Identifying the Substance of the Gene

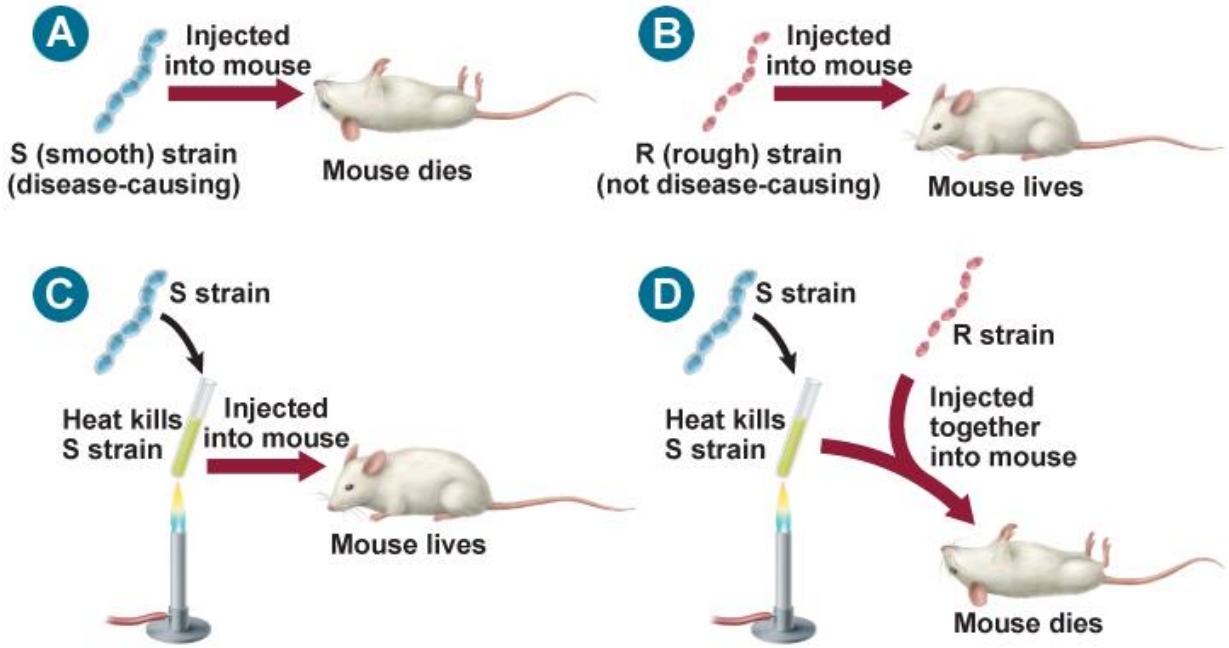
Learning Objectives

- Identify the clues that bacterial transformation yielded about the gene.
- Explain the role bacterial viruses played in identifying genetic material.
- Describe the role of DNA in heredity.

DNA: The Genetic Material

Griffith

- Performed the first major experiment that led to the discovery of DNA as the genetic material



DNA: The Genetic Material

Avery

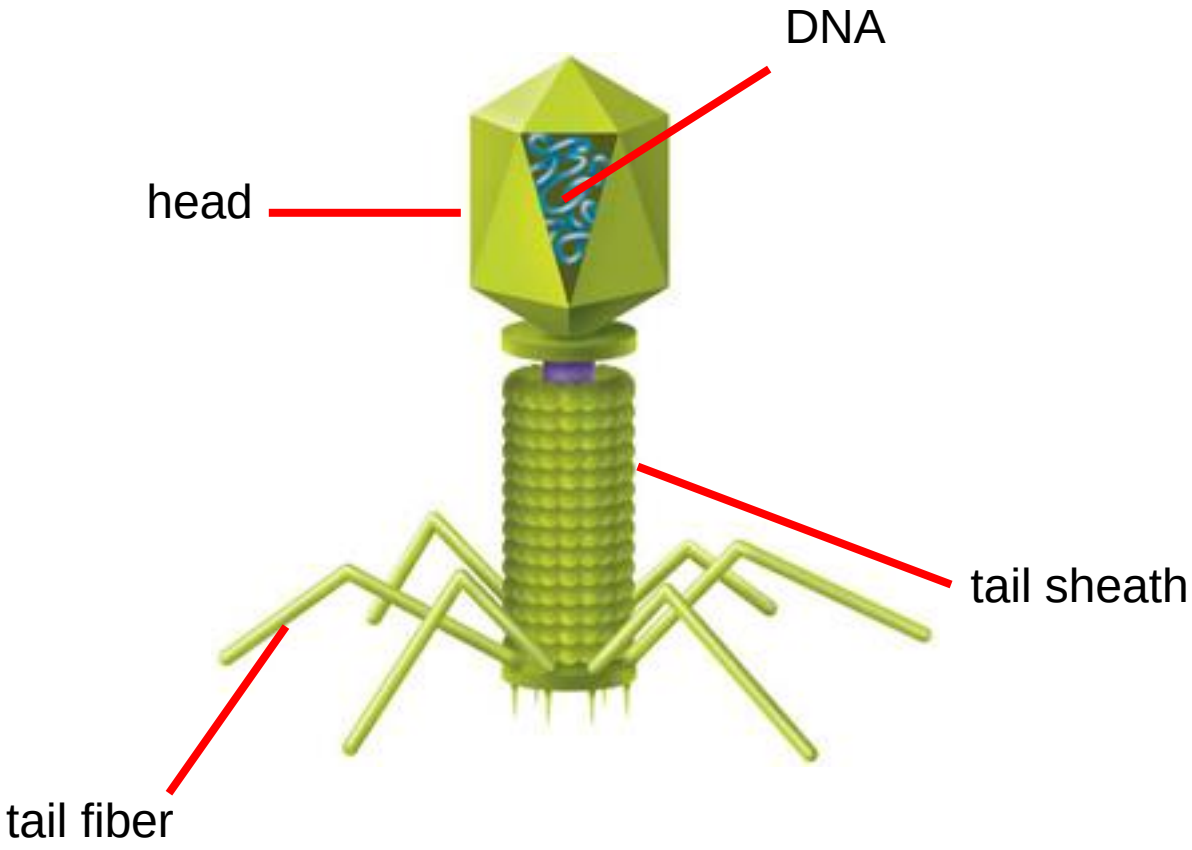
- Identified the molecule that transformed the R strain of bacteria into the S strain
- Concluded that when the S cells were killed, DNA was released
- R bacteria incorporated this DNA into their cells and changed into S cells.

Avery's Experiments

Scientists discovered that the nucleic acid DNA stores and transmits genetic information from one generation of bacteria to the next.

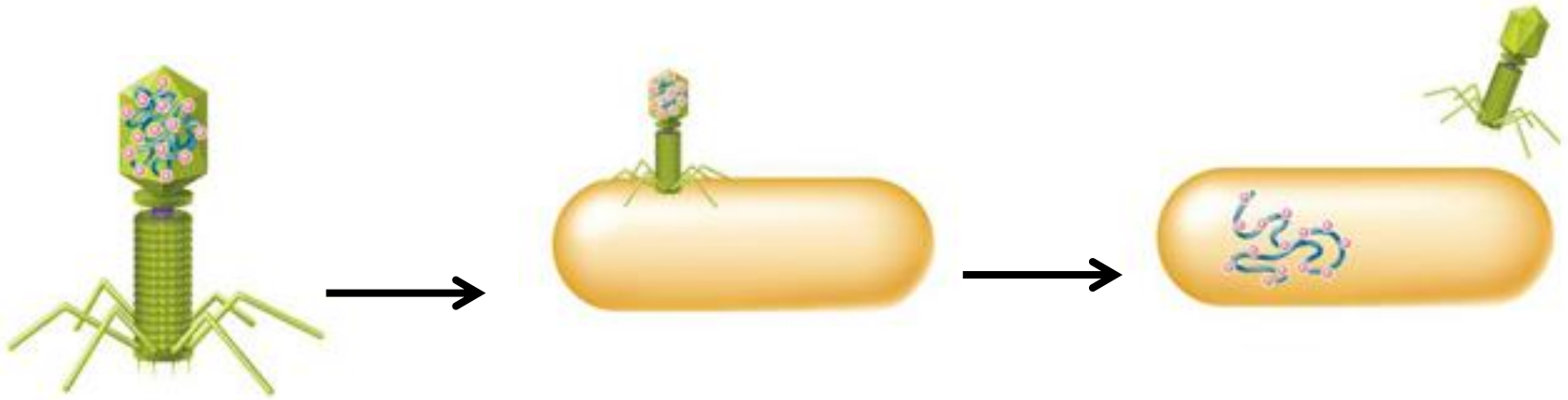
Bacterial Viruses

Bacteriophage: a kind of virus that infects bacteria



Hershey Chase Experiment Animation

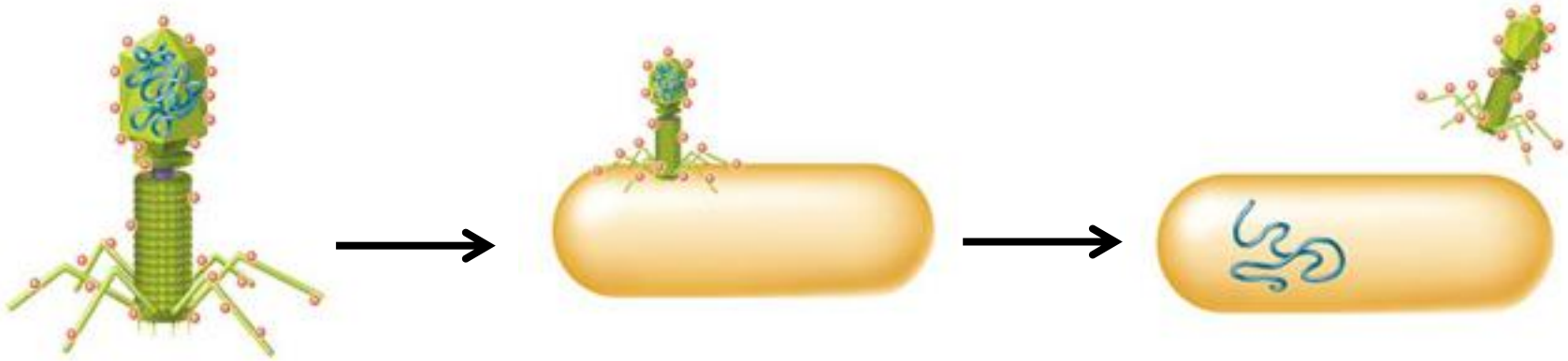
Hershey-Chase Experiment



Bacteriophage with phosphorus-32 in DNA

Phage infects bacterium.

Radioactivity inside bacterium



Bacteriophage with sulfur-35 in protein coat

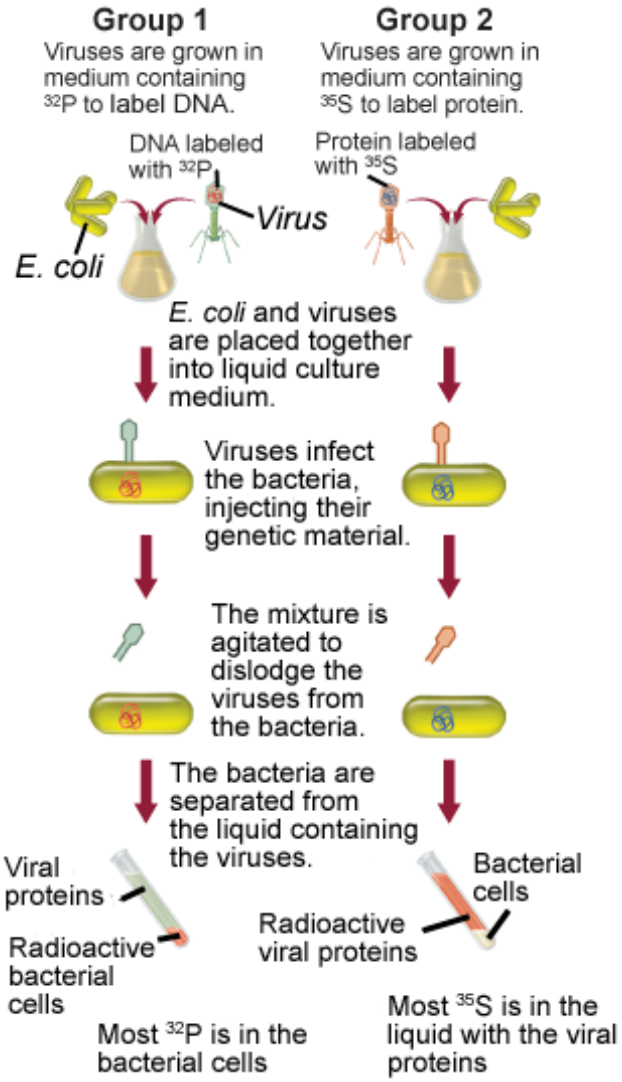
Phage infects bacterium.

No radioactivity inside bacterium

DNA: The Genetic Material

Hershey and Chase

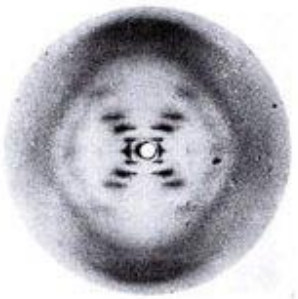
- Used radioactive labeling to trace the DNA and protein
- Concluded that the viral DNA was injected into the cell and provided the genetic information needed to produce new viruses



DNA: The Genetic Material

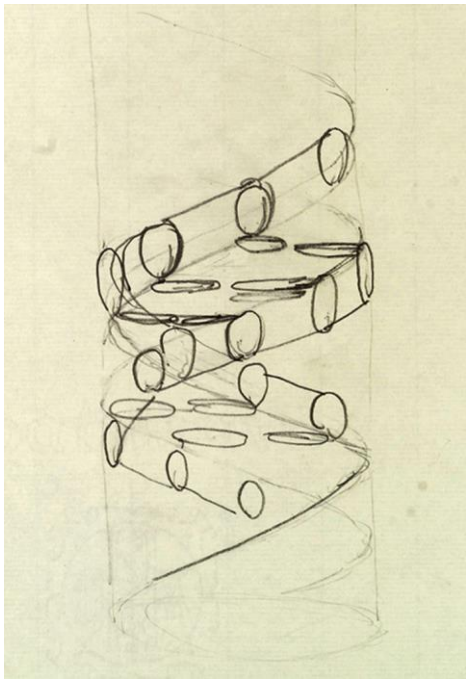
X-ray Diffraction

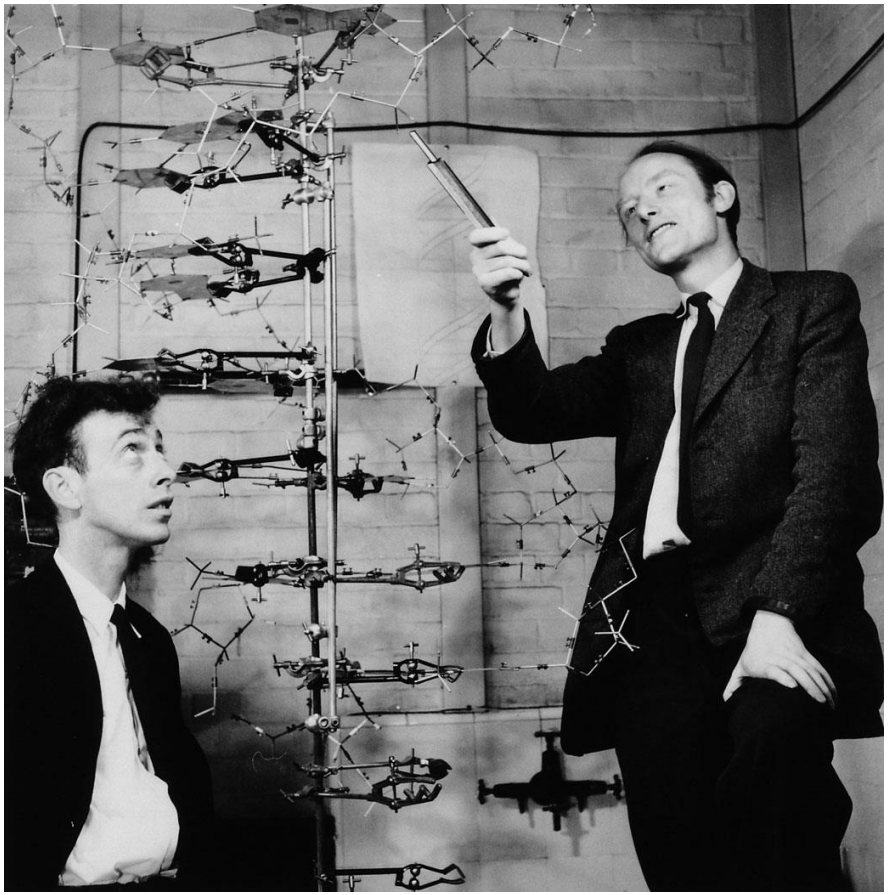
- X-ray diffraction data helped solve the structure of DNA
  - Rosalind Franklin took the famous Photo 51 which helped scientists Watson and Crick describe the double helix



The Work of Watson and Crick

DNA is a double helix, in which two strands of nucleotide sequences are wound around each other.





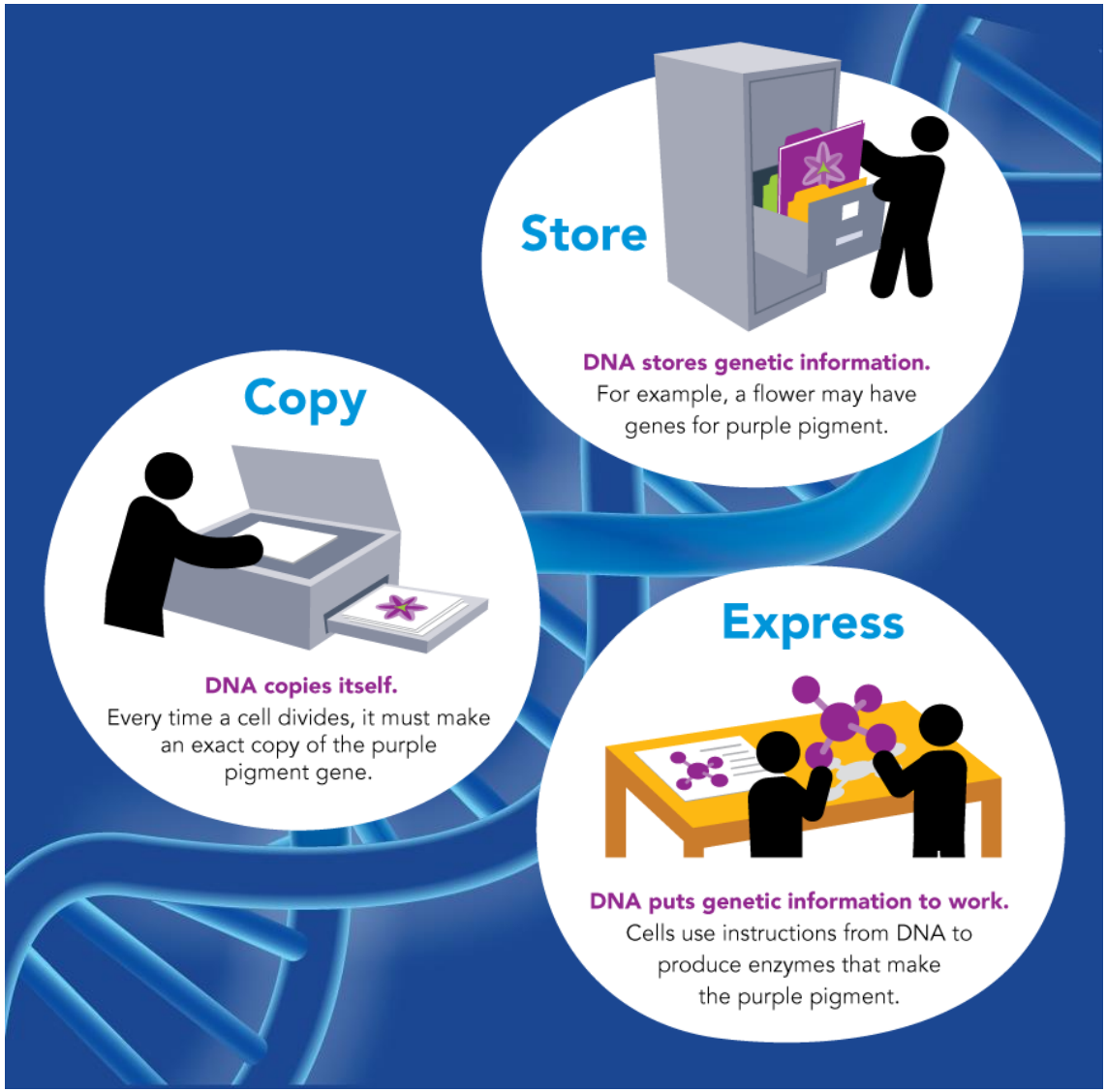
DNA: The Genetic Material

Watson and Crick

- Built a model of the double helix that conformed to the others' research

1. two outside strands consist of alternating deoxyribose and phosphate
2. cytosine and guanine bases pair to each other by three hydrogen bonds
3. thymine and adenine bases pair to each other by two hydrogen bonds

The Role of DNA



The Structure of DNA-Amoeba Sisters DNA Structure and Function

DNA: The Genetic Material

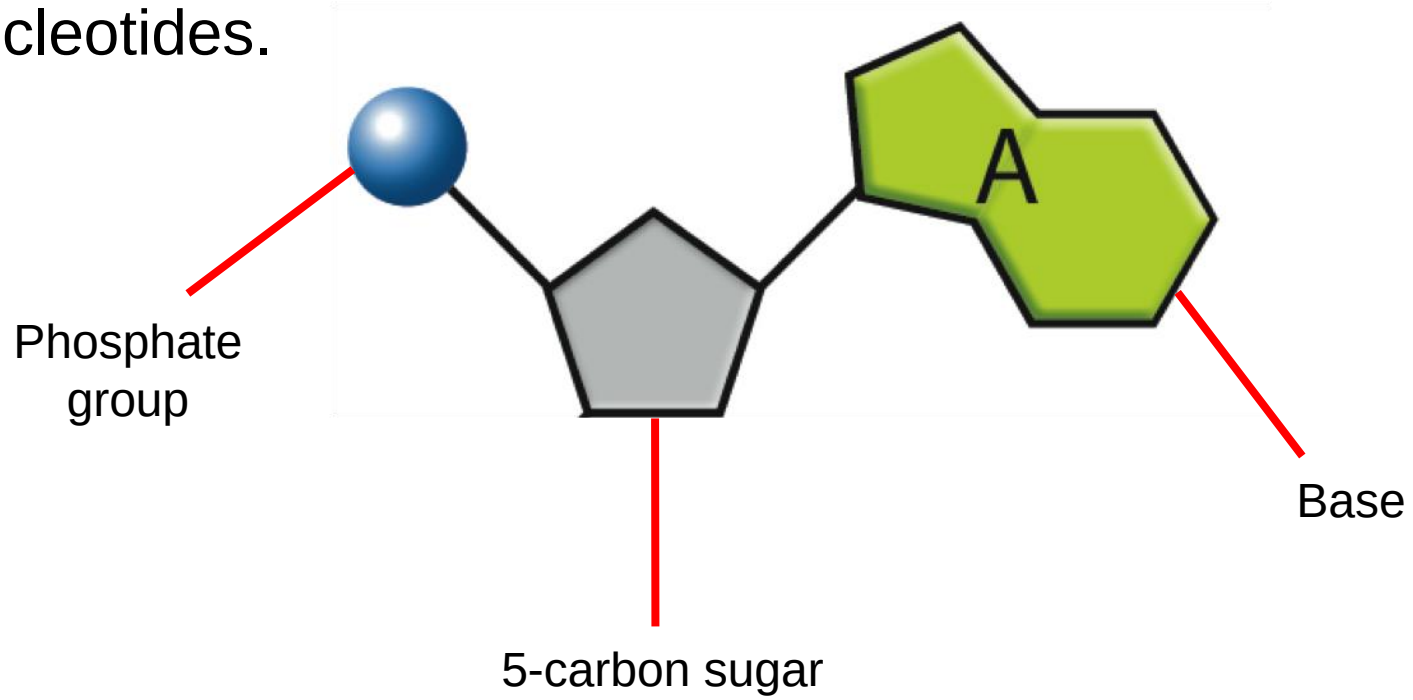
DNA Structure-review your foldable on DNA

- Deoxyribonucleic acid
- Found in nucleus of cell
- DNA often is compared to a twisted ladder.
- Rails of the ladder are represented by the alternating deoxyribose and phosphate.
- 2 types of bases: purine and pyrimidine
- The pairs of bases (cytosine–guanine or thymine–adenine) form the steps.

What did Chargaff discover about the amounts of the bases in DNA?

Nucleotide Structure

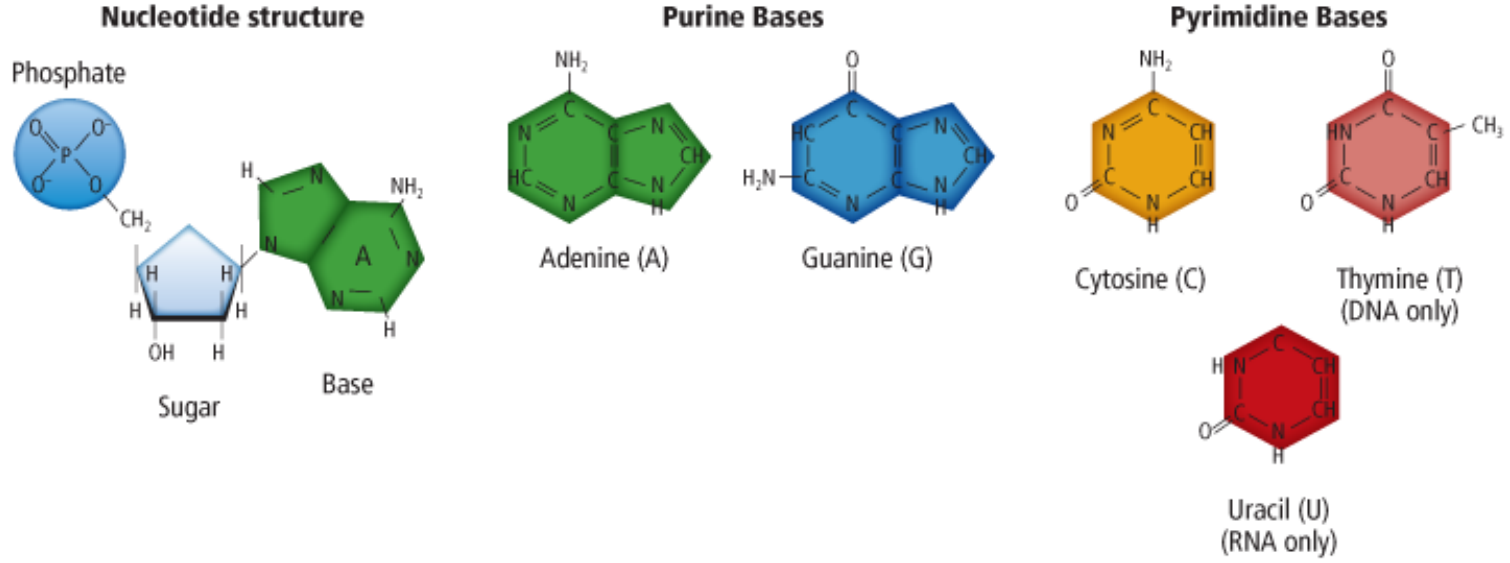
- DNA is made up of nucleotides joined into long strands or chains by covalent bonds.
- Nucleic acids are made up of building blocks called nucleotides.



DNA: The Genetic Material

DNA Structure

- Nucleotides
  - Consist of a five-carbon sugar, a phosphate group, and a nitrogenous base



DNA: The Genetic Material

Chargaff's Data

	Base Composition (Mole Percent)			
Organism	A	T	G	C
Escherichia coli	26.0	23.9	24.9	25.2
Yeast	31.3	32.9	18.7	17.1
Herring	27.8	27.5	22.2	22.6
Rat	28.6	28.4	21.4	21.5
Human	30.9	29.4	19.9	19.8

Chargaff

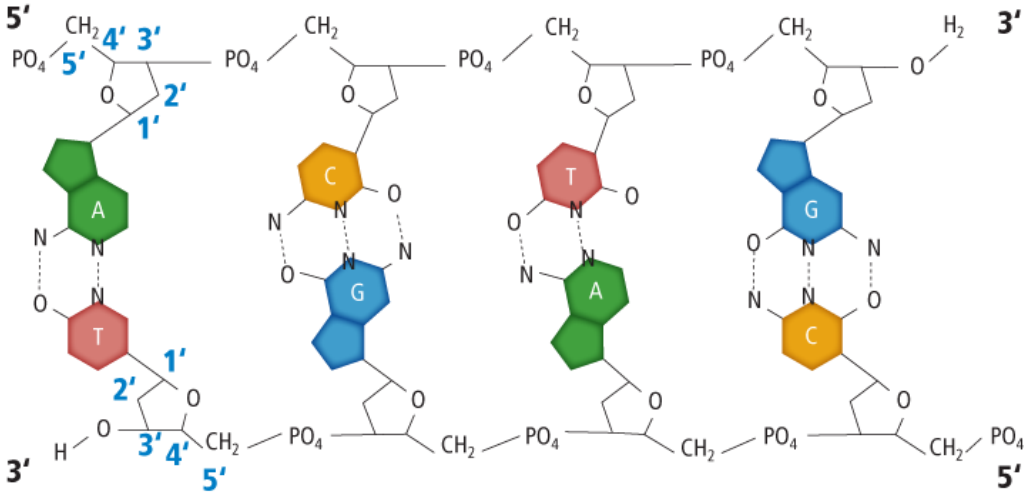
- Chargaff's rule:
  C = G and T = A

Why was this data significant?

DNA: The Genetic Material

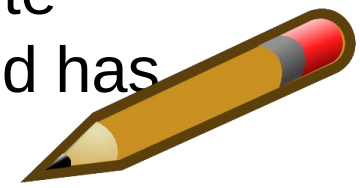
Orientation

The number refers to numbers assigned to five carbon sugar -see blue numbers

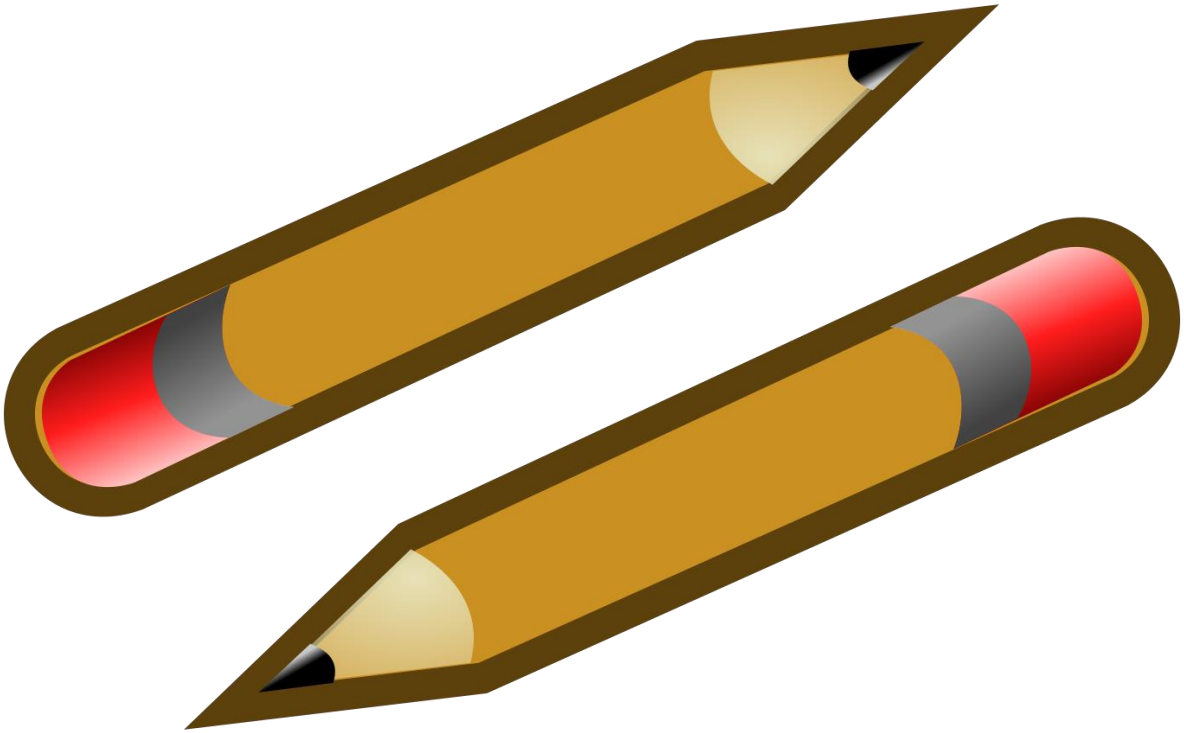


- On the top rail, the strand is said to be oriented 5′ to 3′. 5 prime end has phosphate group

- The strand on the bottom runs in the opposite direction and is oriented 3′ to 5′. 3 prime end has OH sugar group (Antiparallel)



Antiparallel Example



Candy DNA

- Using the materials you have been given, create a model of DNA
- Have a peer check your model-make sure bases are paired correctly
- Save in labeled bag for Friday-DO NOT EAT☺

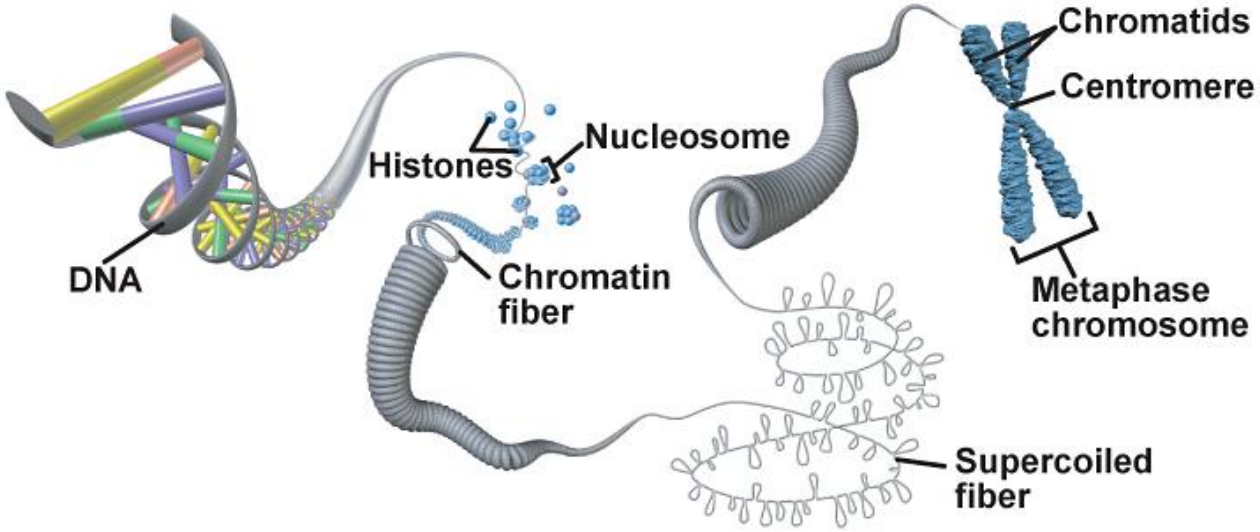
Length of DNA

- Describe in base pairs (bp)
- DNA makes up chromosomes
- Length of human chromosome ranges from 51 million to 245 million bp
- A strand with 140 million bp would be approximately 5 cm long-how does it fit into the tiny nucleus?

DNA: The Genetic Material

Chromosome Structure

- DNA coils around histones to form nucleosomes, which coil to form chromatin fibers.
- The chromatin fibers supercoil to form chromosomes that are visible in the metaphase stage of mitosis.



Activity:

- Supercoiling of DNA

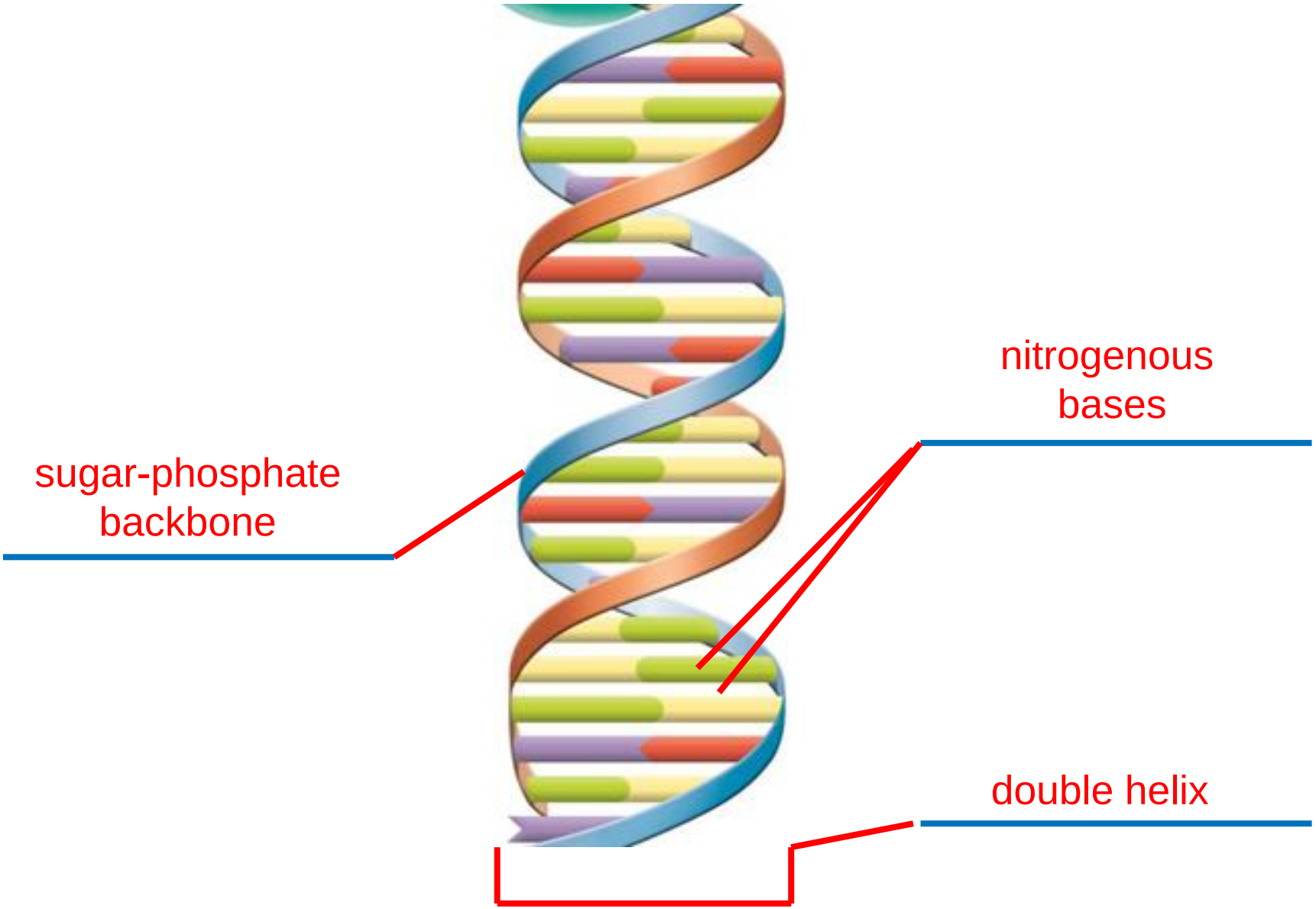
DNA Replication

Lab Activity:

Candy DNA-part I (save model for part 2)

Watch video: Amoeba Sisters DNA Replication

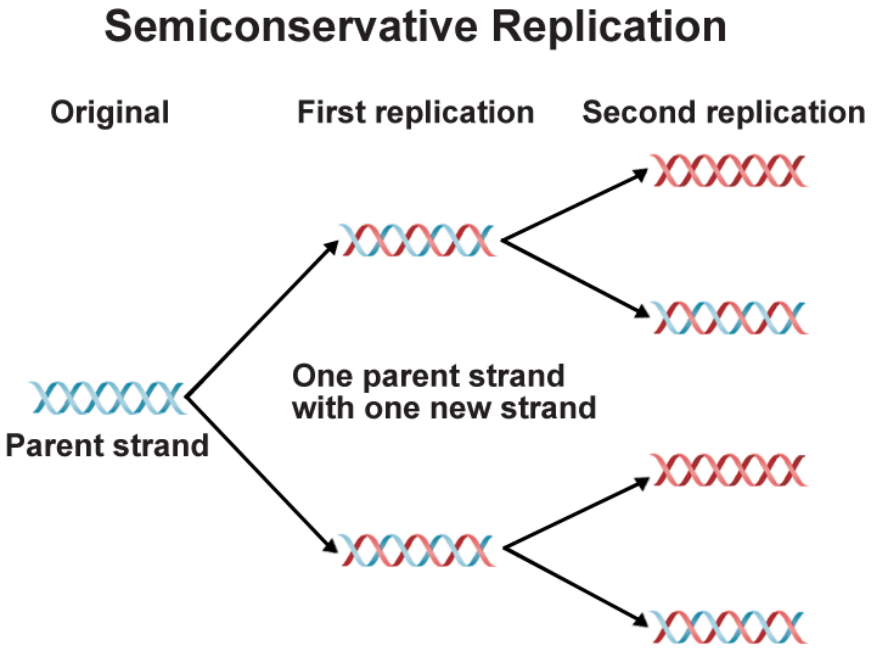
Review of DNA Structure



Replication of DNA

Semiconservative Replication

- Parental strands of DNA separate, serve as templates, and produce DNA molecules that have one strand of parental DNA and one strand of new DNA.



*Replication occurs in 3 stages: unwinding, base pairing and joining

Replication of DNA

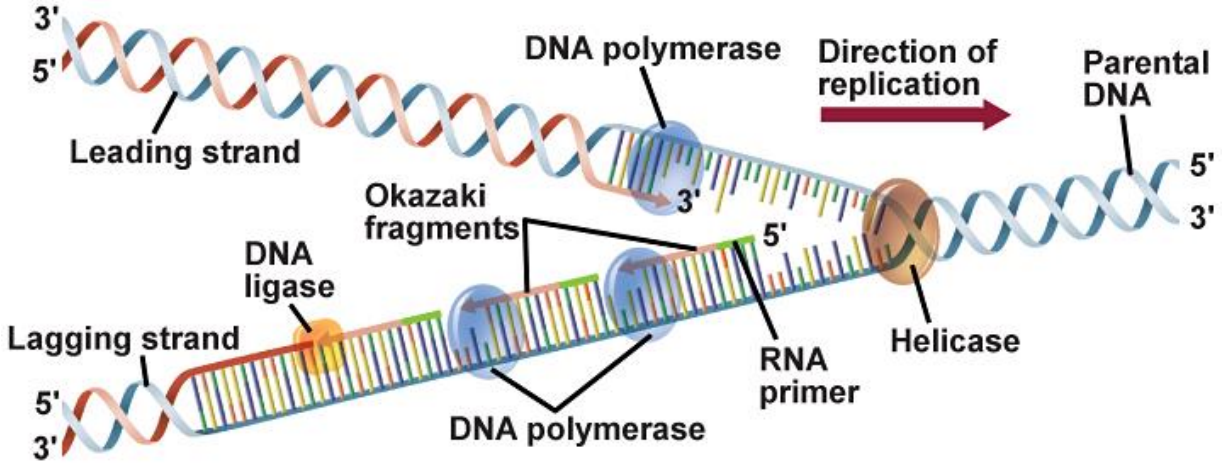
Unwinding

- DNA **helicase**, an enzyme, is responsible for unwinding and unzipping the double helix.
- RNA **primase** adds a short segment of RNA, called an RNA primer, on each DNA strand.

Replication of DNA

Base pairing

- DNA polymerase continues adding appropriate nucleotides to the chain by adding to the 3′ end of the new DNA strand.



Replication of DNA

- One strand is called the leading strand and is elongated as the DNA unwinds.
- The other strand of DNA, called the lagging strand, elongates away from the replication fork.
- The lagging strand is synthesized discontinuously into small segments, called Okazaki fragments.

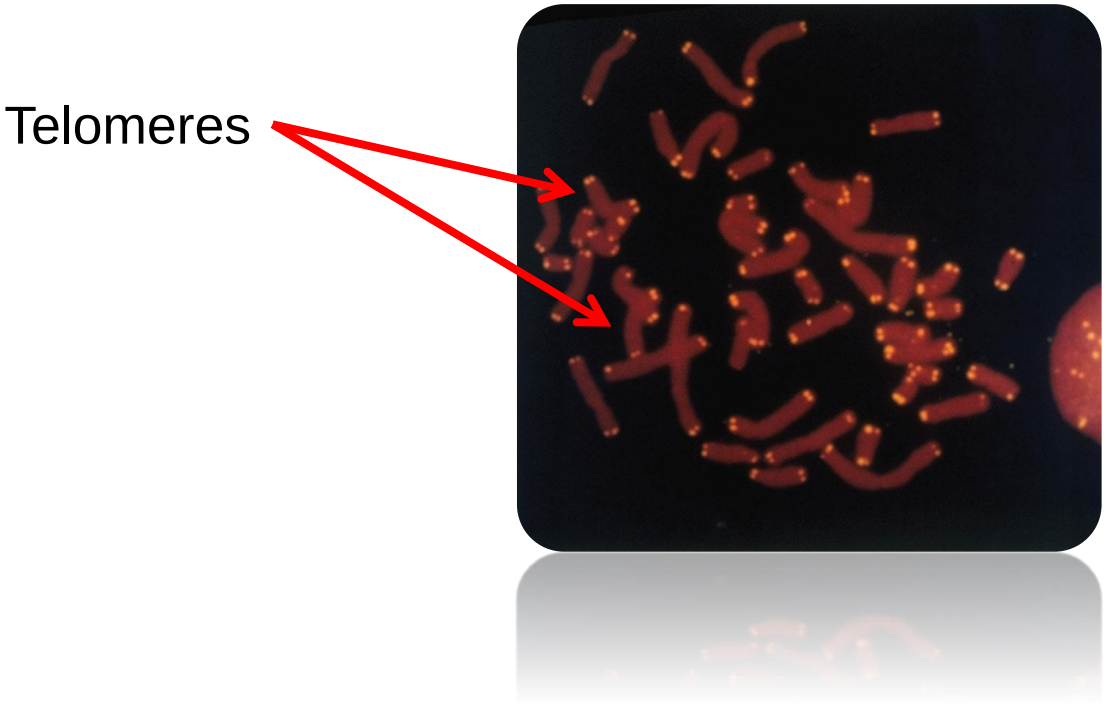
Replication of DNA

Joining

- DNA polymerase removes the RNA primer and fills in the place with DNA nucleotides.
- DNA ligase links the two sections.

Telomeres

- **Telomeres:** the tips of eukaryotic chromosomes
- The enzyme telomerase adds short, repeated DNA sequences to telomeres as the chromosomes are replicated.

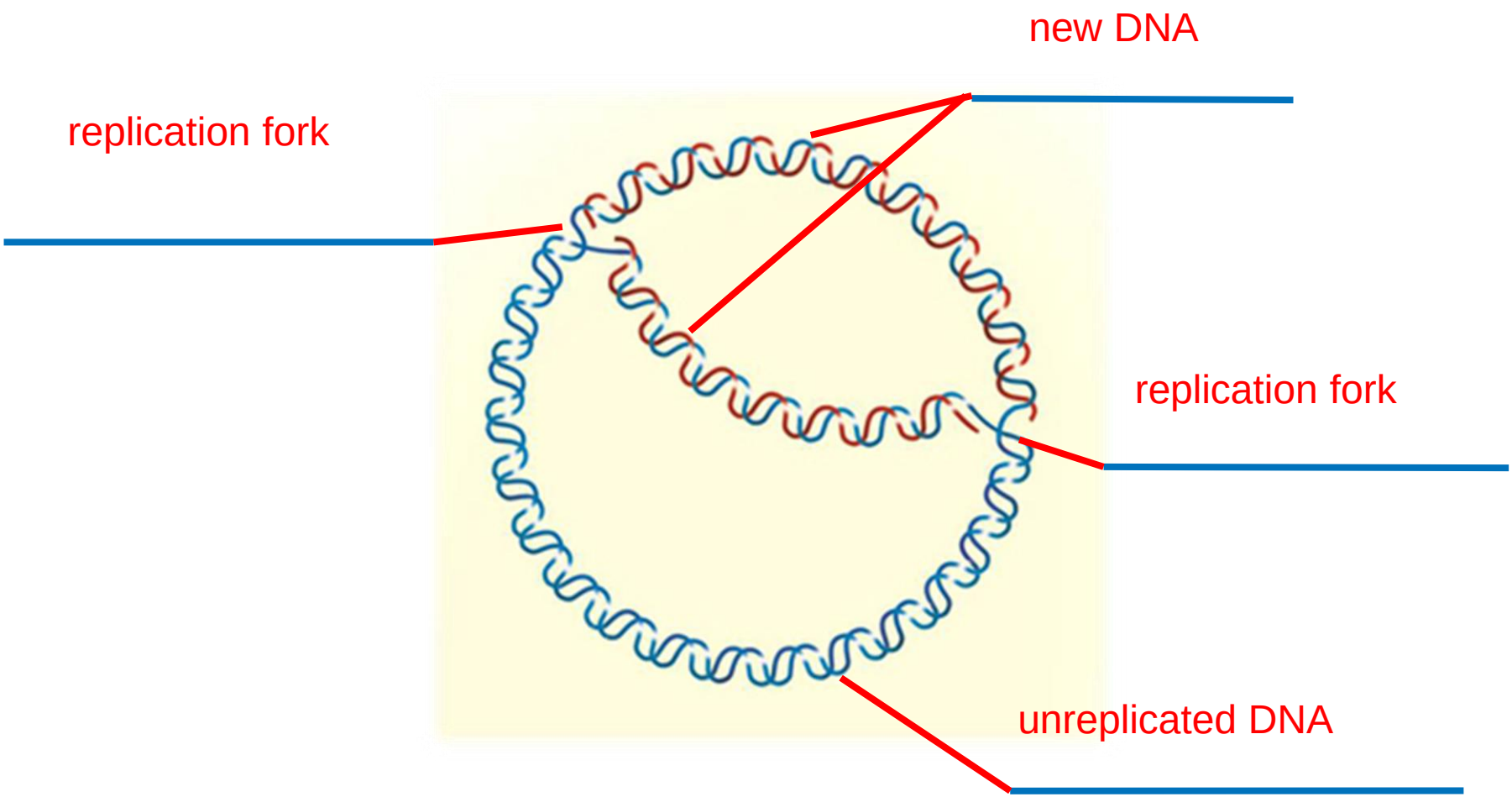


Replication of DNA

Comparing DNA Replication in Eukaryotes and Prokaryotes

- Eukaryotic DNA unwinds in multiple areas as DNA is replicated.
- In prokaryotes, the circular DNA strand is opened at one origin of replication.

Prokaryotic DNA Replication



Eukaryotic DNA Replication