

TOPIC FIVE: Genetics

A. Humans have 46 chromosomes, or 23 homologous pairs.

Common mistake: *Humans have 23 chromosomes (or 46 pairs of chromosomes, or some other incorrect number).* These numbers are often confused. You must memorize them correctly.

B. Chromosome pairs carry alleles for the same trait. We all have two alleles for each gene — 1 from each parent, 1 on each member of the homologous pair.

C. Sex chromosomes — In humans, females are XX and males are XY.

The Y chromosome is much smaller than the X, so males carry only a single gene for some traits. This makes males more likely to have some traits (like color blindness). These are called **sex linked traits**.

D. While genes determine our traits, **the environment can affect expression of genes.**

E. Each chromosome has hundreds or thousands of genes.

F. Each gene codes for a particular protein.

Common mistake: *Genes/DNA are made from protein.* Genes carry the *instructions* to make protein. The genes themselves are made from nucleic acids.

G. DNA is made of 4 bases: **ATCG**. A **three-letter codon** represents a specific **amino acid**. These amino acids are assembled into **proteins**.

H. Base pairs: A-T and C-G (in RNA, A-U and C-G).

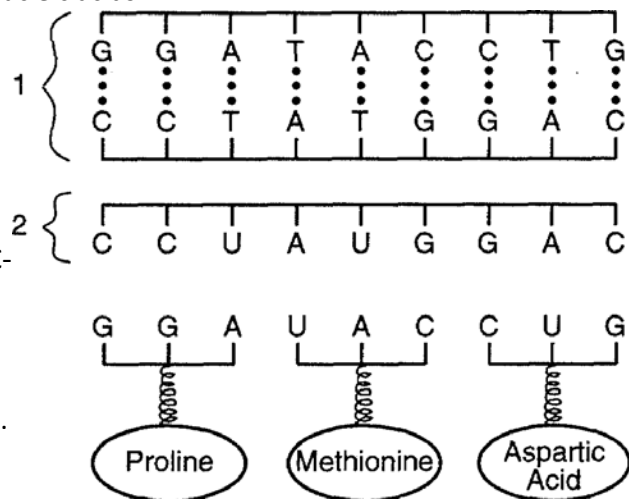
I. RNA carries the genetic code to **ribosomes** and the ribosomes synthesize (make) protein.

J. Changes to DNA are called **mutations**.

They can only be passed on if they occur in reproductive cells (sperm or egg).

1. Common **mutagenic agents** include **radiation, chemicals, and viruses**.

2. Mutations may cause a change in the structure of the protein coded for by a gene. This will have an affect on the way the protein works (if it still works at all).

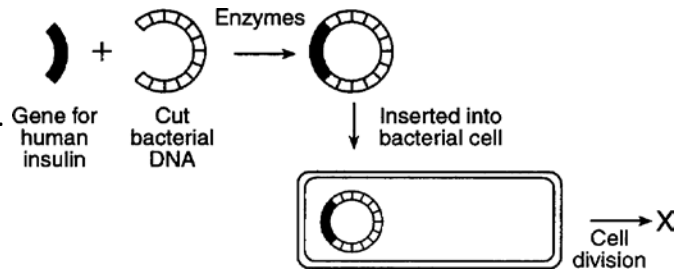


K. All cells in the body contain the same genes. Only some of these genes are turned on. We do not yet know exactly why this happens.

L. You must know examples of genetic technology:

1. **Selective breeding** produces animals and plants with desired traits (disease resistance, larger fruit, more meat or milk, specific colors).

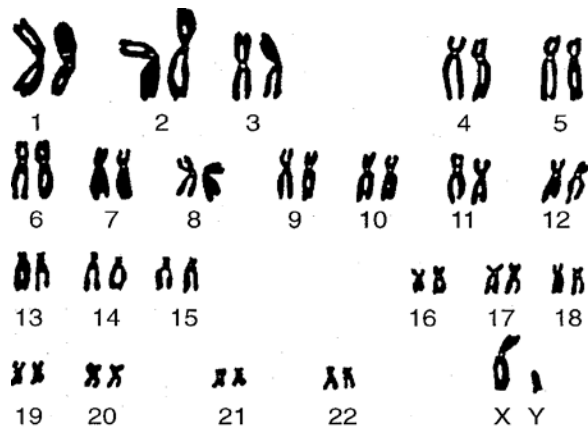
2. **Genetic engineering or gene splicing** inserts genes of one organism into the genes of another. Enzymes are used to cut and copy the DNA segments. Bacteria are often used because they have no nucleus protecting their DNA and they reproduce very quickly, allowing large amounts of medicine (insulin) to be made. The example of gene splicing you MUST know:



- a. **The gene to make human insulin was inserted into bacteria.**
- b. **These bacteria can now make insulin that is exactly the same as human insulin.**
- c. **This insulin is used by diabetics.**
- d. **This is safer than the cow and sheep insulin that were used in the past.**

3. New technologies (**karyotyping, DNA fingerprinting**) are making it easier to diagnose and treat genetic disease, though we cannot yet cure them.

M. Genetic research has posed many **ethical** problems (i.e. right and wrong) that science alone cannot answer.



A **karyotype** shows all 23 pairs of human chromosomes. Note the last pair identifies this as a male.

Adapted from *What You Absolutely Must Know to Pass the NYS Living Environment/Biology Regents*
www.newyorkscienceteacher.com