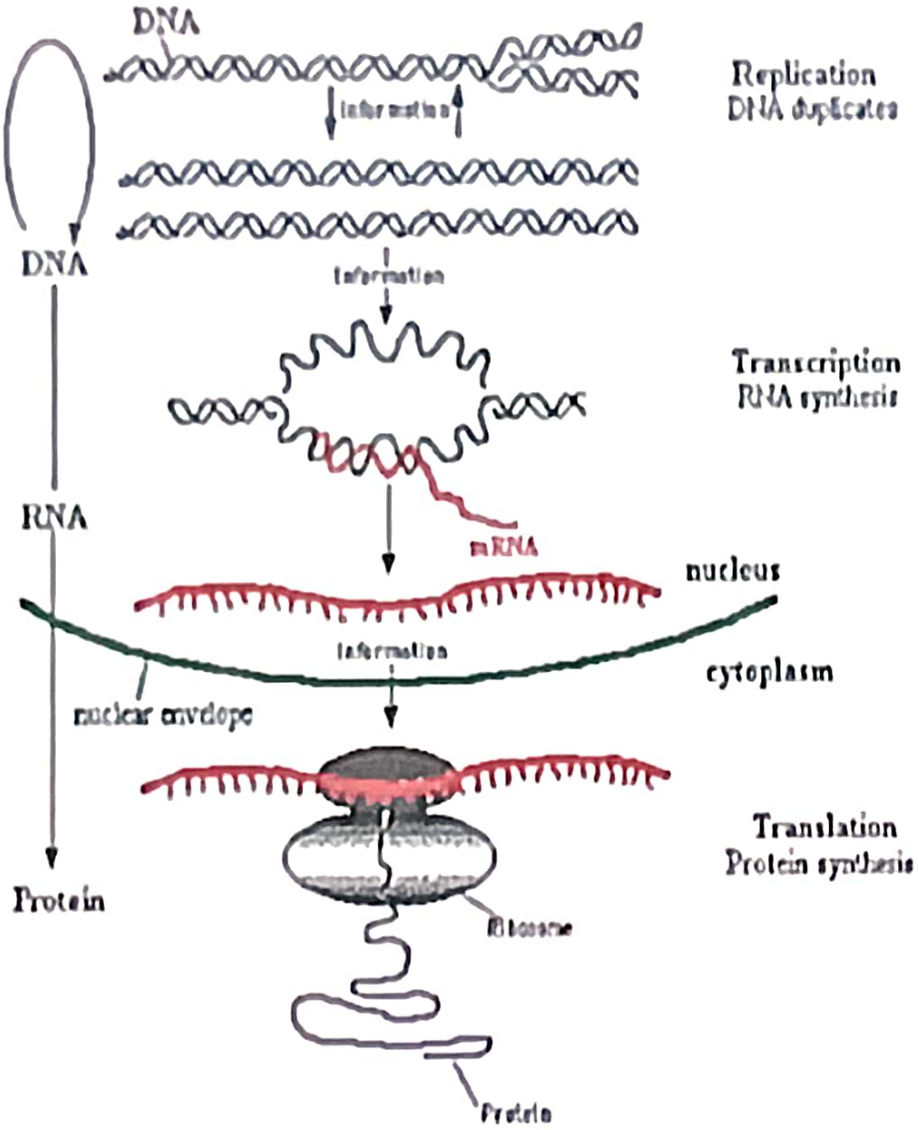
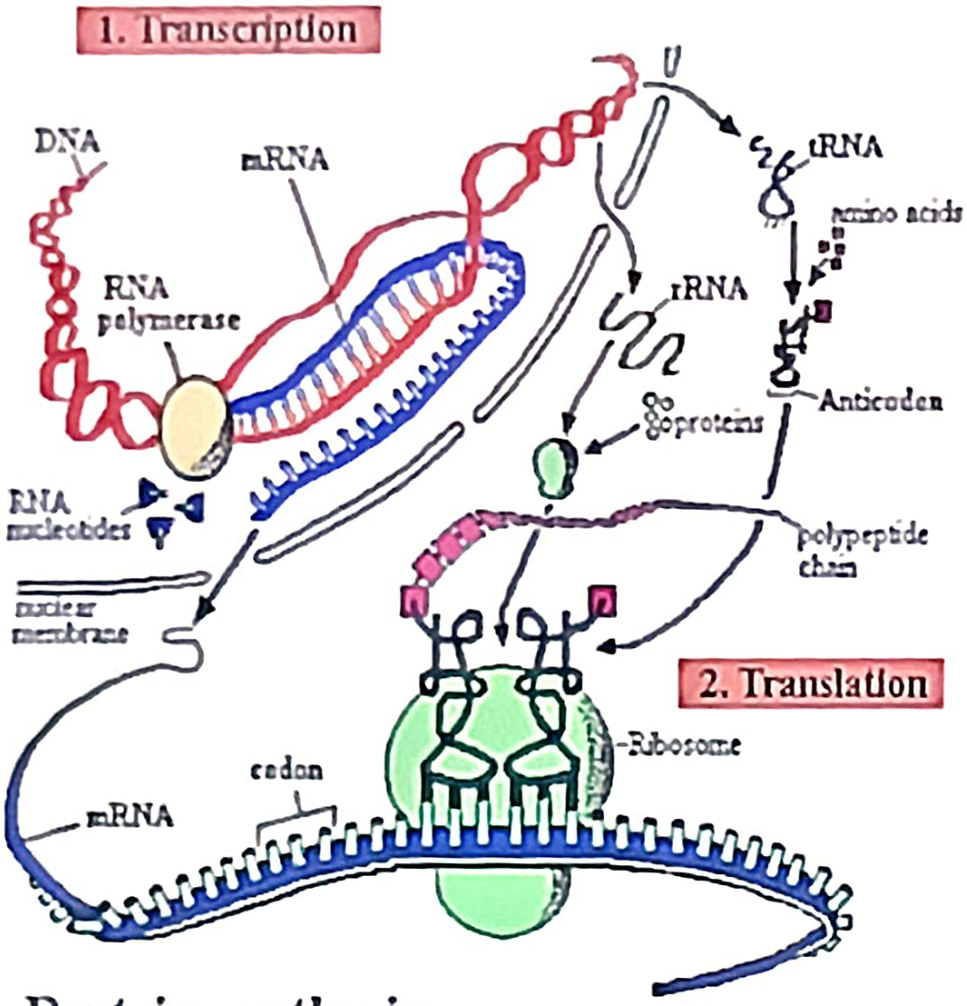


The Central Dogma of Molecular Biology

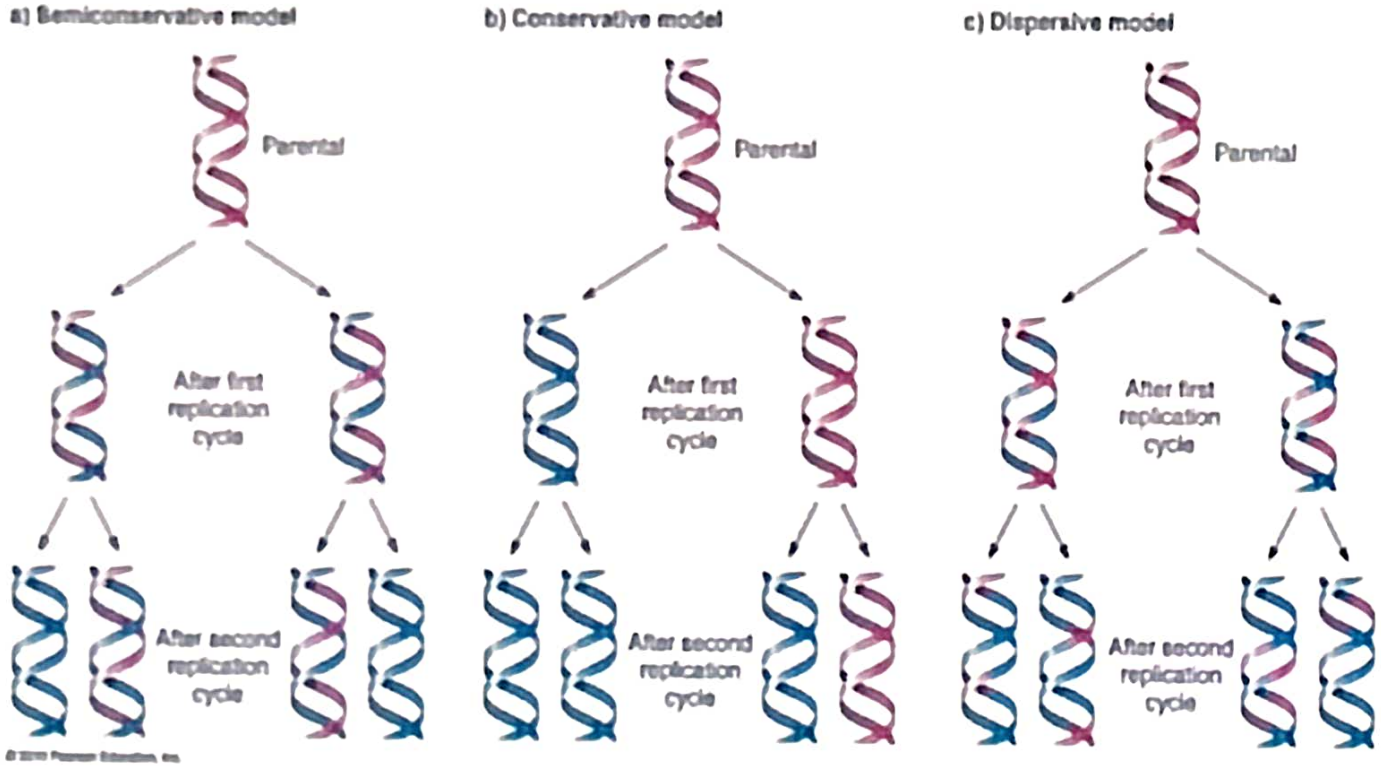
Information Flow in Nucleated Cell



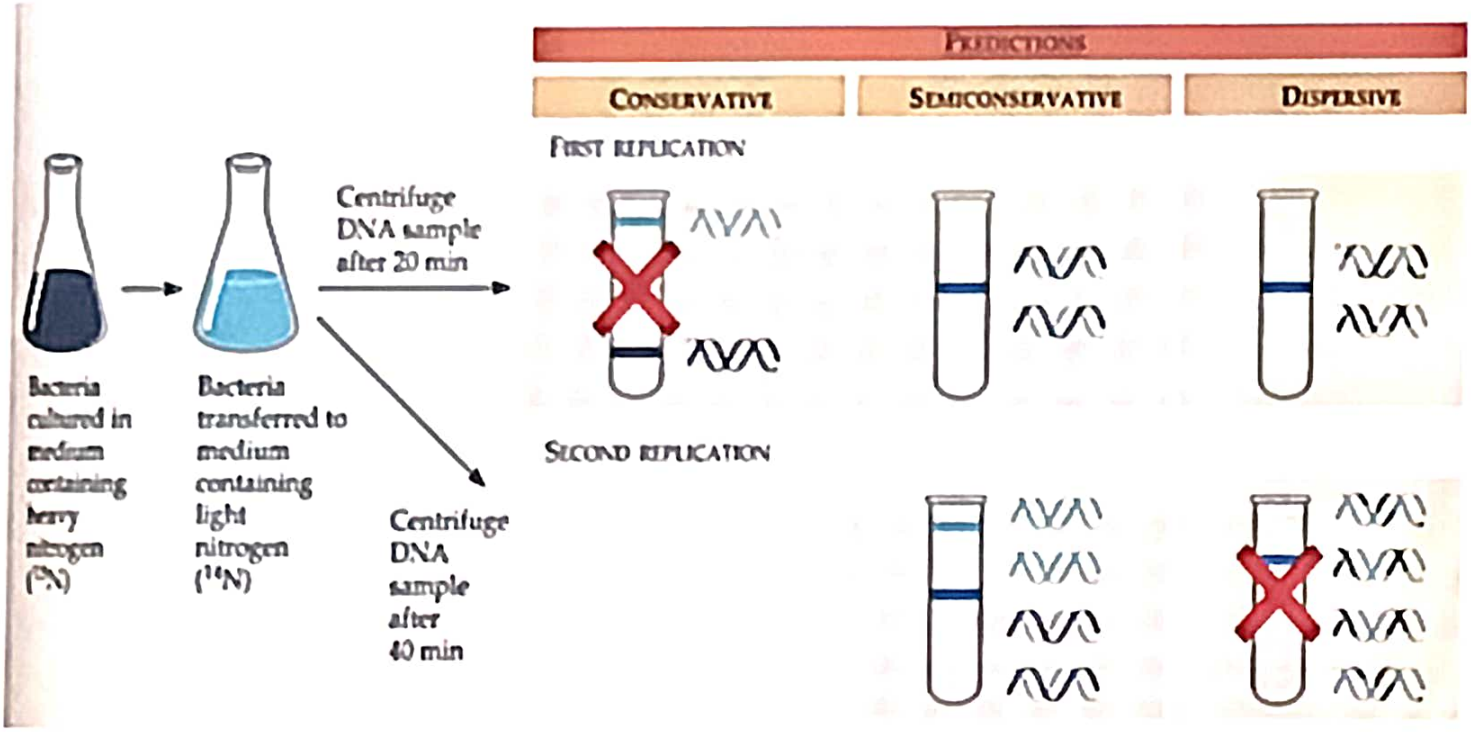
Protein synthesis

DNA Replication

- Purpose: cells need to make a copy of DNA before dividing so each daughter cell has a complete copy of genetic information
- 3 proposed Models of Replication

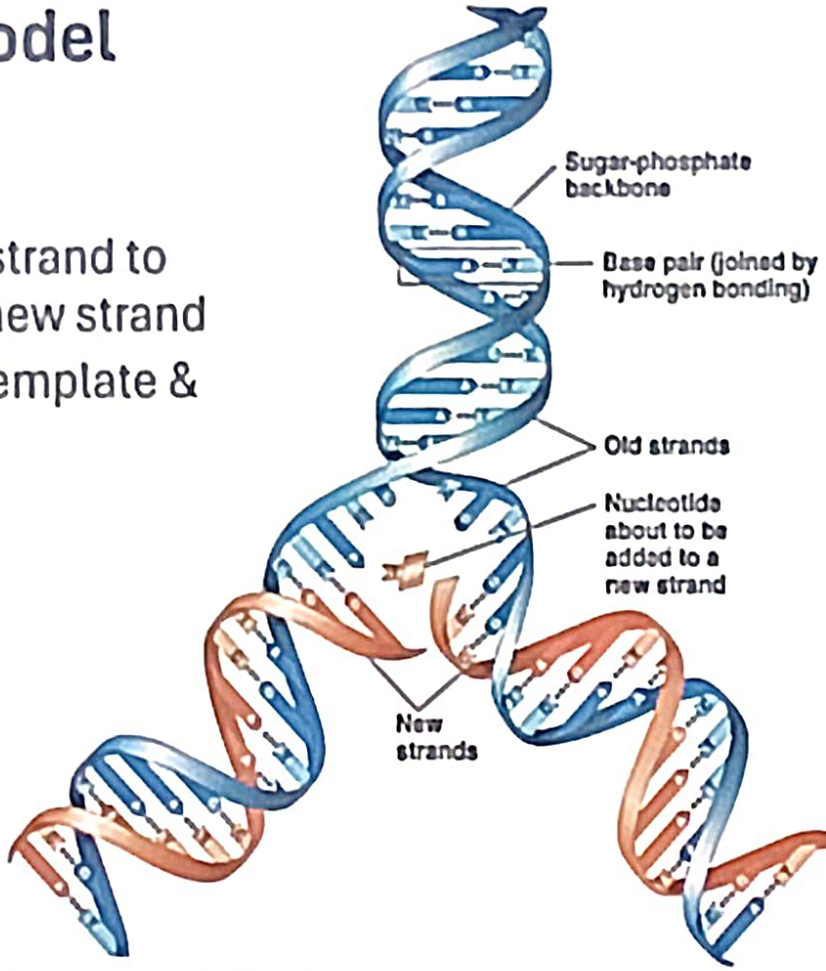


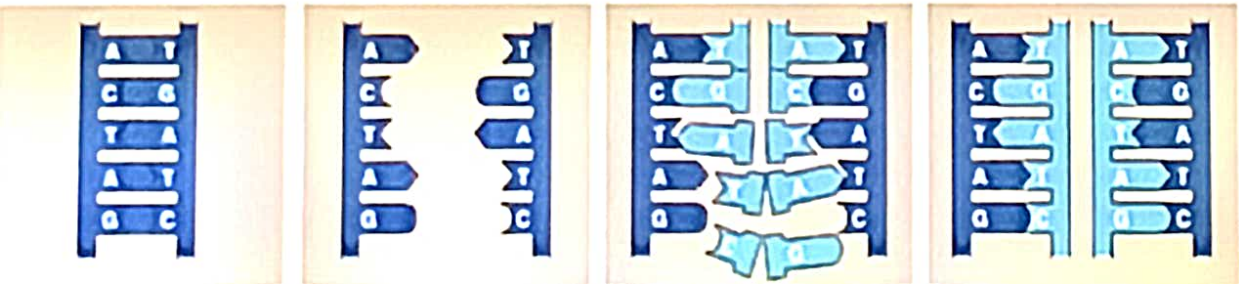
Meselson and Stahl Experiment



Semi-Conservative Model

- Replication of DNA
  - base pairing allows each strand to serve as a template for a new strand
  - new strand is 1/2 parent template & 1/2 new DNA

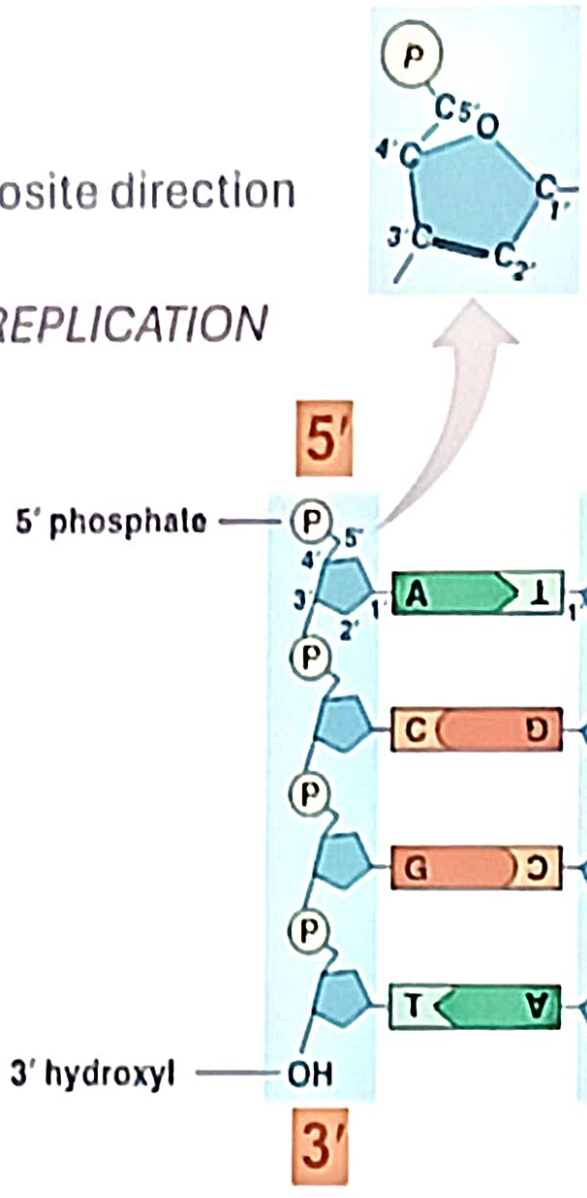




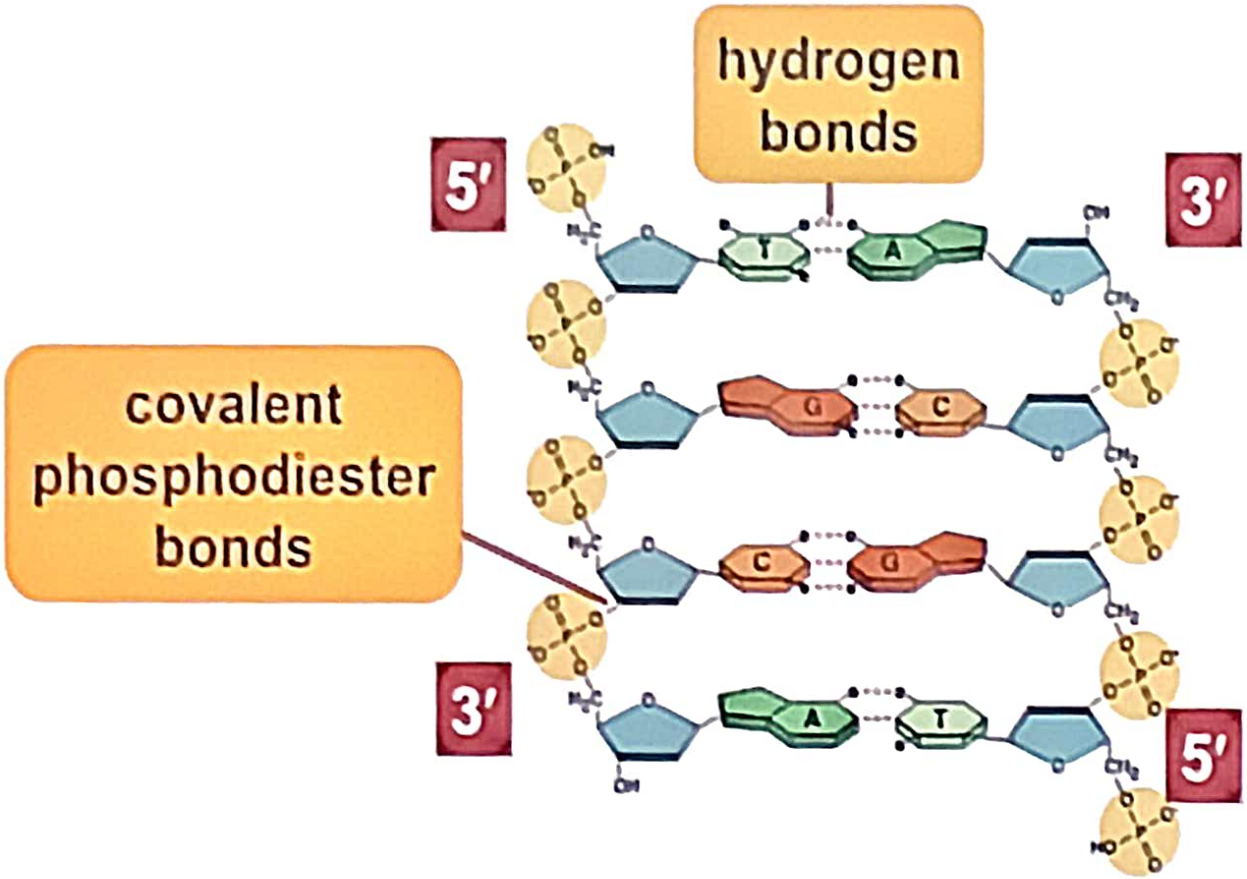
Anti-parallel strands

- DNA molecule has "direction"
- Complementary strand runs in opposite direction

THIS WILL CAUSE A PROBLEM FOR REPLICATION



Bonding in DNA

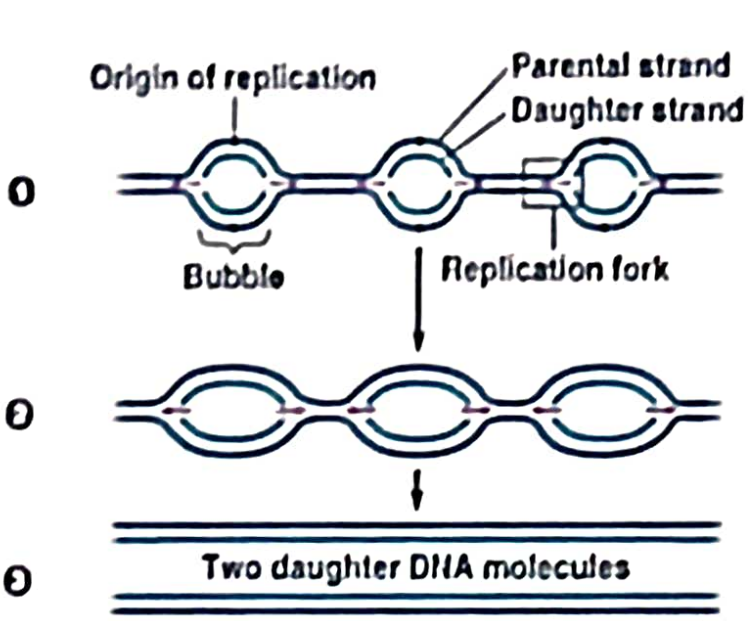


....strong or weak bonds?

How do the bonds fit the mechanism for copying DNA?

DNA Replication

- Large team of enzymes coordinates replication



(a) In eukaryotes, DNA replication begins at many sites along the giant DNA molecule of each chromosome.

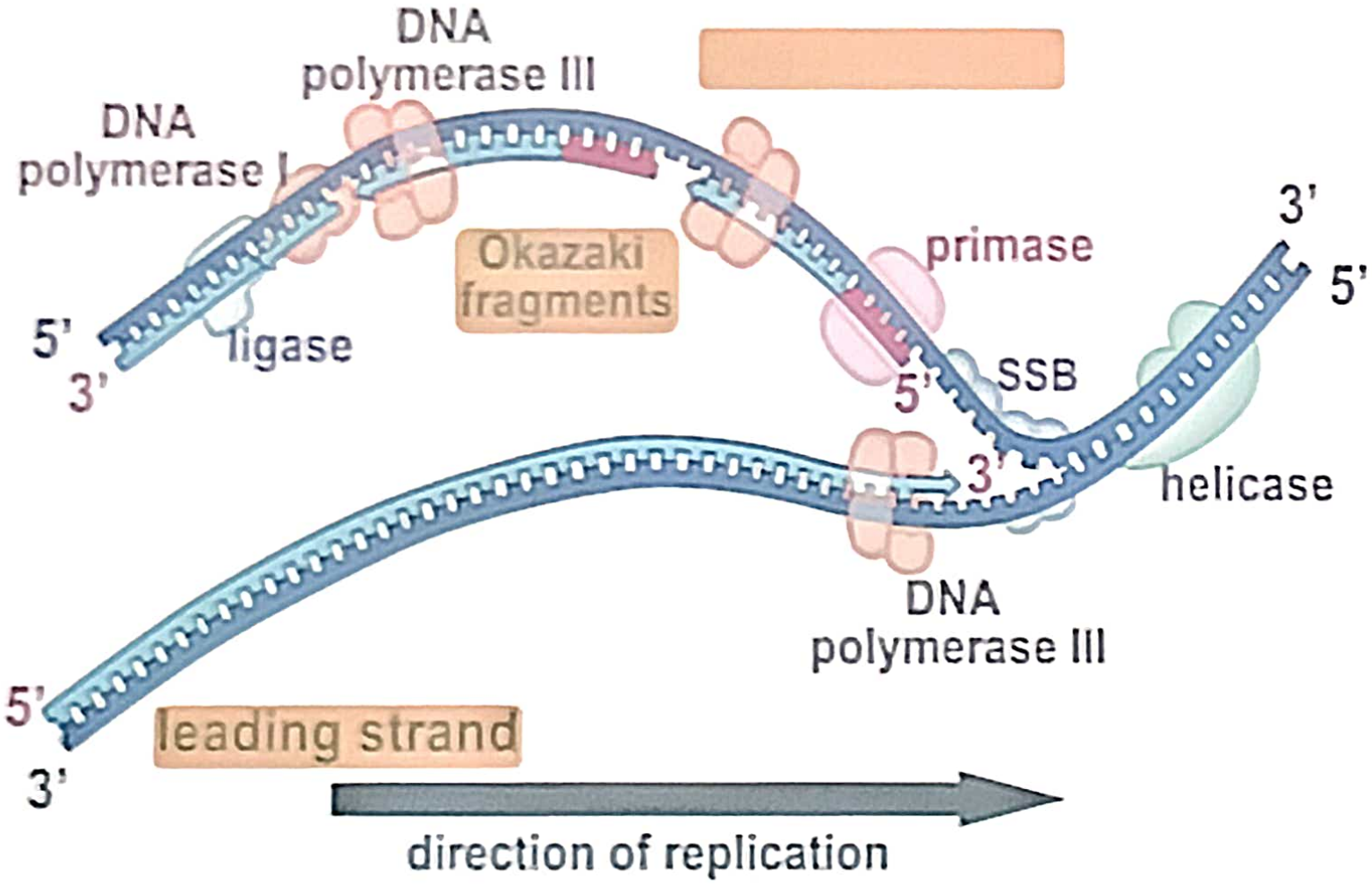
(b) In this micrograph, three replication bubbles are visible along the DNA of cultured Chinese hamster cells. The arrows indicate the direction of DNA replication at the two ends of each bubble (TEM).

The mechanism of DNA replication

Arthur Kornberg, a Nobel prize winner and other biochemists deduced steps of replication

- Initiation
  - Proteins bind to DNA and open up double helix
  - Prepare DNA for complementary base pairing
- Elongation
  - Proteins connect the correct sequences of nucleotides into a continuous new strand of DNA
- Termination
  - Proteins release the replication complex

Replication fork



SSB = single-stranded binding proteins

Steps involved in DNA Replication in Prokaryotes (*E.coli*)

In prokaryotes, the DNA is circular. Replication starts at a single origin (Ori C) and is bi-directional and semi-conservative.

The region of replicating DNA associated with the single origin is called a replication bubble or replication eye and consists of two replication forks moving in opposite direction around the DNA circle.

The resulting positive supercoiling (torsional stress) is relieved by topoisomerse I and II (DNA gyrase) by inducing transient single stranded breaks.

Step 3: The enzyme RNA primase (primase, an RNA polymerase) then attaches to the DNA and synthesizes a short RNA primer to initiate synthesis of the leading strand of the first replication fork.

DNA polymerase III synthesizes DNA for both leading and lagging strands.

Step 5: After DNA synthesis by DNA pol III, DNA polymerase I uses its 5'-3' exonuclease activity to remove the RNA primer and fills the gaps with new DNA.

Step 6: Finally, DNA ligase joins the ends of the DNA fragments together.