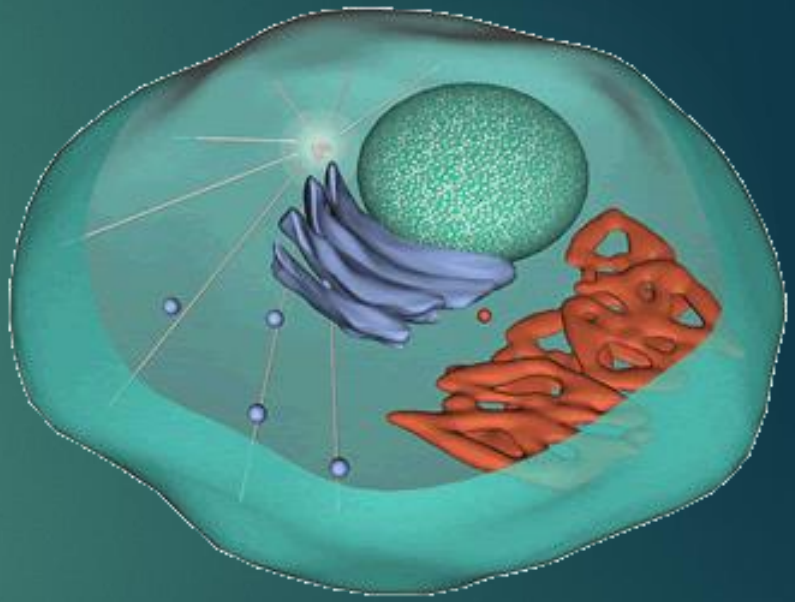
Controlling the Cell's Activities



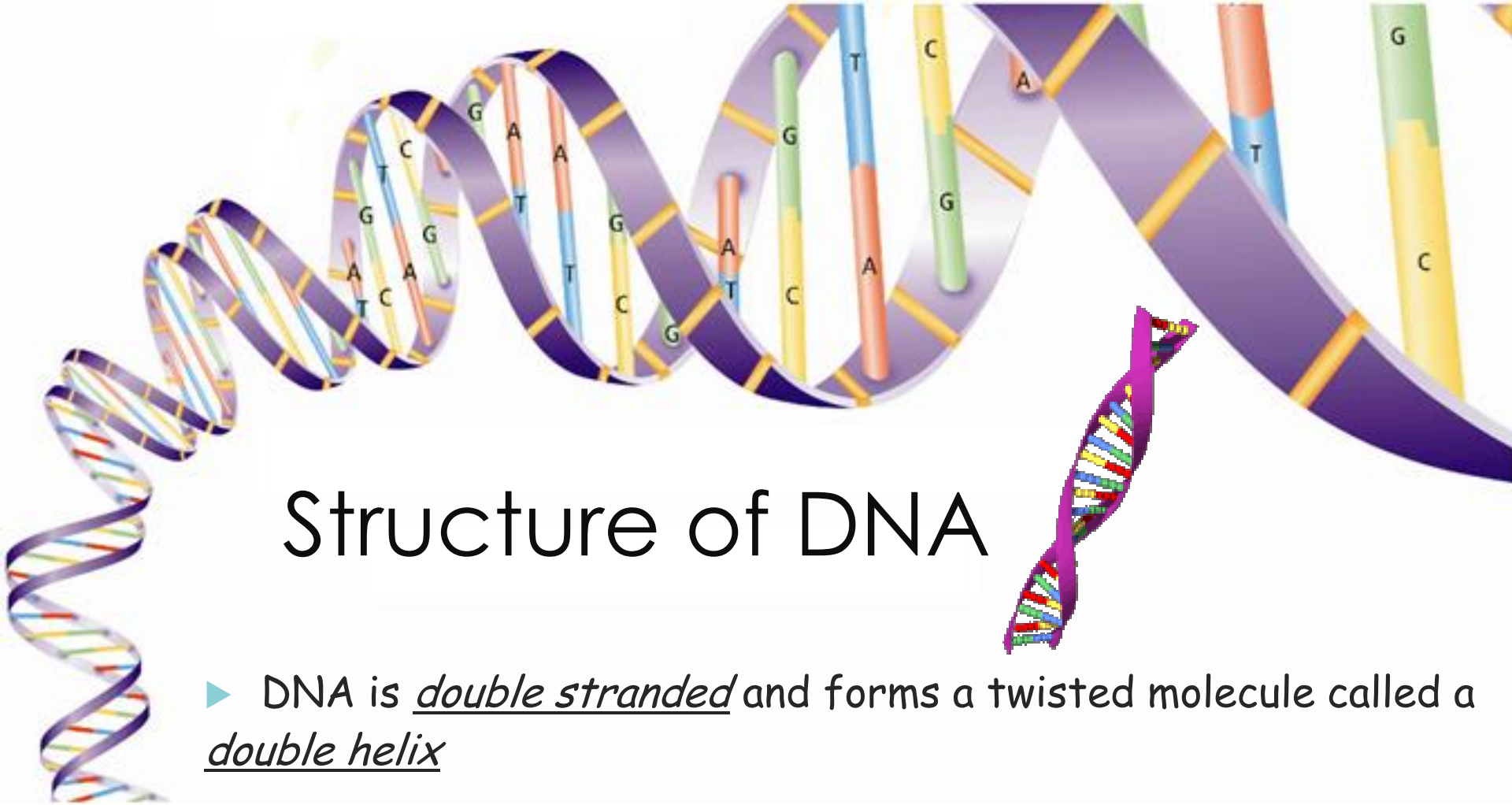
NUCLEUS & DNA

Function of Nucleus

- Regulates all of cell's activities
- Controls production of proteins (hormones, enzymes etc.)
- These proteins control cell growth, reproduction, repairs and energy use
- Contains the DNA

DNA
(Deoxyribonucleic Acid)

- Contains "instructions" for protein production
- Different species have slight differences in their DNA
- Each individual has unique DNA (like a fingerprint)



Structure of DNA

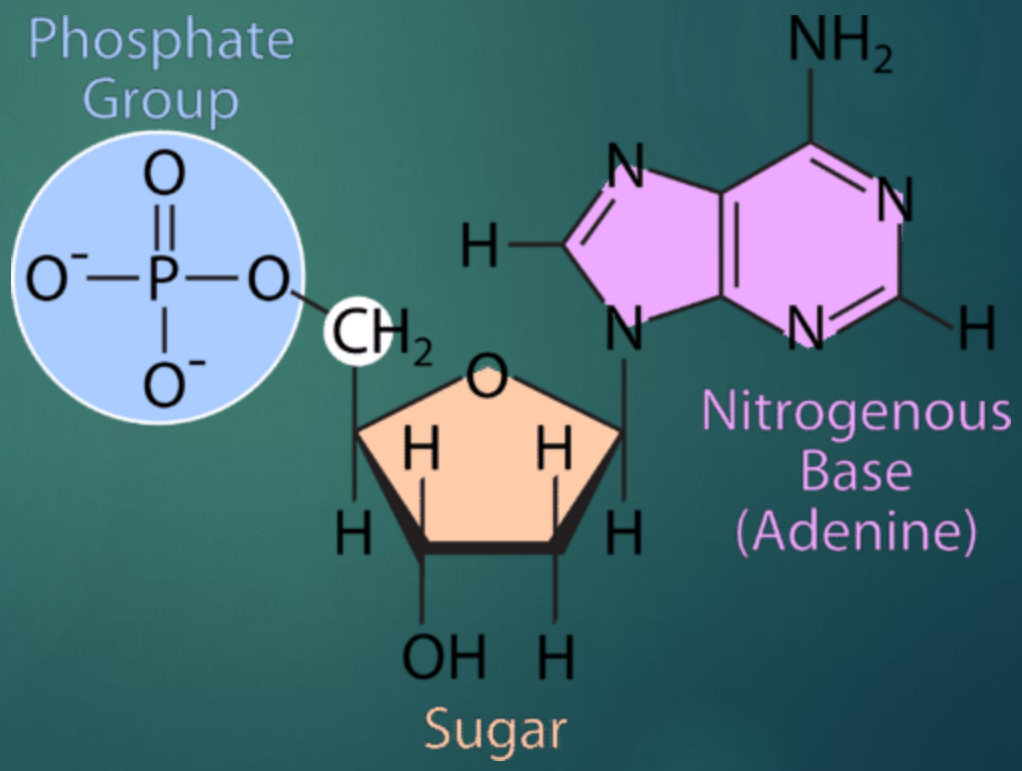
- DNA is *double stranded* and forms a twisted molecule called a *double helix*
- DNA is made of *4* nucleotides (also called bases):
- *Adenine* (A), *Thymine* (T), *Guanine* (G), *Cytosine* (C)
- The nucleotides are joined to a "back-bone" made of *sugar* and *phosphate* molecules

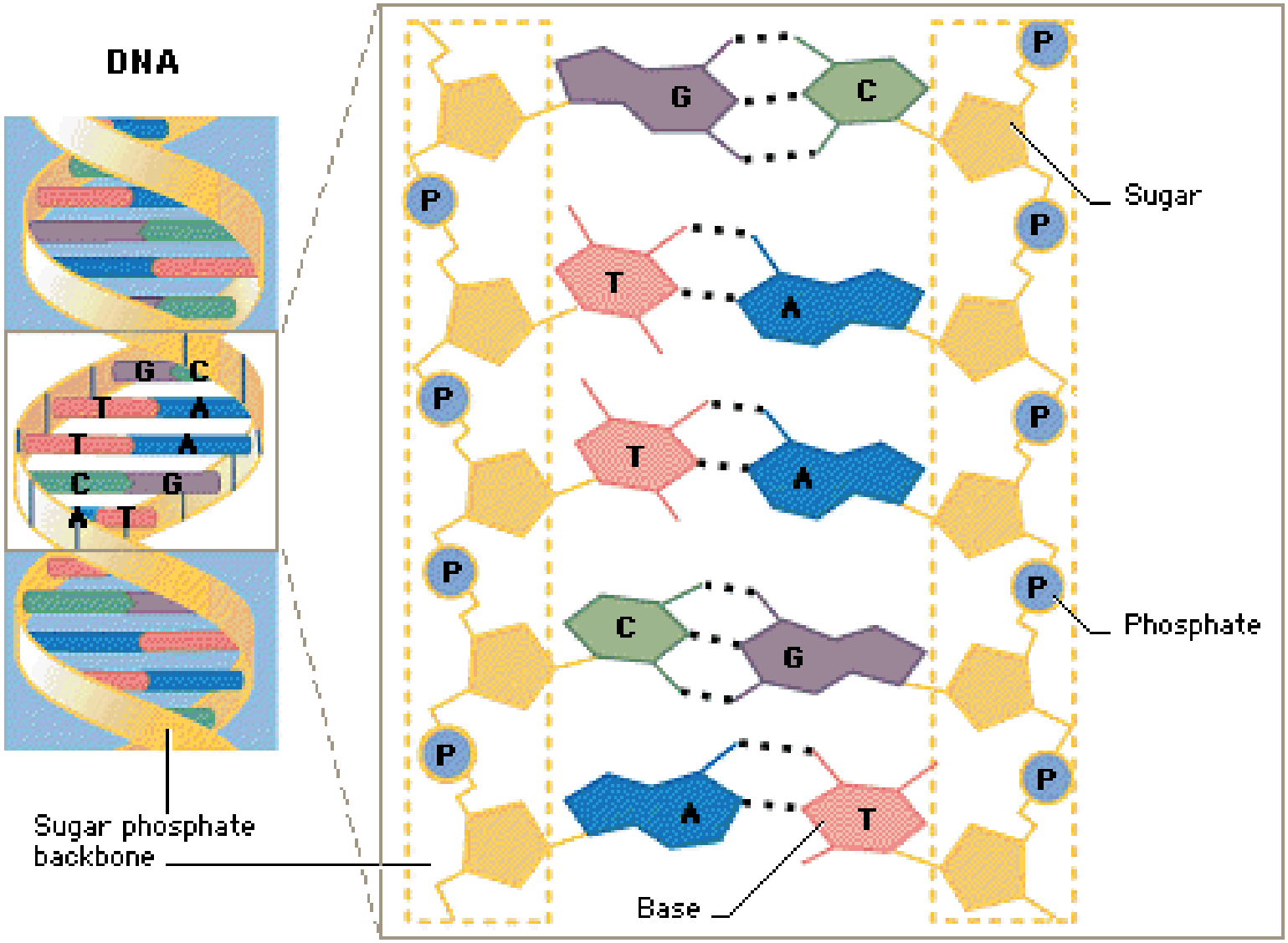
Structure of DNA

- *Bonds* form between the nucleotides to hold the two strands of the molecule together.
- *Adenine* always bonds with *Thymine* A=T (double bond)
- *Guanine* always bonds with *Cytosine* G≡C (triple bond)

Nucleotide

- Basic unit made up of one sugar, one phosphate and one of the 4 bases
- Each DNA strand can be thousands of nucleotides long

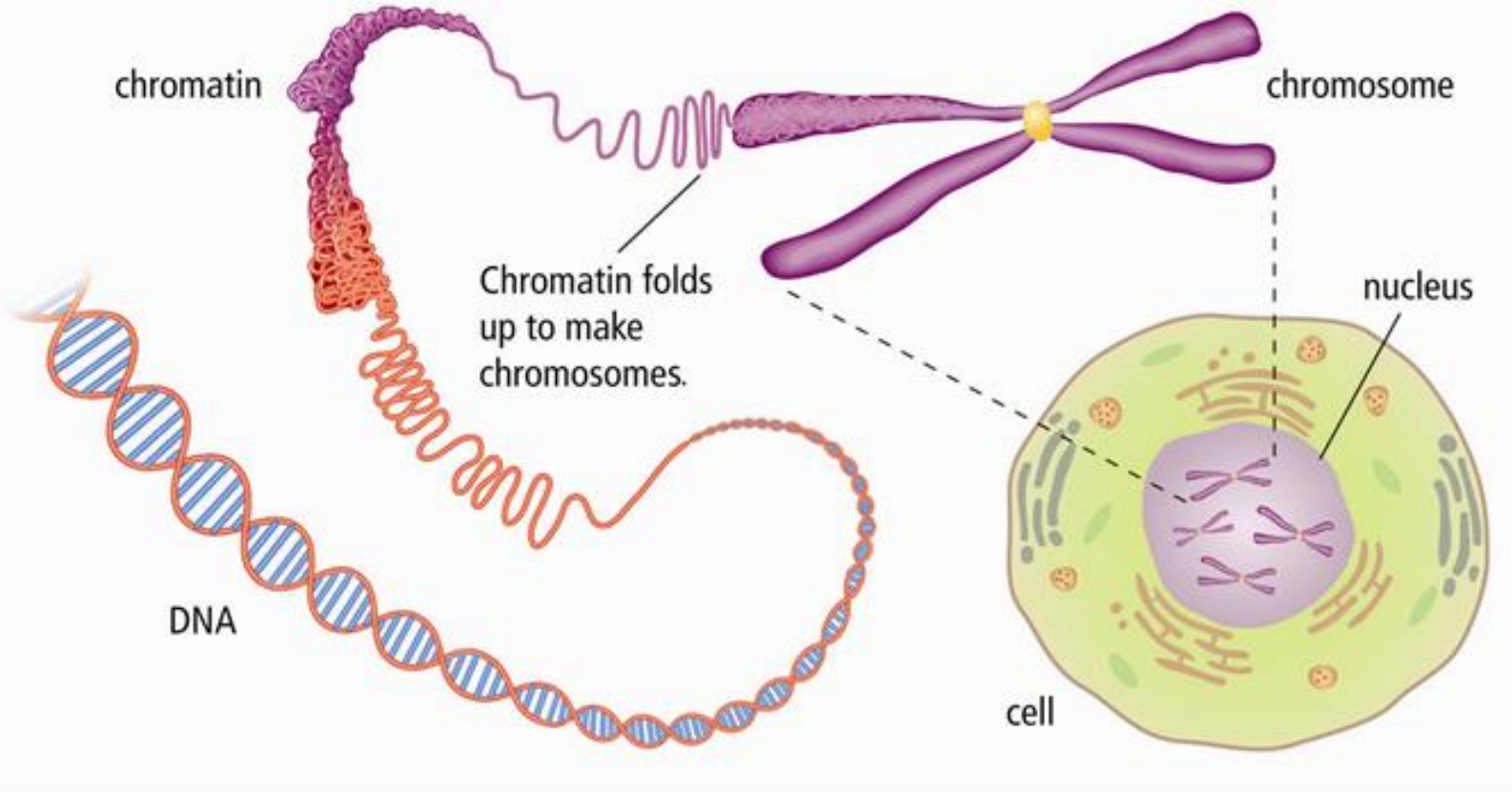



DNA
G
C
T
A
T
A
C
G
A
T
Sugar phosphate backbone
P
Sugar
Phosphate
Base

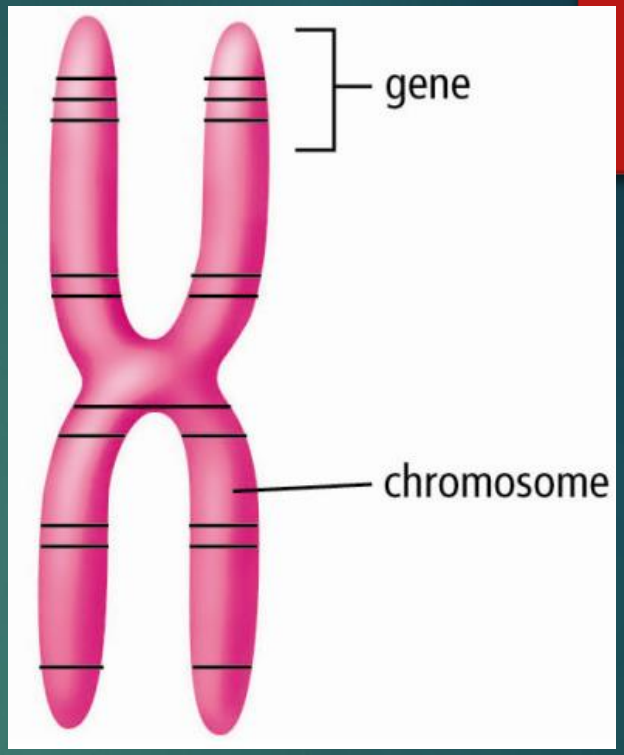
Most of the time, DNA exists in the nucleus as *chromatin*.

Chromatin contains *DNA and proteins*

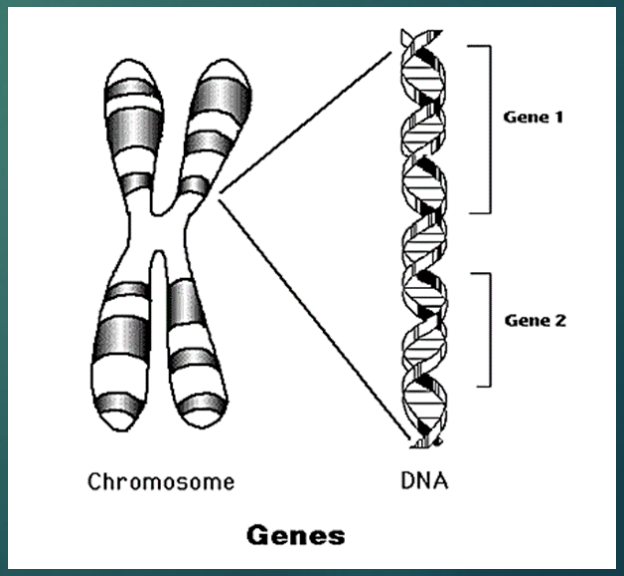
Chromatin fold up to make X-shaped structures called *chromosomes* during cell division.



Chromosomes contain hundreds of *genes*, with each *gene* being located at a particular part of the chromosome



Genes: *short chains of DNA*. These DNA sequences store the information needed to make specific *proteins*.

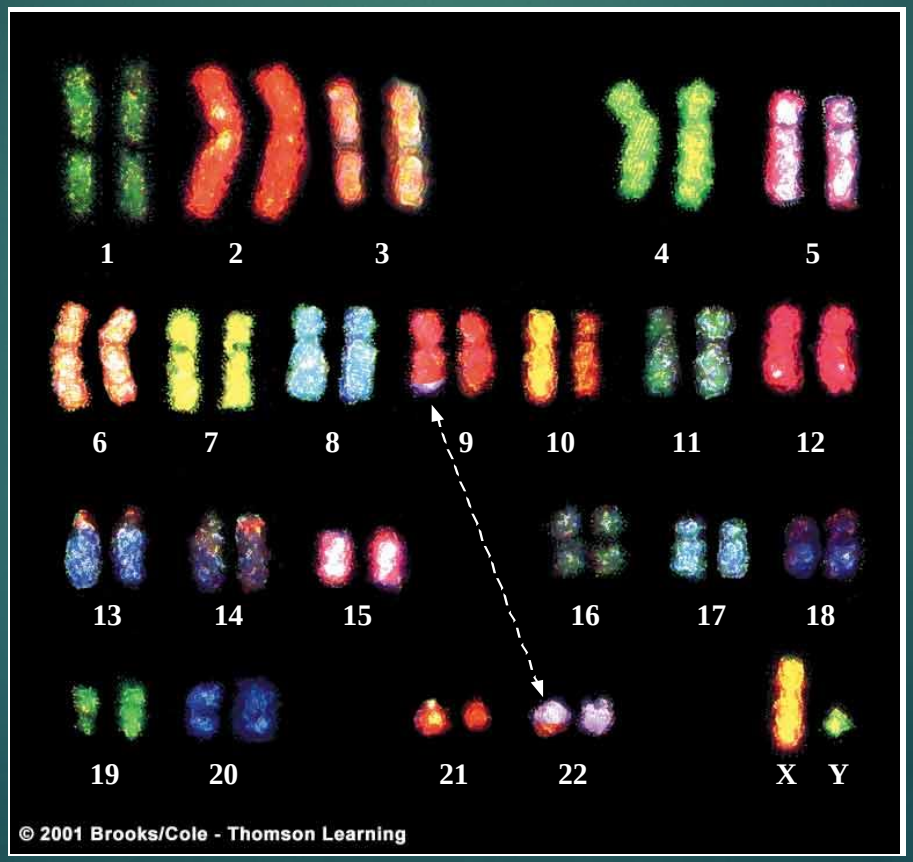


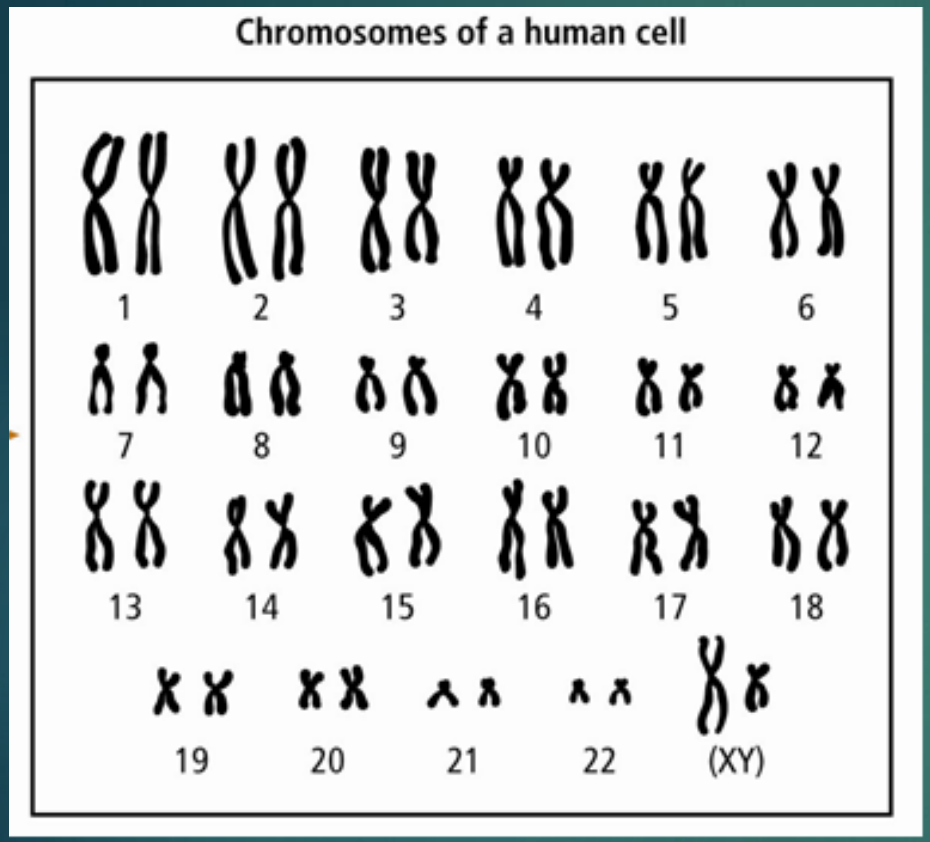
Chromosomes

Every organism has a characteristic number of *chromosomes*.

Chromosomes within the nucleus are *found in pairs*.

Most human cells have *46* chromosomes, arranges in *23 pairs*.



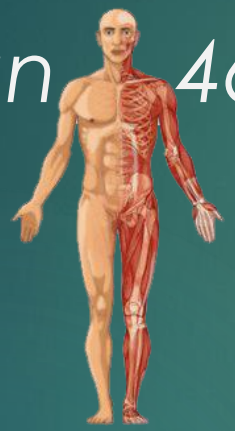


One of these pairs of chromosomes determines the *sex* of the individual.

In males, the 23rd pair of chromosomes is the *XY* pair, in females, it is the *XX* pair.

Every living thing has a charactgeristic number of chromosomes

- Human 46



- Dog 78

Mosquito 6

Pea Plant 14

Sugar cane 80

Causes of Mutations

- 1. exposure to nuclear radiation
- 2. exposure to ultraviolet radiation (sunlight)
- 3. exposure to certain chemicals (mutagens)
- 4. mistakes in DNA replication (1 in every 100,000,000 base pairs)
- - some are repaired by the cells

How mutations happen

- Radiation or chemicals can modify bases so they pair up with the wrong partner
  - This can sometimes be repaired by the cell
- Nuclear radiation can cut the "backbone" by breaking bonds to the phosphate groups
  - Broken pieces join up with other DNA strands but the sequence is not correct

Mutation Example

Original message

- **The bat saw the cat eat the rat.**

Exchange one letter - different message

- **The cat saw the bat eat the rat.**

Exchange another letter - unclear message

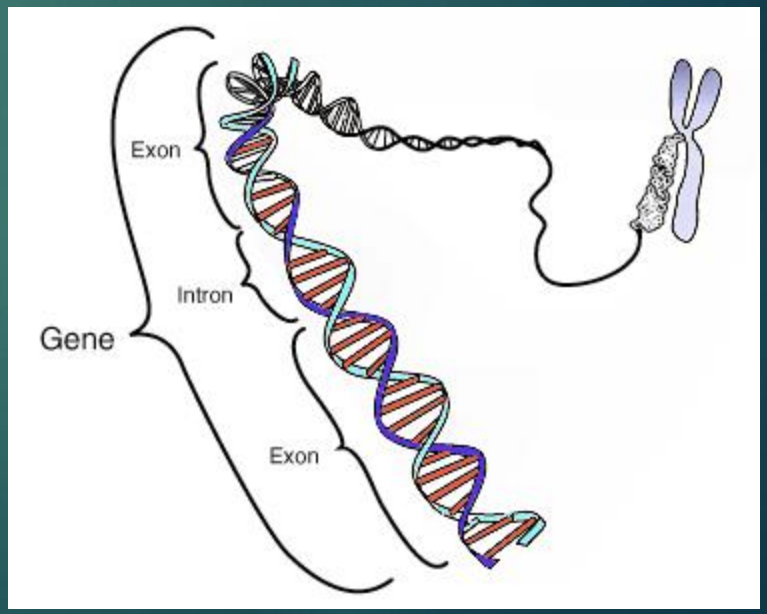
- **The cat was the bat eat the rat.**

Remove one letter - nonsense

- **The atw ast heb ate att her at.**

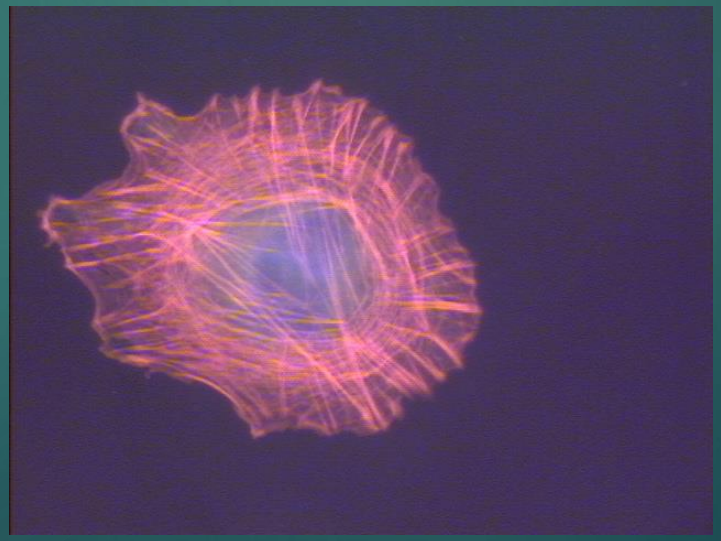
Genes

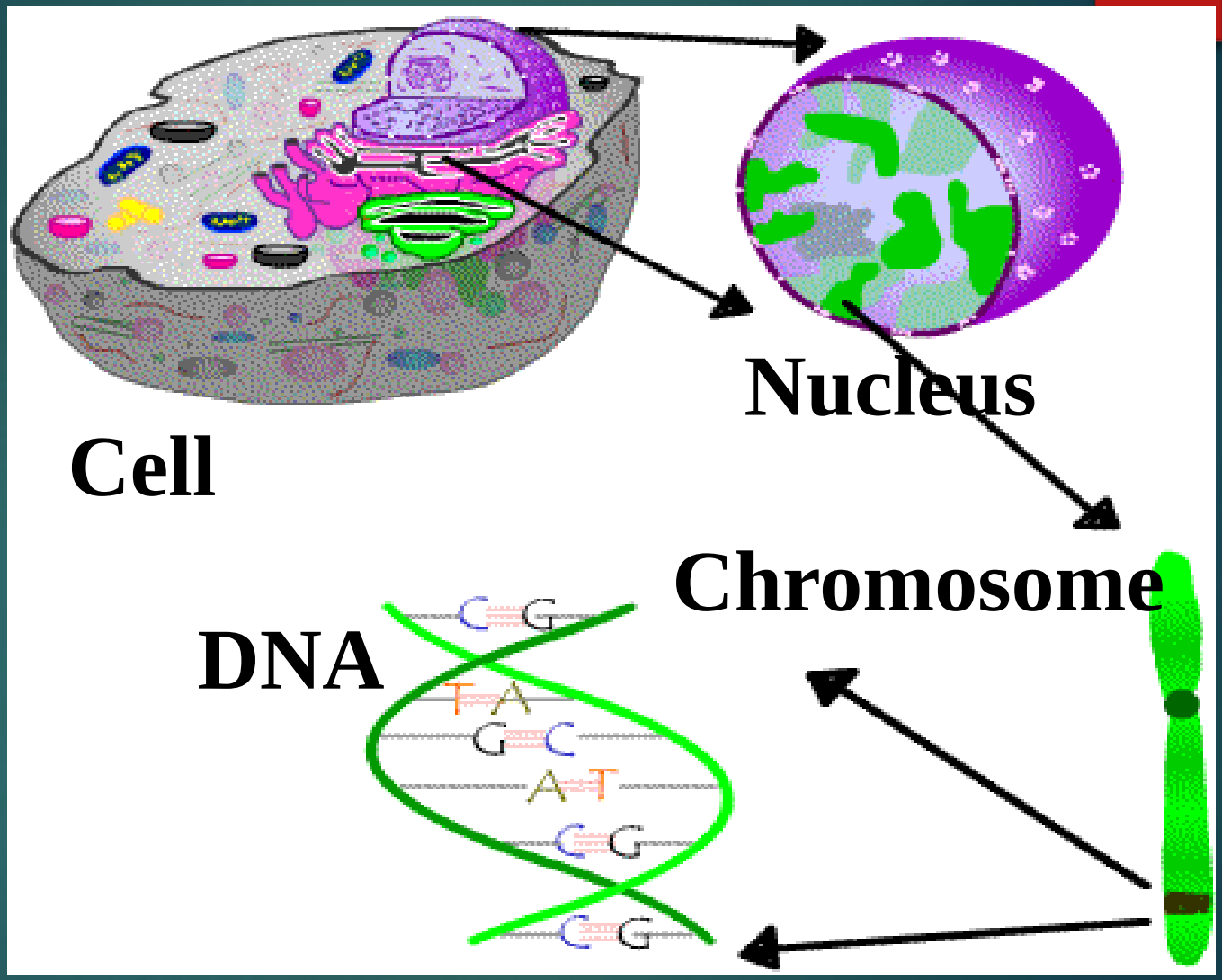
- Each group of 3 nucleotides (3 bases) is the code to add a certain building block (amino acid) to the proteins
- Changes in the order of nucleotides mean the wrong protein is made
- This change is called a mutation



Plant & Animal Cells

- Nuclear membrane separates nucleus from cytoplasm
- Membrane controls movement in and out of nucleus *(like the cell membrane)*




Cell
Nucleus
Chromosome
DNA
C G
T A
G C
A T
C G
C G