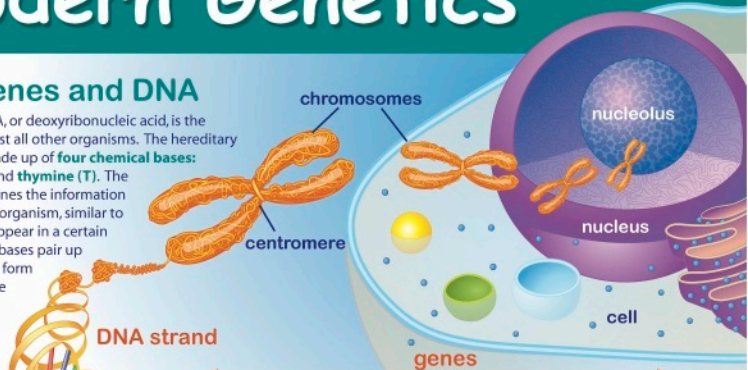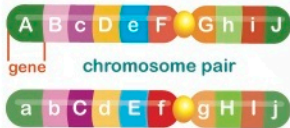# Modern Genetics

Chromosomes, Genes and DNA
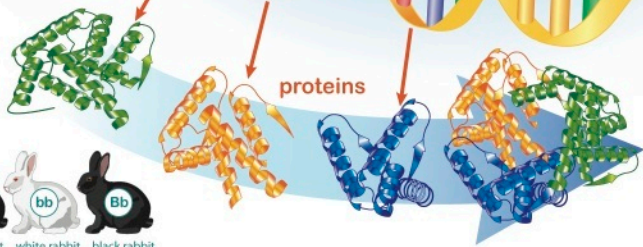
Chromosomes are made up of **DNA**. DNA, or deoxyribonucleic acid, is the **hereditary material** in humans and almost all other organisms. The hereditary information in DNA is stored as a **code** made up of **four chemical bases: adenine (A), guanine (G), cytosine (C)**, and **thymine (T)**. The order, or sequence, of these bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences. DNA bases pair up with each other, **A with T** and **C with G**, to form units called **base pairs**. Each chromosome contains thousands of genes. A **gene** is a section of a DNA strand that is made up of a series of bases which contains the information for cells to make one specific **protein**.

chromosomes

nucleolus

nucleus

centromere

cell

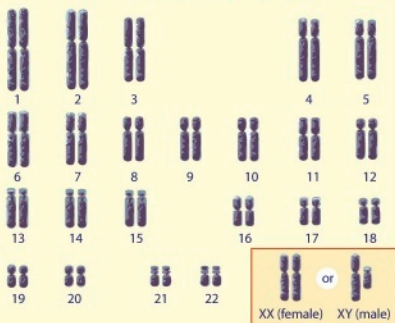DNA strand

genes

proteins

gene

chromosome pair

Phenotypes and Genotypes

A **phenotype** is the physical appearance of a particular organism. The **genotype** is the genetic make-up of a particular organism.

Phenotype	Genotype
Black fur	BB
Black fur	Bb
White fur	bb

black rabbit   white rabbit   black rabbit

Human Karyotype

A **karyotype** is a picture of the complete set of **chromosomes** in a cell. Scientists examine a karyotype to identify and evaluate the size, shape, and number of chromosomes in a human cell. Extra, missing, or abnormal positions of chromosome pieces can cause problems with a person's growth, development, and body functions. A normal human male karyotype is represented as 46,XY and a normal female karyotype is represented as 46,XX. Individuals with chromosomal disorders include Down Syndrome (47, XY, +21) and Turner's Syndrome (45, X) among others.

XX (female)   or   XY (male)

DNA Fingerprinting

Each person has a unique set of DNA. Because of this uniqueness, it can be used to produce a genetic fingerprint known as **DNA fingerprinting**. It is a method used by scientists to solve crimes, determine familial relationships or to track hereditary diseases.

1. DNA is extracted from the cell.

2. The extracted DNA is cut into smaller pieces with special enzymes.

3. The DNA pieces are placed on a gel that uses electric current to push them through the gel and separate them according to size. The larger DNA pieces remain closer to the top, while the smaller ones move towards the bottom.

4. The separated DNA pieces on the gel are then stained to reveal their unique banded pattern known as a **DNA fingerprint**.

DNA added

gel

electrophoresis system