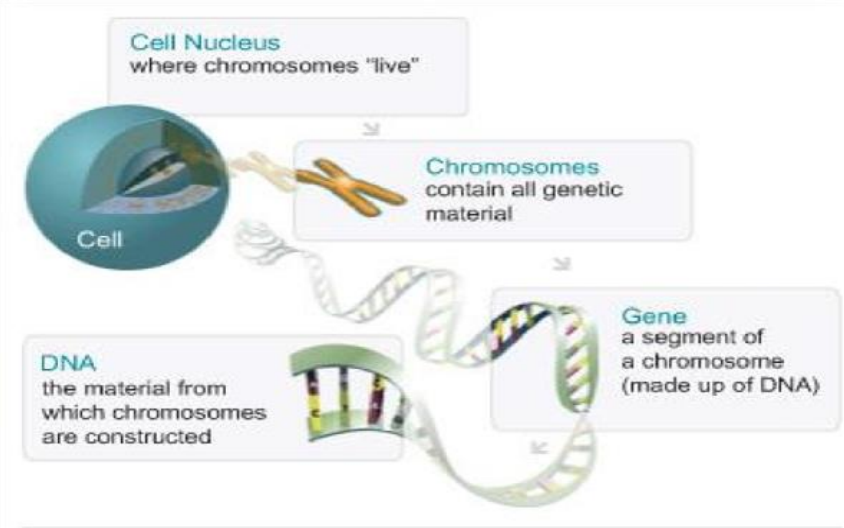
18. **dominant allele** - an allele that is always expressed when present, regardless of whether the organism is homozygous or heterozygous for that gene.

**What is genetics?**

- "Genetics is the study of **heredity**, the process in which a parent passes certain **genes** onto their children."

What does that mean?

- Children **inherit** their biological parents' genes that express specific **traits**, such as some physical characteristics, natural talents, and genetic disorders.



**Heredity** describes how some traits are passed from parents to their children .

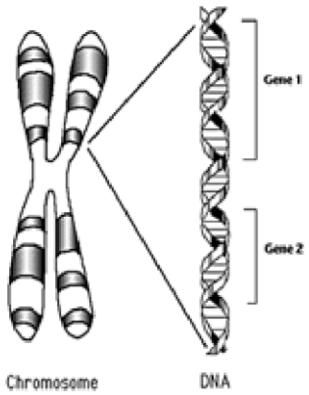
The traits are expressed by genes, which are small sections of DNA that are coded for specific traits .

Genes are found on chromosomes .

Humans have two sets of 23 chromosomes—one set from each parent.

## Genetic Information

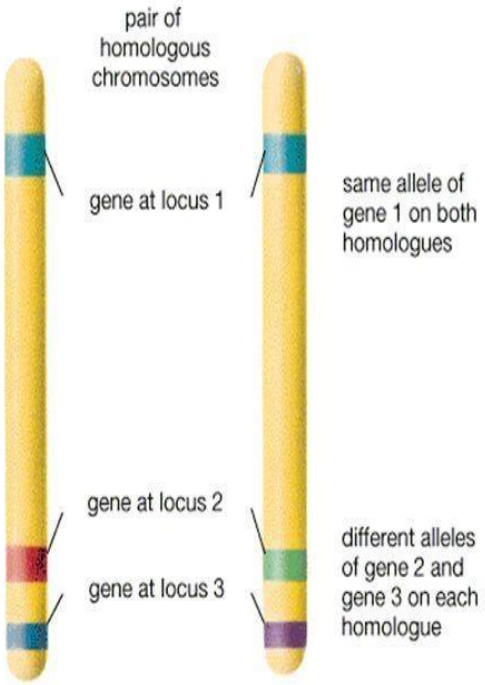
- **Gene** – basic unit of genetic information. Genes determine the inherited characters.
- **Genome** – the collection of genetic information.
- **Chromosomes** – storage units of *genes*.
- **DNA** – is a nucleic acid that contains the genetic instructions specifying the biological development of all cellular forms of life

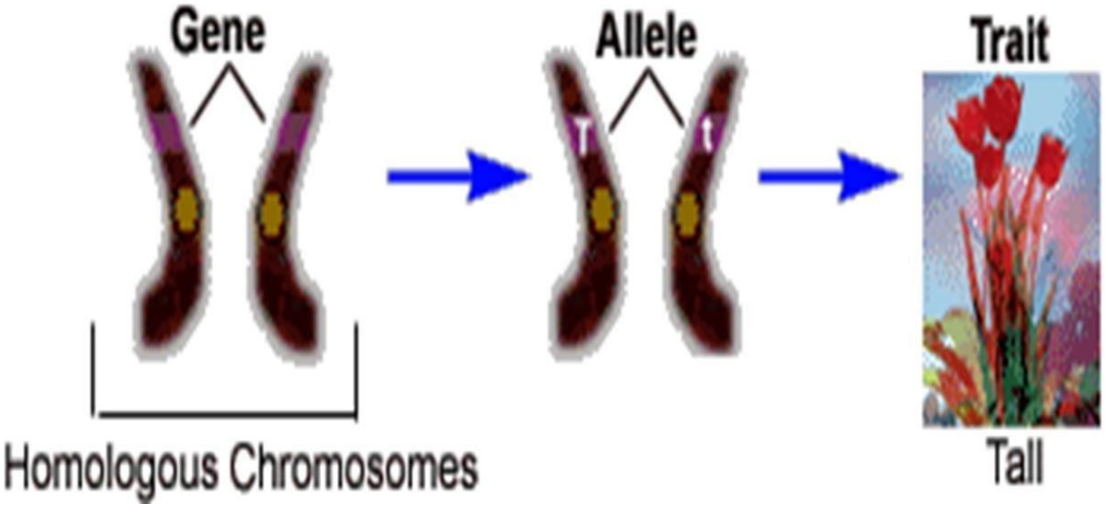



**Genes**

# Homologous Chromosomes, Genes, and Alleles

- Chromosome pair:
  - "homologous chromosomes"
- pair has genes at the same loci
  - "alleles"
  - may be the same or different



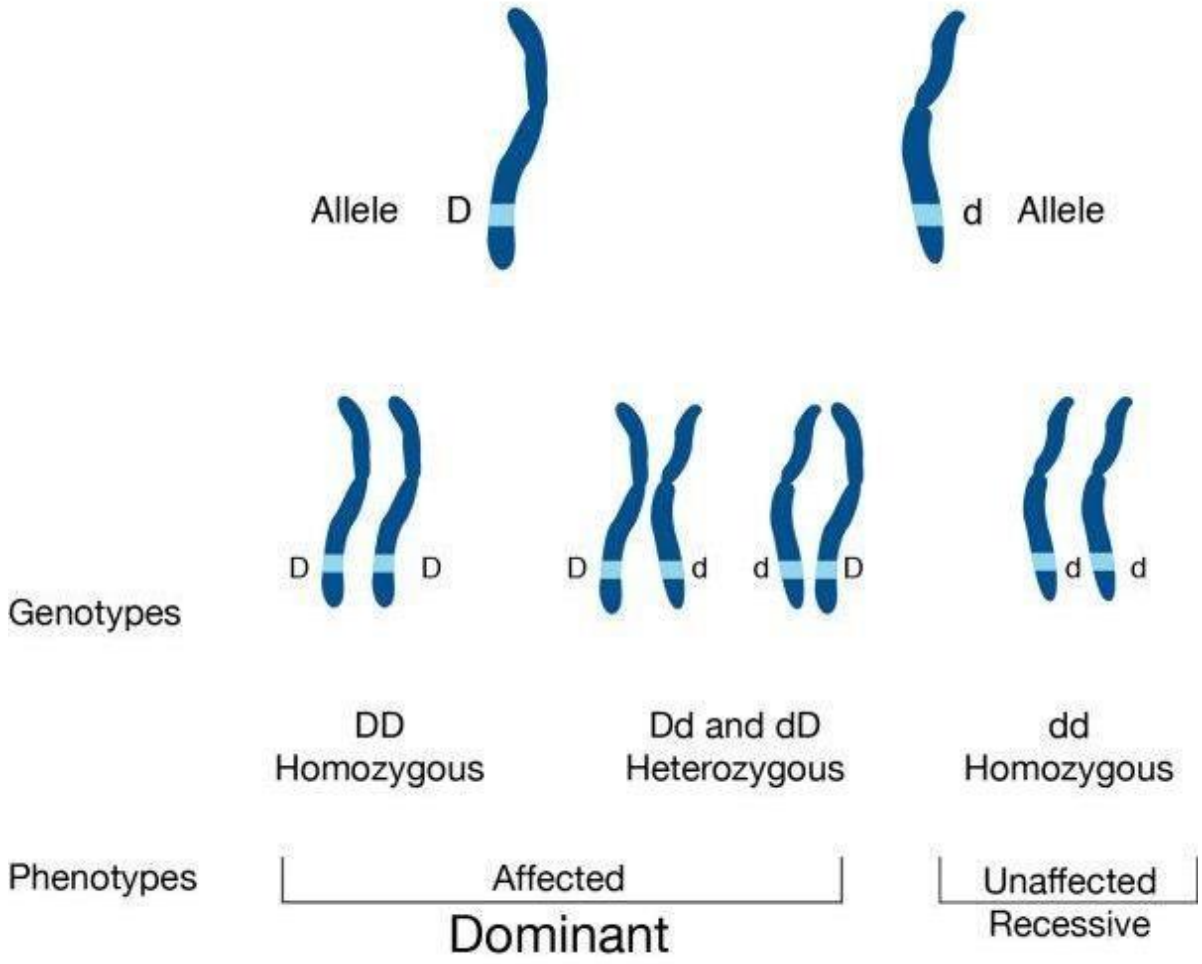
## Genes

- Heritable units of information about traits
- Each gene has a specific **locus** on a chromosome
- But remember, gene is a stretch of DNA

## Alleles and Loci

An **allele** is a gene that has more than one form. Each of the forms is referred to as an allele. For example, the gene for red flowers and the gene for white flowers are two different alleles.

A **locus** (plural: **loci**) is the location of a gene on a chromosome. The gene for red flowers and the gene for white flowers are two different alleles at the same locus. A single chromosome can have a gene for white flowers or a gene for red flowers but not both.
There are two **loci** illustrated below, one is for flower color and the other is for stem length. Flower color has five **alleles** and stem length has two.


Allele D
d Allele
Genotypes
D D
D d
d D
d d
DD
Homozygous
Dd and dD
Heterozygous
dd
Homozygous
Phenotypes
Affected
Dominant
Unaffected
Recessive

## What Is a Gene?

Each cell in the human body contains about 25,000 to 35,000 genes, which carry information that determines your **traits** (say: **trates**). Traits are characteristics you inherit from your parents; this means your parents pass some of their characteristics on to you through genes. For example, if both of your parents have green eyes, you might inherit the trait of green eyes from them. Or if your mom has freckles, you might inherit that trait and wind up with a freckled face. And genes aren't just in humans — *all* animals and plants have genes, too.

Genes hang out all lined up on thread-like things called **chromosomes** (say: **kro**-moh-somes). Chromosomes come in pairs, and there are hundreds, sometimes thousands, of genes in one chromosome. The chromosomes and genes are made of DNA, which is short for **deoxyribonucleic** (say: dee-**ox**-see-ri-bo-nyoo-**clay**-ik) **acid**.

Chromosomes are found inside cells, the very small units that make up all living things. A cell is so tiny that you can only see it through the lens of a strong

microscope, and there are *billions* of cells in your body. Most cells have one **nucleus** (say: **noo**-clee-us).

In humans, a cell nucleus contains 46 individual chromosomes or 23 pairs of chromosomes (chromosomes come in pairs, remember? 23 X 2 = 46). Half of these chromosomes come from one parent and half come from the other parent. But not every living thing has 46 chromosomes inside of its cells. For instance, a fruit fly cell only has four chromosomes!

## How Do Genes Work?

Each gene has a special job to do. It carries blueprints — the instructions — for making proteins (say: pro-teens) in the cell. Proteins are the building blocks for everything in your body. Bones and teeth, hair and earlobes, muscles and blood, all are made up of proteins (as well as other stuff). Those proteins help our bodies grow, work properly, and stay healthy. Scientists today estimate that each gene in the body may make as many as 10 different proteins. That's over 300,000 proteins!

Like chromosomes, genes come in pairs. Each of your biological parents has two copies of each of their genes, and each parent passes along just one copy to make up the genes you have. Genes that are passed on to you determine many of your traits, such as your hair color and skin color.

Take the gene that helps the body make **hemoglobin** (say: **hee**-muhglow-bin), for example. Hemoglobin is an important protein that is needed for red blood cells to carry oxygen throughout the body. If parents pass on altered hemoglobin genes to their child, the child may only be able to make a type of hemoglobin that doesn't work properly. This can cause a condition known as anemia (say: uh-**nee**-mee-uh), a condition in which a person has fewer healthy red blood cells.

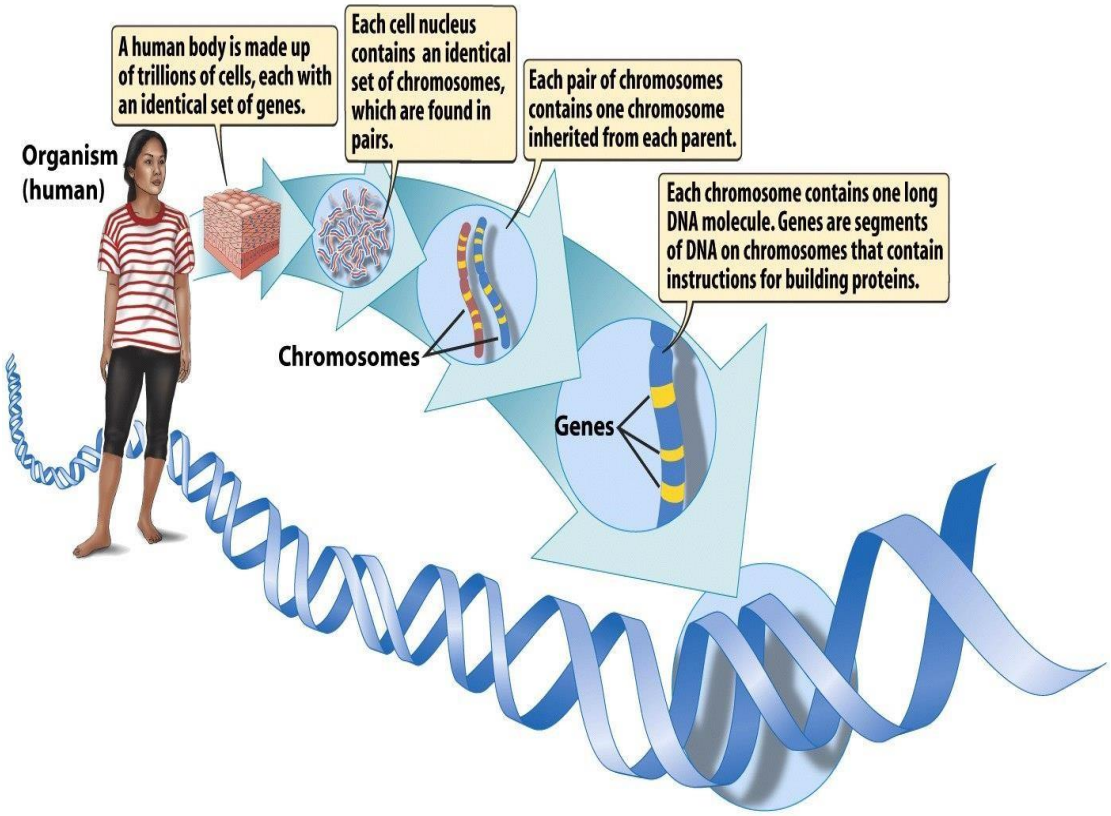



Figure 10-2 Discover Biology 3/e