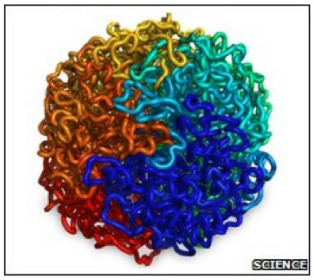
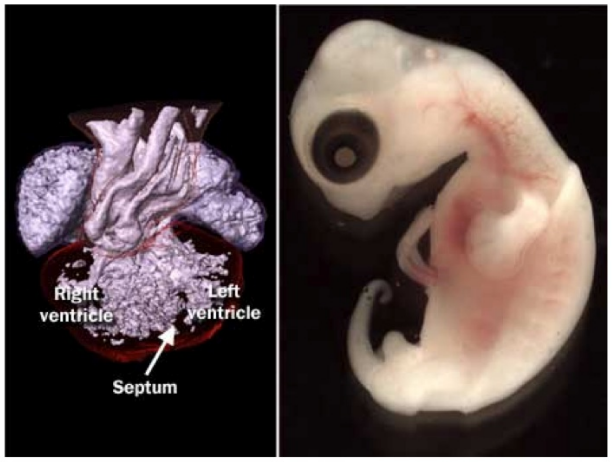
Cells Store, Use, and Transmit Information



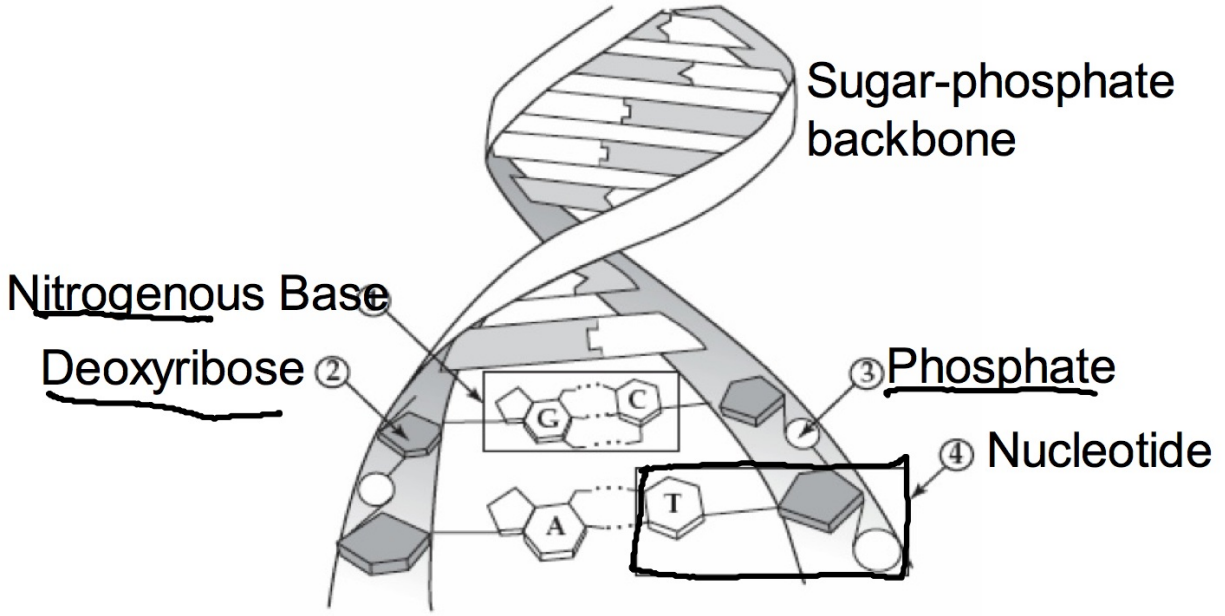


DNA: Deoxyribonucleic Acid

- Molecule responsible for the transmission of genetic information.
  - It's why you resemble your parents!
  - It's why you resemble your siblings!
  - It's why you resemble other humans!
  - It's why humans and apes resemble each other!

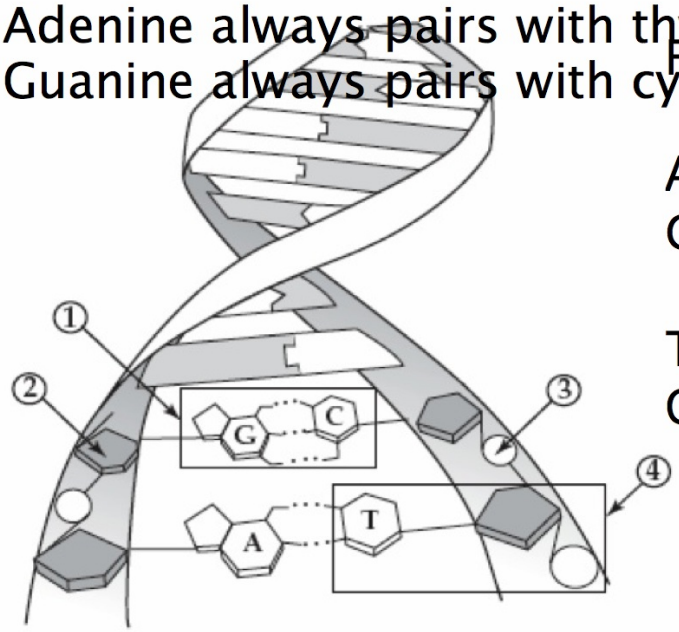
- Molecule responsible for coding information for proteins.
  - DNA provides the blueprints for coding for proteins.
    - Plans --> Building proteins --> Life functions!

DNA Structure and Discovery: The Famous Double Helix



Nucleotide: Phosphate + deoxyribose + nitrogenous base

Adenine always pairs with thymine: 2 hydrogen bonds.
Guanine always pairs with cytosine: 3 hydrogen bonds.



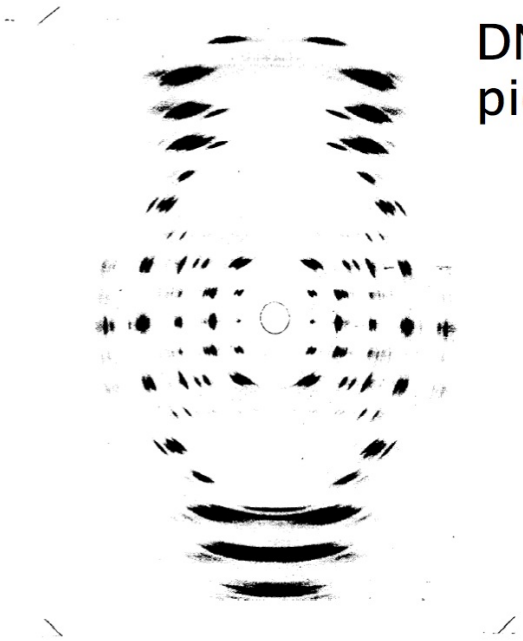
Four bases:

Adenine A
Guanine G
Thymine T
Cytosine C

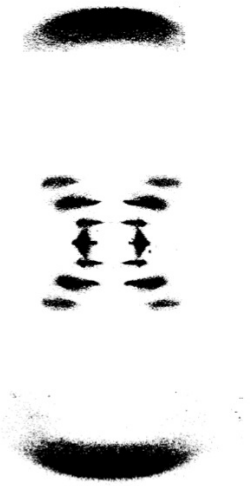
ATG CCA TAG
TAC GGT ATC

DNA Structure and Discovery

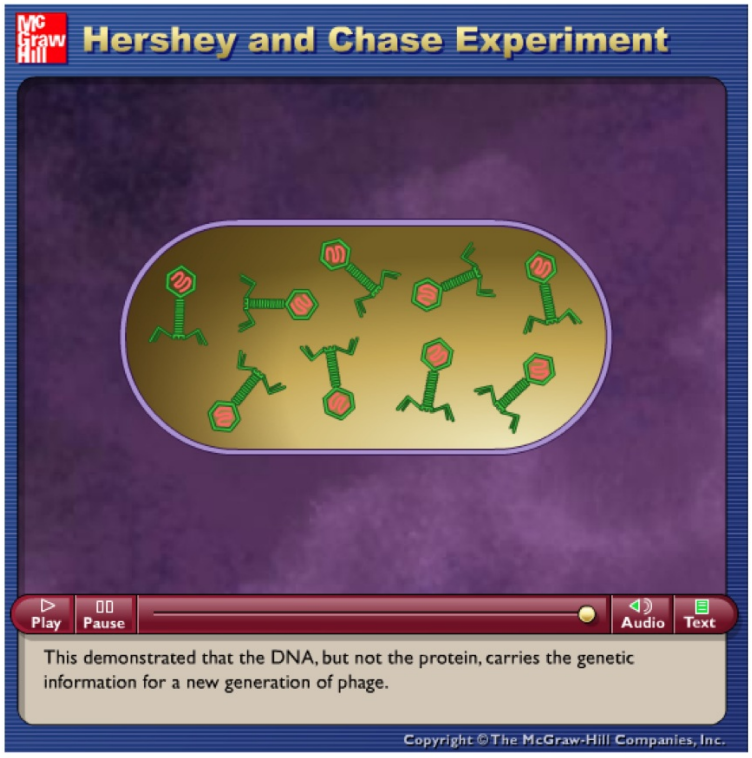
The structure of DNA was first characterized by:
JAMES FRANCES. ROSALIND MAURICE.
Watson and Crick .... and Franklin and Wilkins.



DNA's first clear pictures!

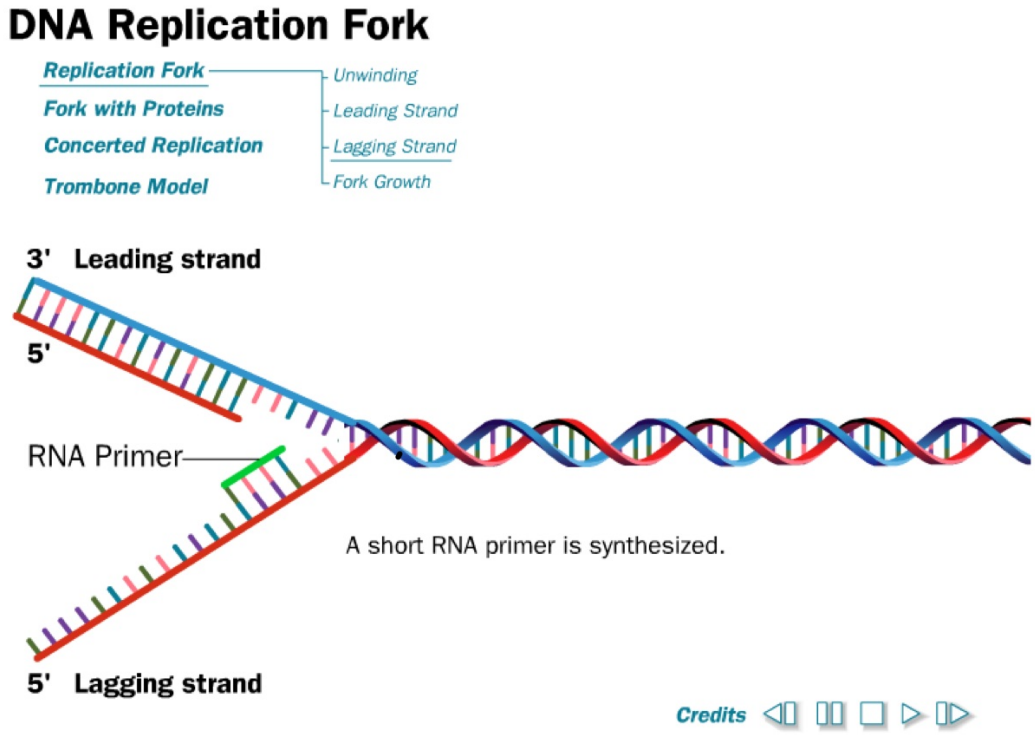


Proving DNA is the genetic material

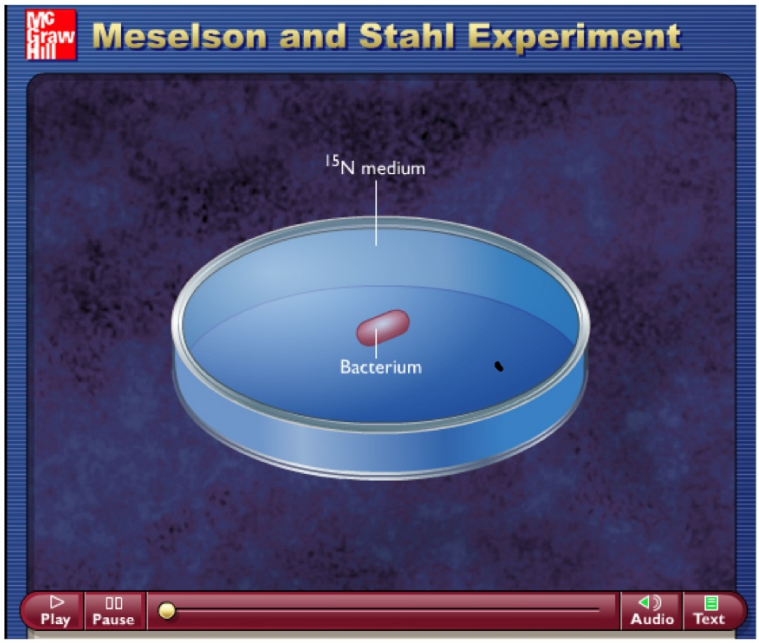


DNA Replication

DNA needs to make copies of itself. Why? To make more cells! Click here for video!



DNA replication is semi-conservative.



Gene to protein:

- What is a gene?
  - Segment of DNA that codes for a particular protein.

- To do this, we must convert the language of DNA to the language of proteins.

NUCLEOTIDES (DNA) → → AMINO ACIDS (PROTEINS)

  - Transcription
  - Translation

Transcription

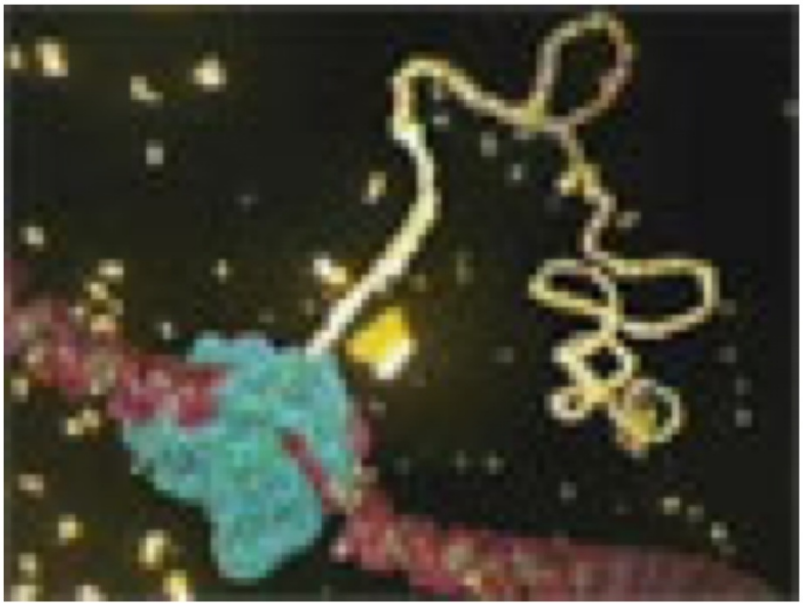
How do we get the information stored in DNA, which is in the nucleus, to the ribosomes (protein factories) in the cytoplasm?

Use a messenger!

mRNA - messenger ribonucleic acid.

- Contains a different sugar in its sugar-phosphate backbone: ribose.
- Uses 'U' - uracil - instead of T. U pairs with A.
- mRNA is single stranded.

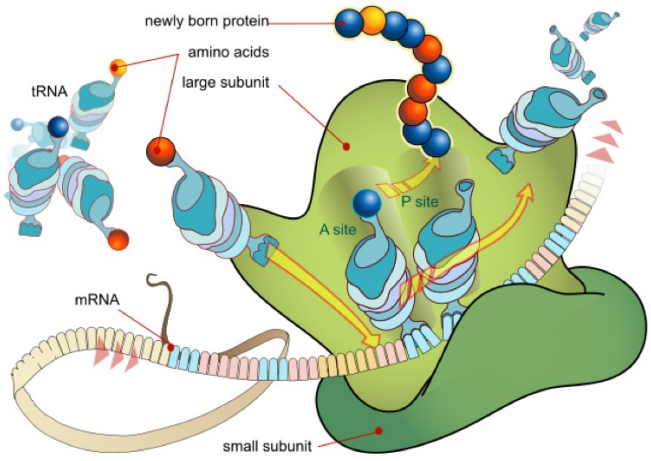
Watch transcription in action!

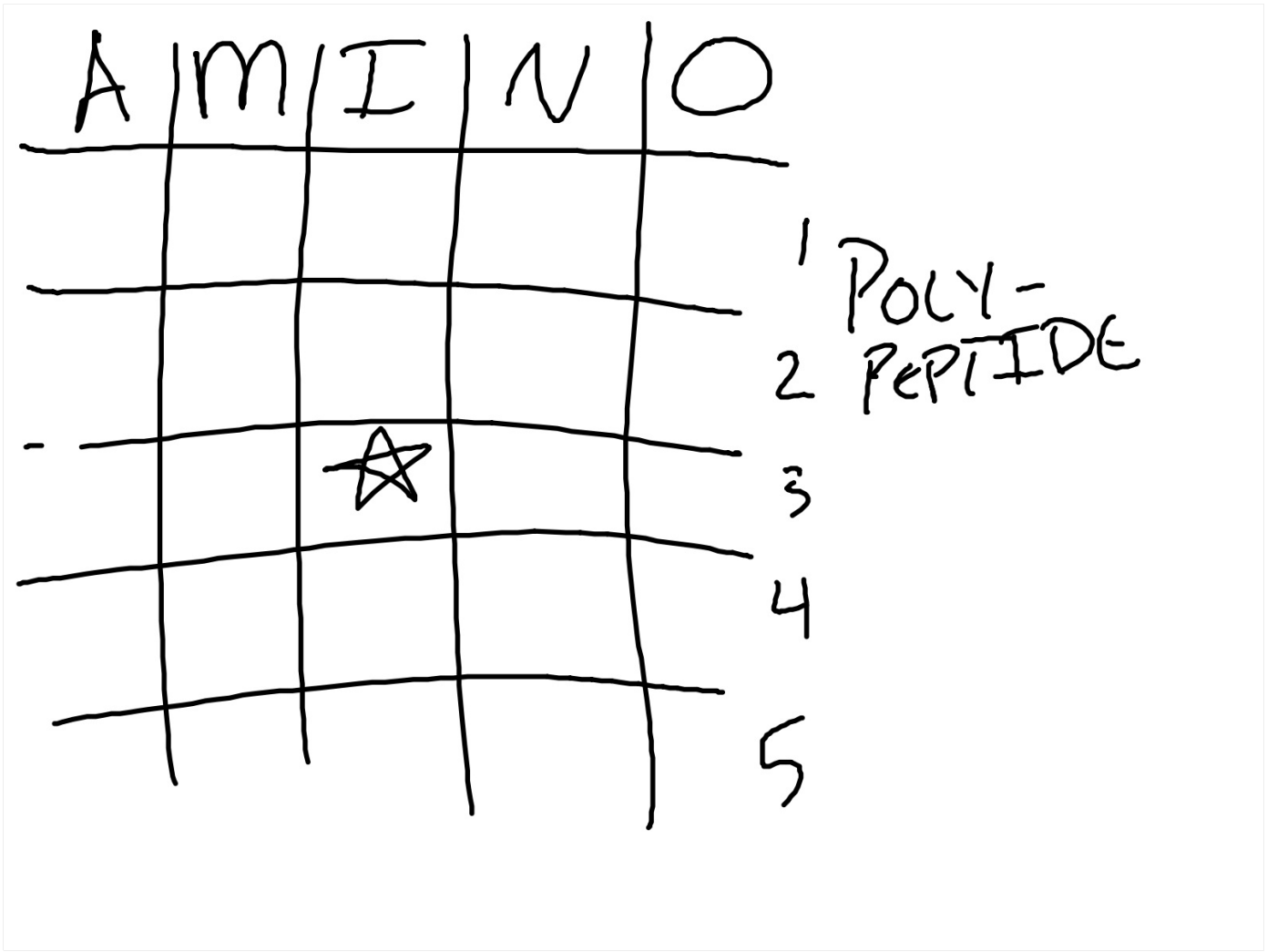


Translation

Once the message reaches the cytoplasm:

- It is translated from the language of nucleotides to the language of amino acids.
- Amino acids are the building blocks of proteins.

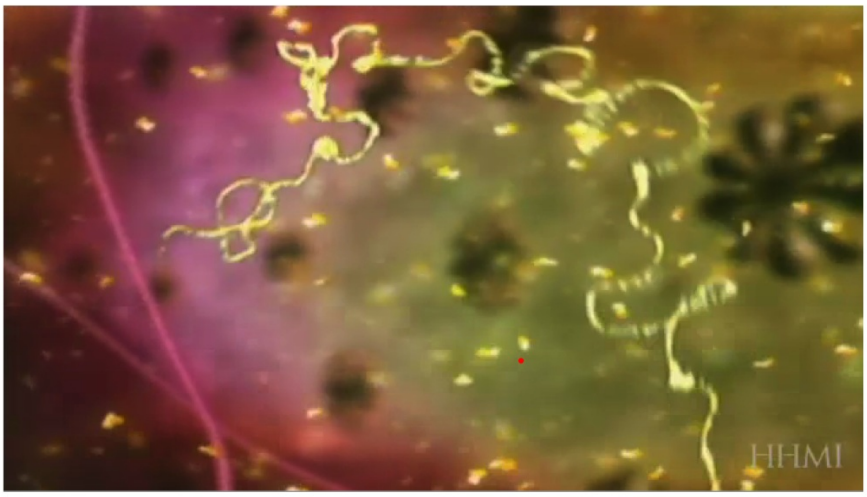



AMINO
1
2
3
4
5
POLY-
PEPTIDE

Translation in six easy steps:

- The mRNA reaches the cytoplasm.
- The subunits of the ribosome attach to the mRNA.
- The ribosome begins "reading" the mRNA.
- Transfer RNA (tRNA) brings amino acids to the ribosome. These "match" the codons and correspond to an amino acid.
- The amino acids link together.
- After 500 to several thousand amino acids – you have a protein!

Watch translation in action!



Mutation: Changes in DNA

Mutations lead to new DNA sequences.

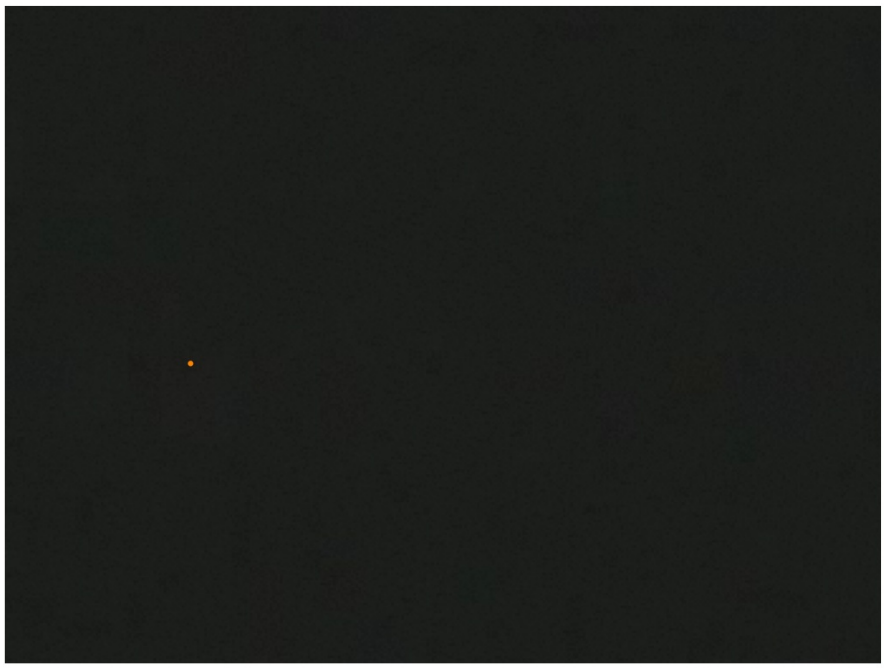
Changes in DNA can lead to changes in the proteins that DNA codes for – which can change organisms!

These mutations can be harmful or beneficial. Most are neutral.

Causes of mutations:

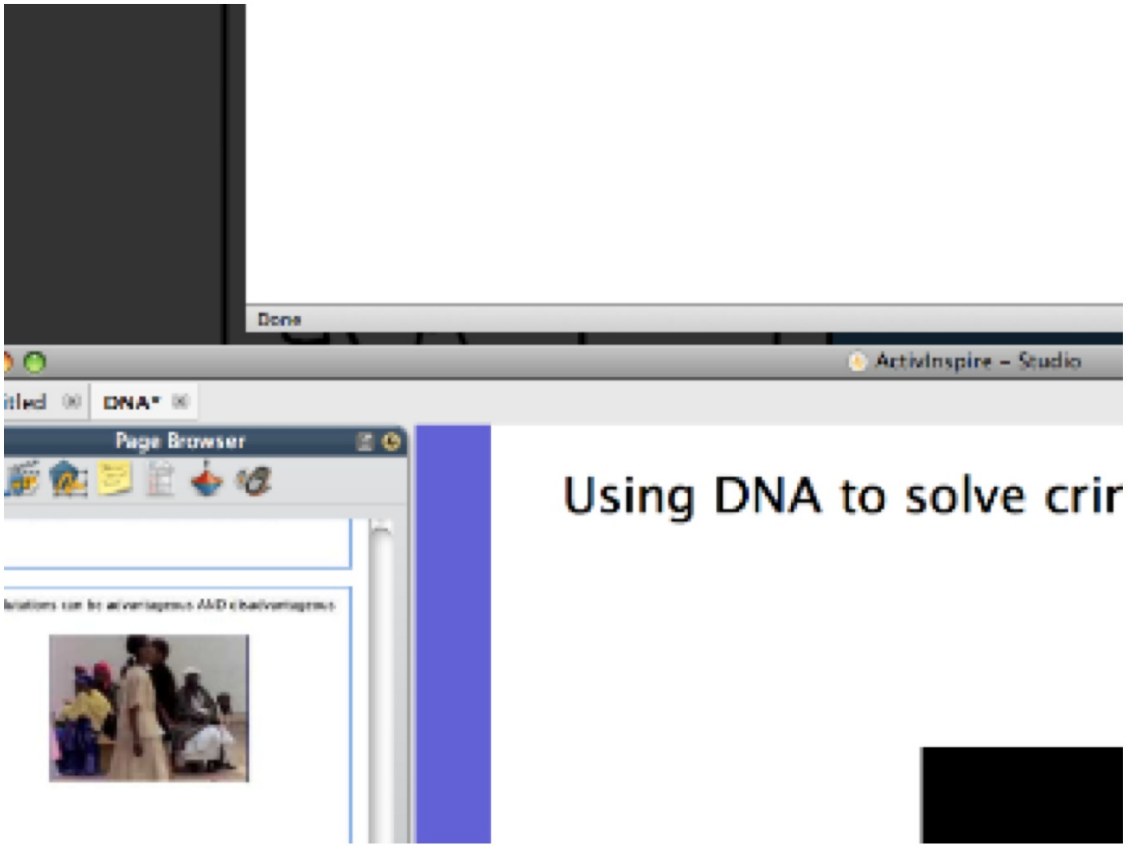
- Mistakes in copying DNA and/or the cell cycle.
- Environmental factors – UV light, cigarette smoke, toxins, etc.
- Viruses (ex. HPV causes cervical cancer)

Mutations Affect the Genetic Code - and Proteins!



Mutations can be advantageous AND disadvantageous

Using DNA to solve crimes: Genetic Profiling



Gel Electrophoresis: An Introduction

DNA Packaging: Putting DNA into Chromosomes

- After DNA replication – when DNA is copied – DNA is packed into chromosomes in order to move it during cell division (mitosis).

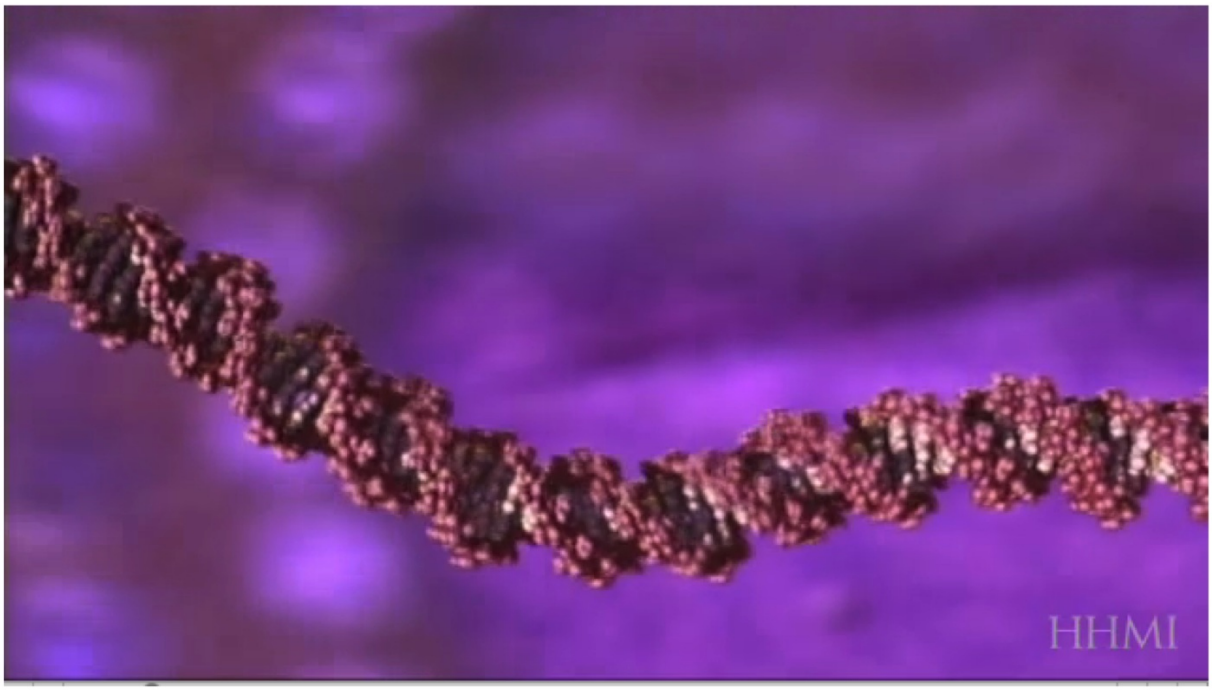
Sister chromatid

Sister chromatid

Centromere

HISTONES

DNA is packaged into chromosomes

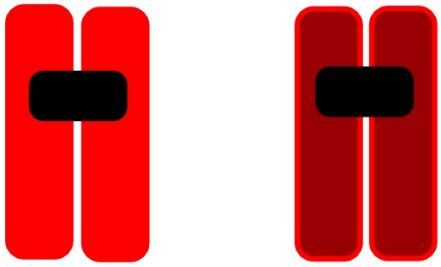


Similar, but not the same: **Homologous** chromosomes

Humans have 23 pairs of chromosomes.

You get one member of each pair from your father and one member of each pair from your mother.

These chromsomes generally contain the same genes, but these may have different codes (**alleles**).



Making homologous chromosomes.

1. Adjust the size of chromosomes to match your assigned chromosome. (Fold the sock over, etc.)
2. Clip your sets of sister chromatids together with binder clips. This is the centromere.
3. Mark your maternal and paternal chromosome with different colors of electrical tape.
4. Mark a gene on each chromosome (with two different color bands of electrical tape) that is similar but not the same.

Silent brainstorming:

What makes someone/something male?

What makes someone/something female?


genes
HHMI
16:03
58:51

Place this chromosome in the partially completed karyotype below by clicking on its homologous chromosome. If you match the chromosome correctly, you will proceed to the next chromosome. If you match incorrectly, a page will explain why the chromosome you chose is not the unknown's pair and you can choose again.