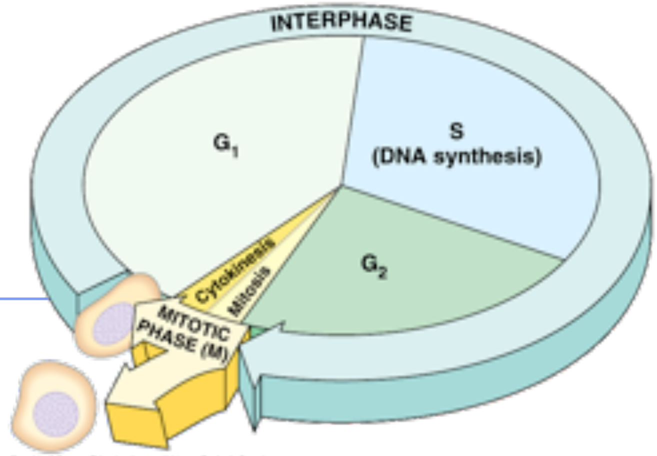
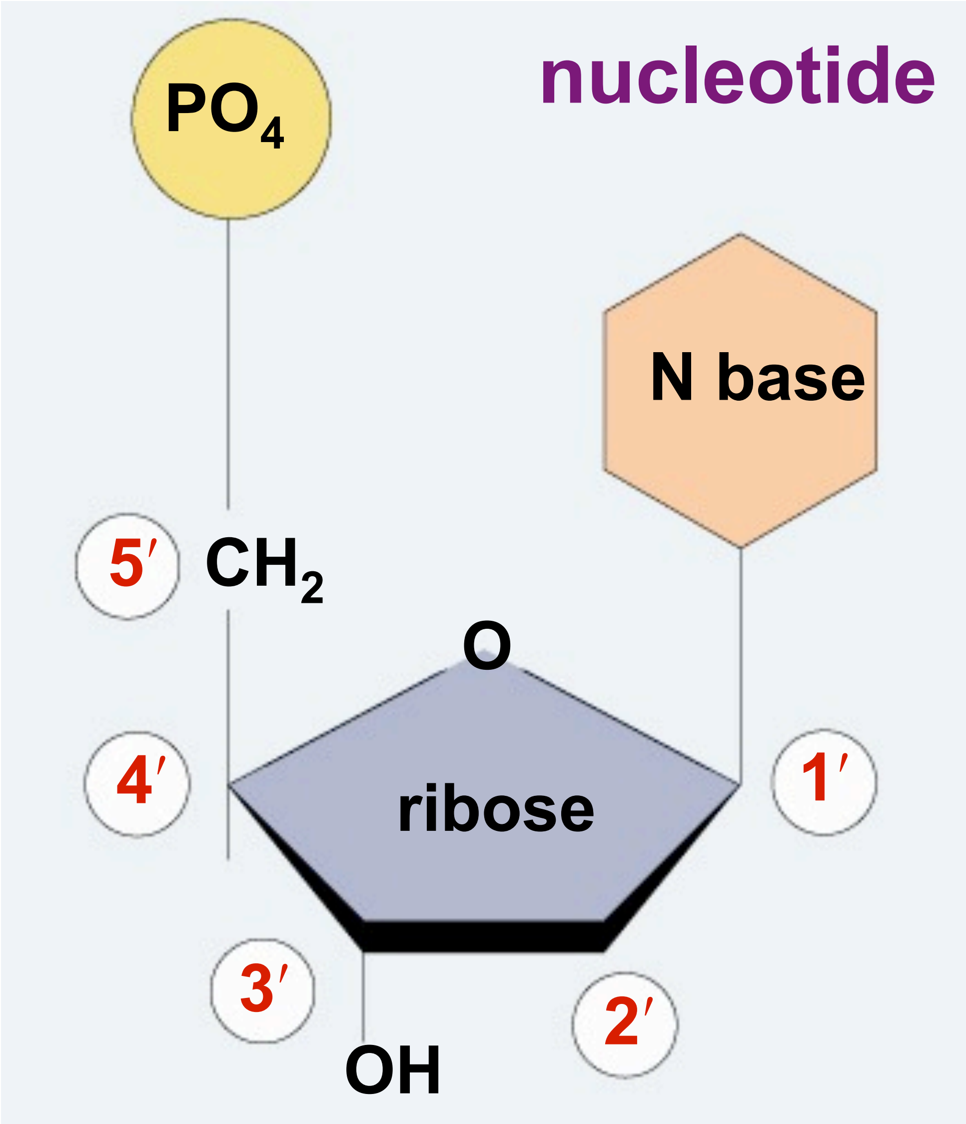



# DNA Replication

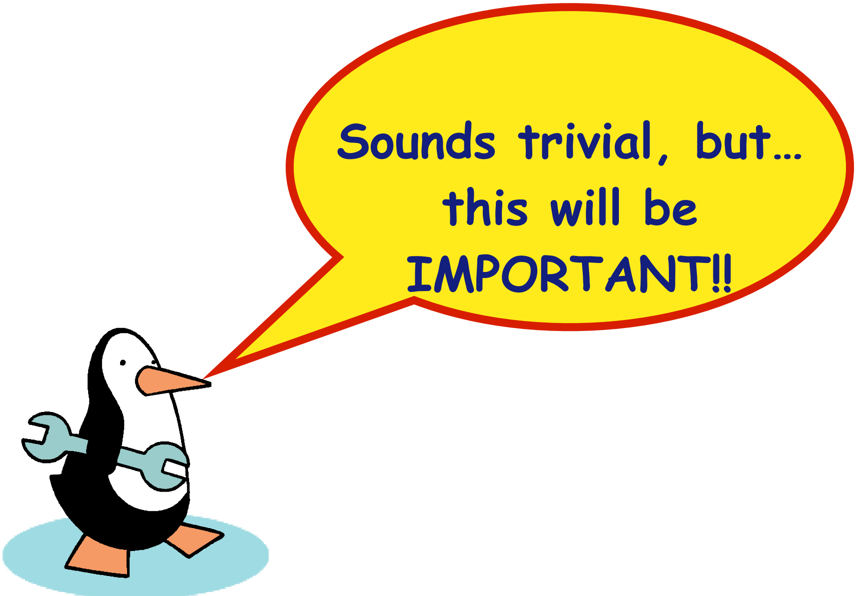
# Directionality of DNA

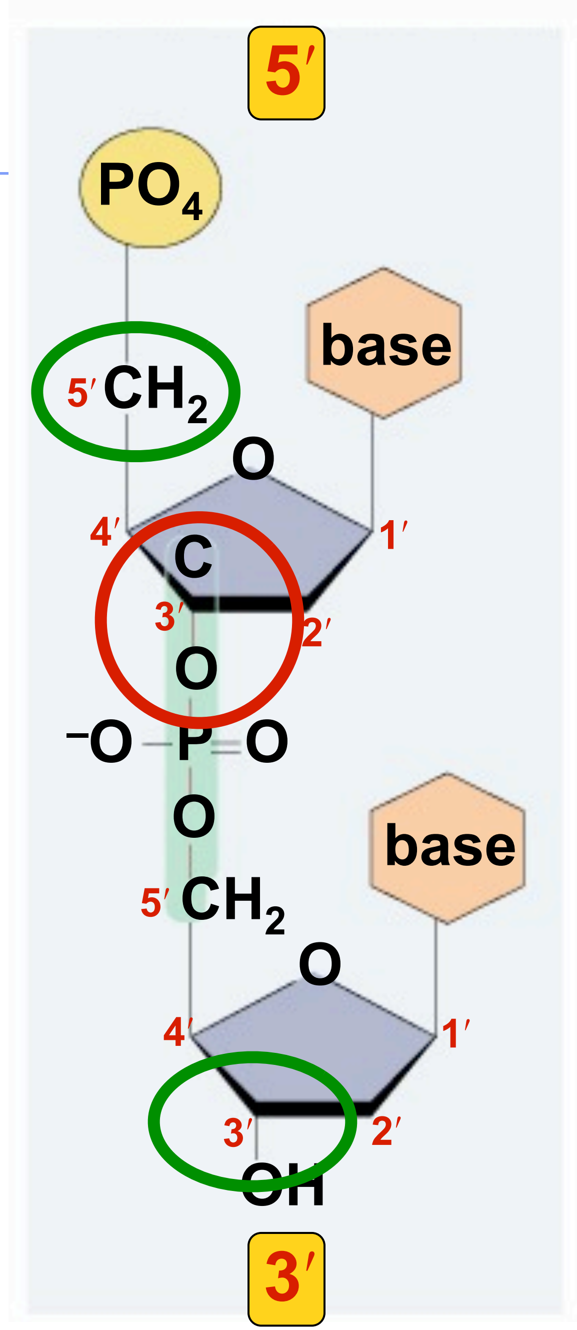
- You need to number the carbons!
  - it matters!

# The DNA backbone

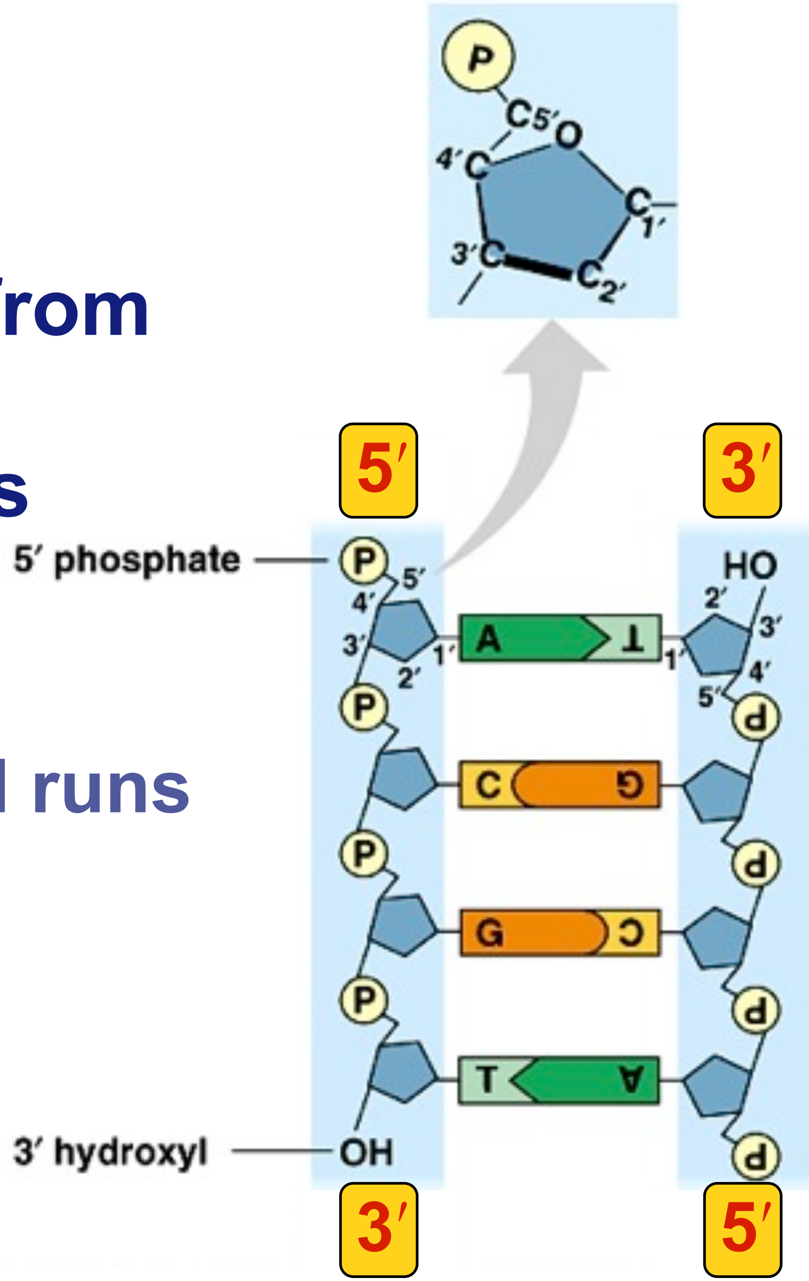
- Putting the DNA backbone together
  - refer to the 3′ and 5′ ends of the DNA
    - the last trailing carbon



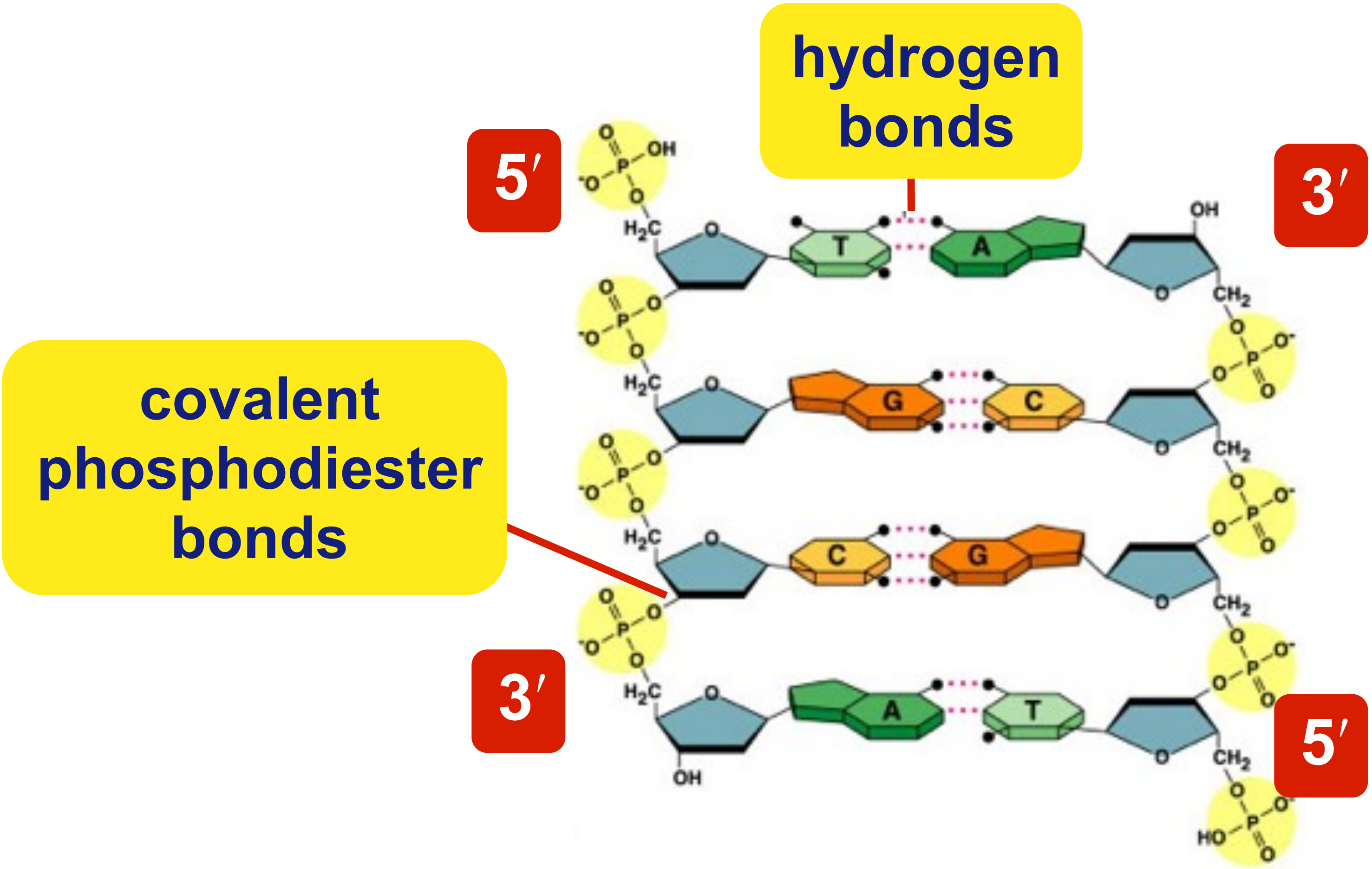



# Anti-parallel strands

- Nucleotides in DNA backbone are bonded from phosphate to sugar between 3′ & 5′ carbons
  - DNA molecule has "direction"
  - complementary strand runs in opposite direction



# Bonding in DNA

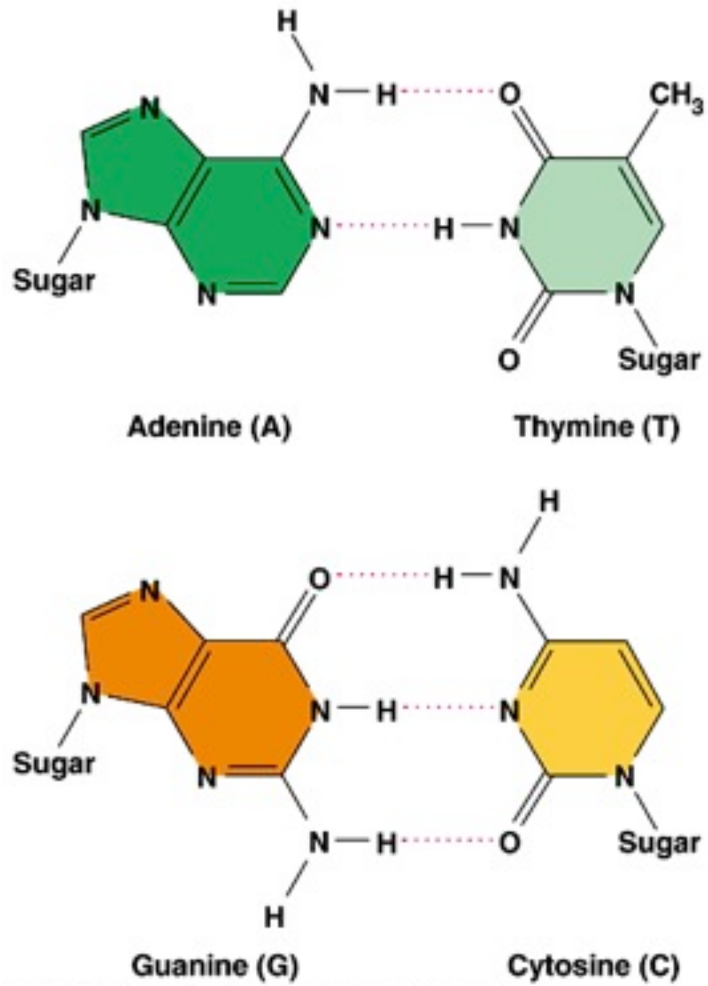



….strong or weak bonds?

How do the bonds fit the mechanism for copying DNA?

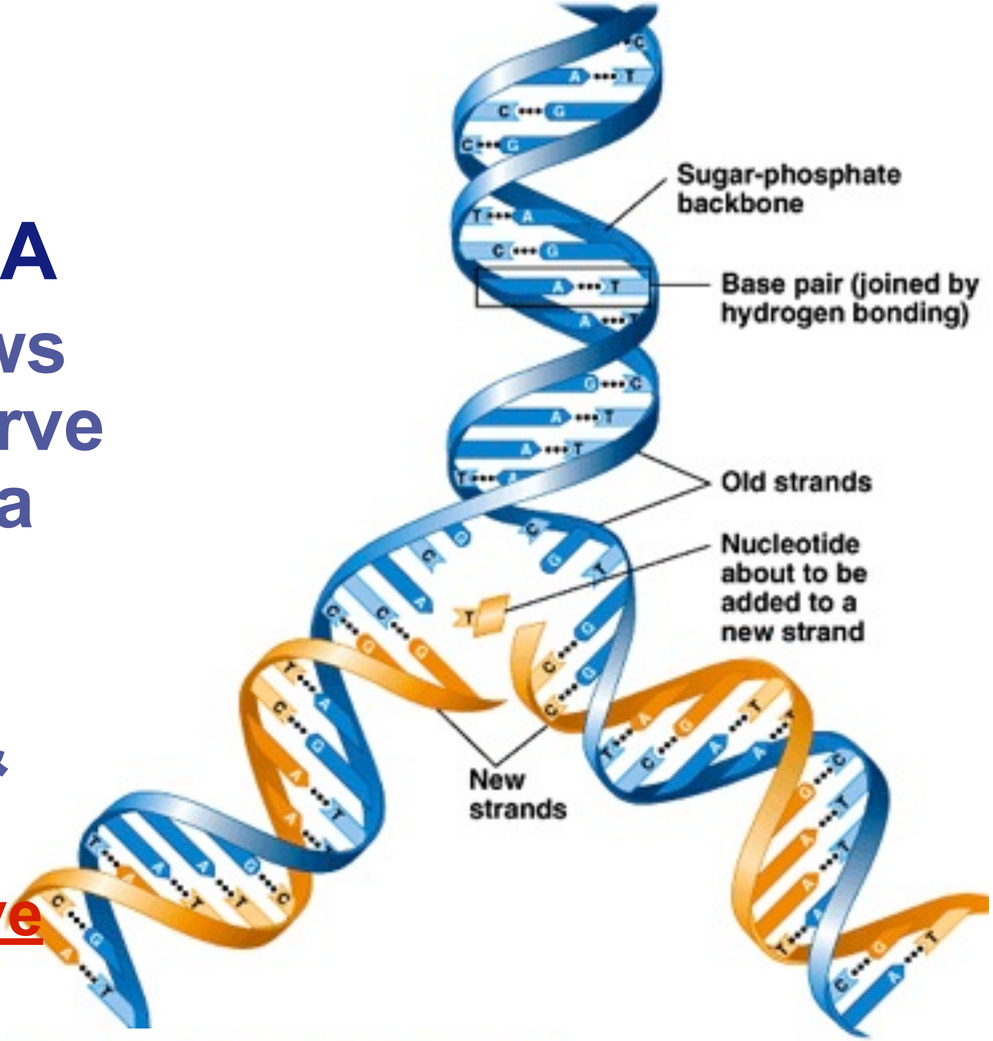
# Base pairing in DNA

- Purines
  - adenine (A)
  - guanine (G)
- Pyrimidines
  - thymine (T)
  - cytosine (C)
- Pairing
  - A : T
    - 2 bonds
  - C : G
    - 3 bonds



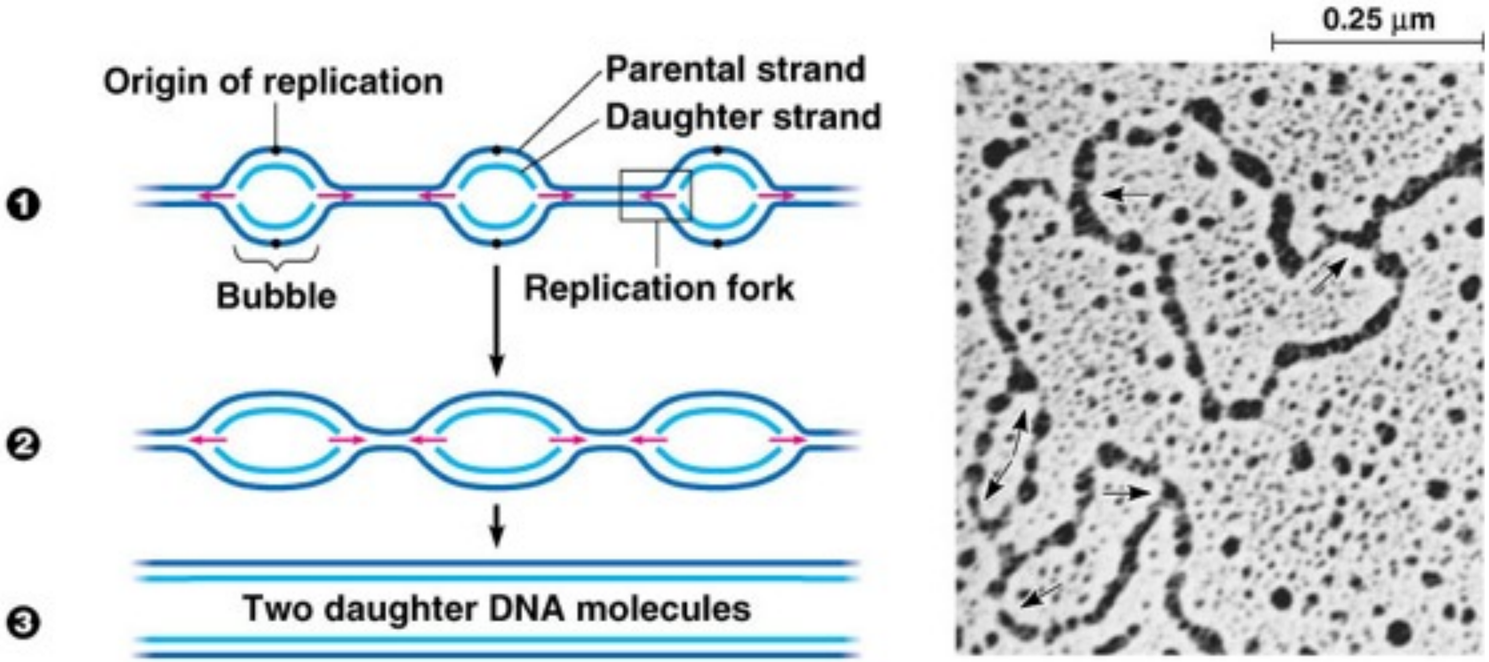
# Copying DNA

- **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
    - **semi-conservative** copy process




# DNA Replication


- Large team of enzymes coordinates replication

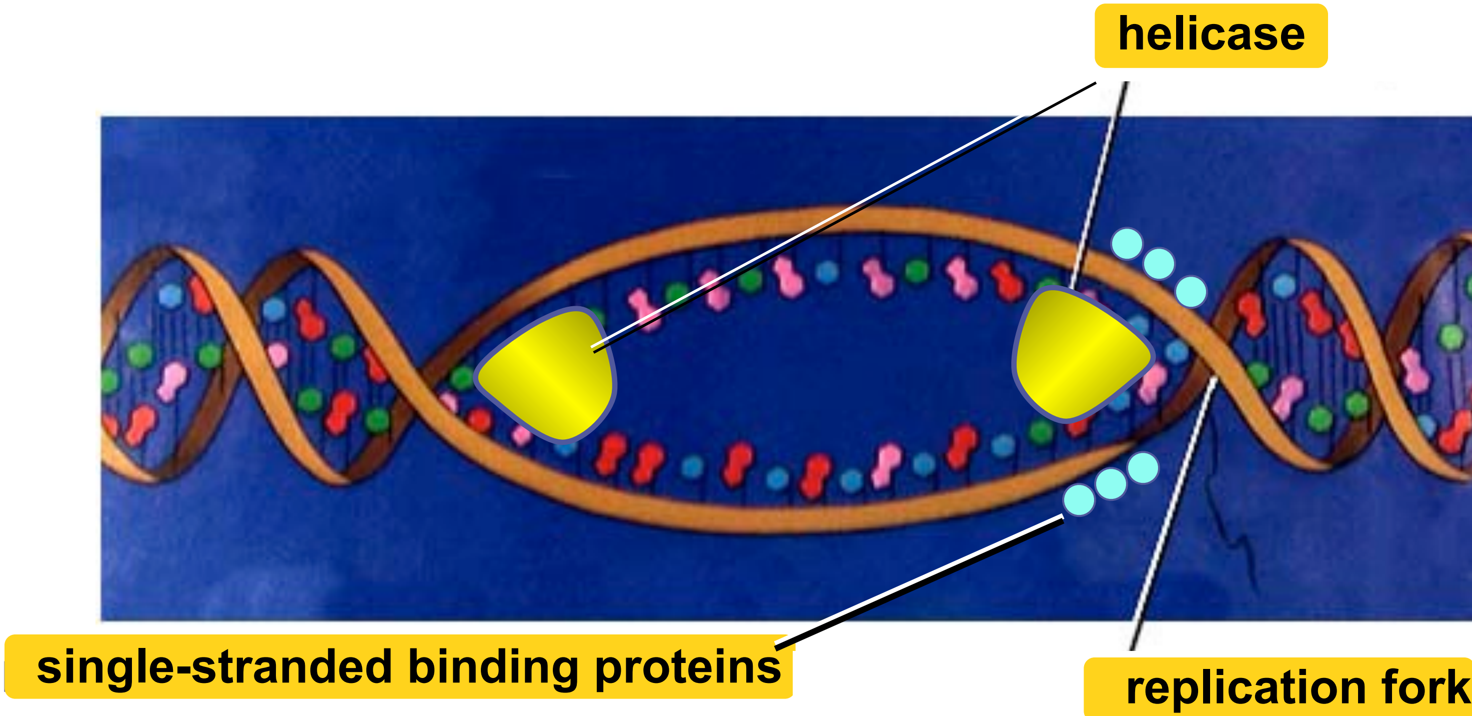



(a) In eukaryotes, DNA replication begins at many sites along the giant DNA molecule of each chromosome.

(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).

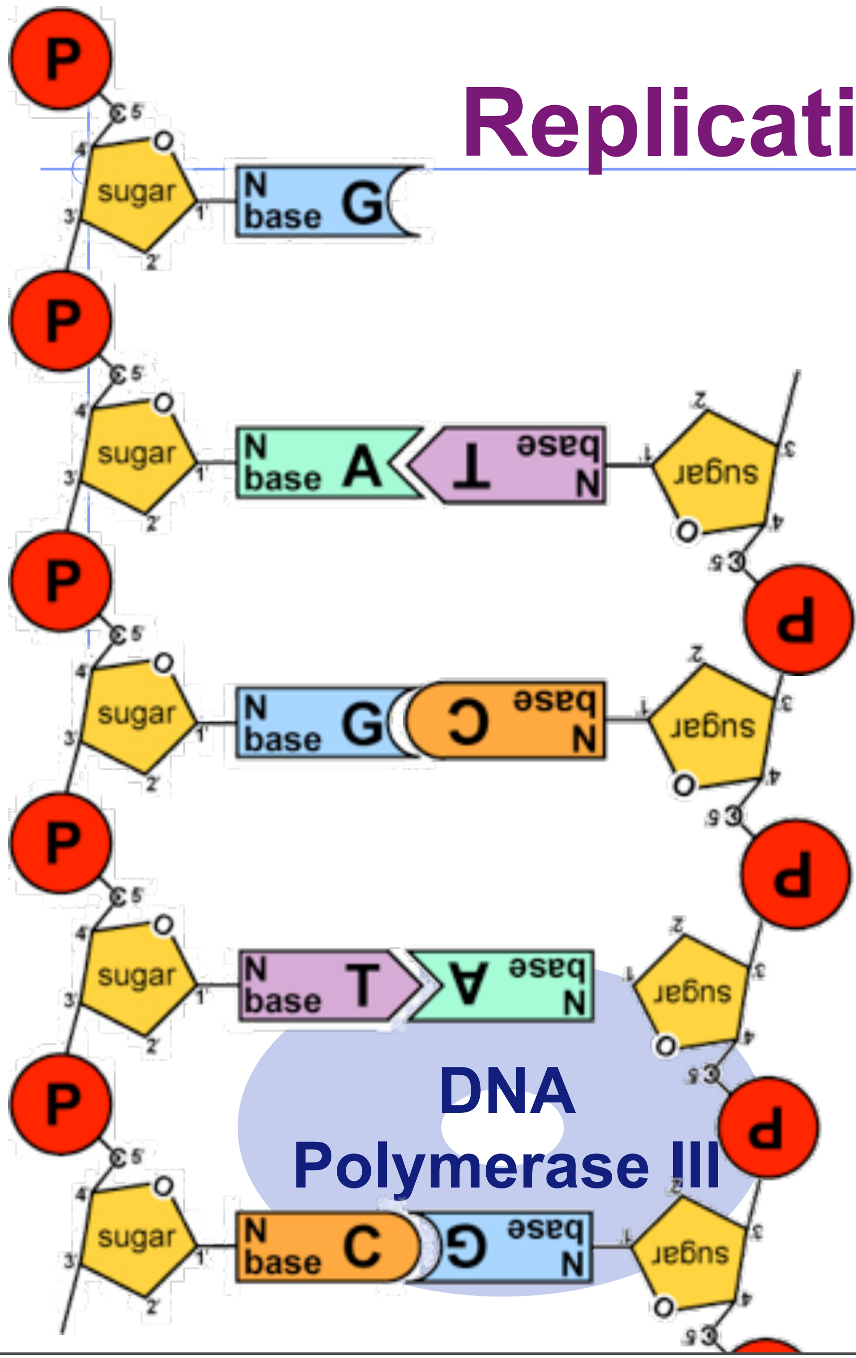
# Replication: 1st step

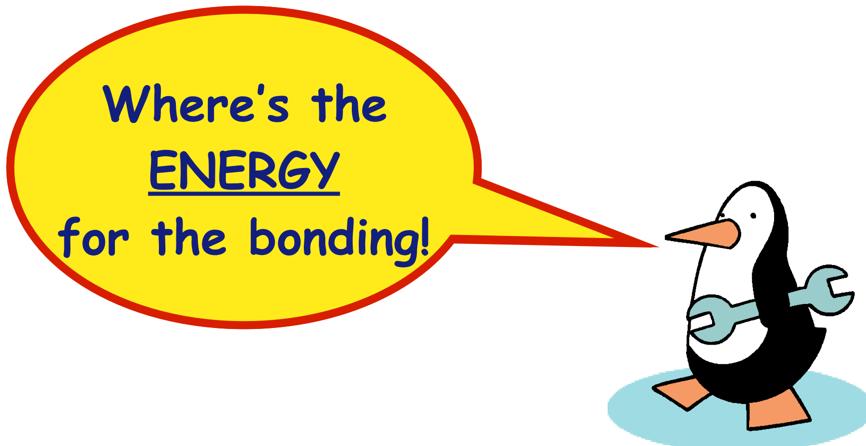

- Unwind DNA
  - helicase enzyme
    - unwinds part of DNA helix
    - stabilized by single-stranded binding proteins



# Replication: 2nd step

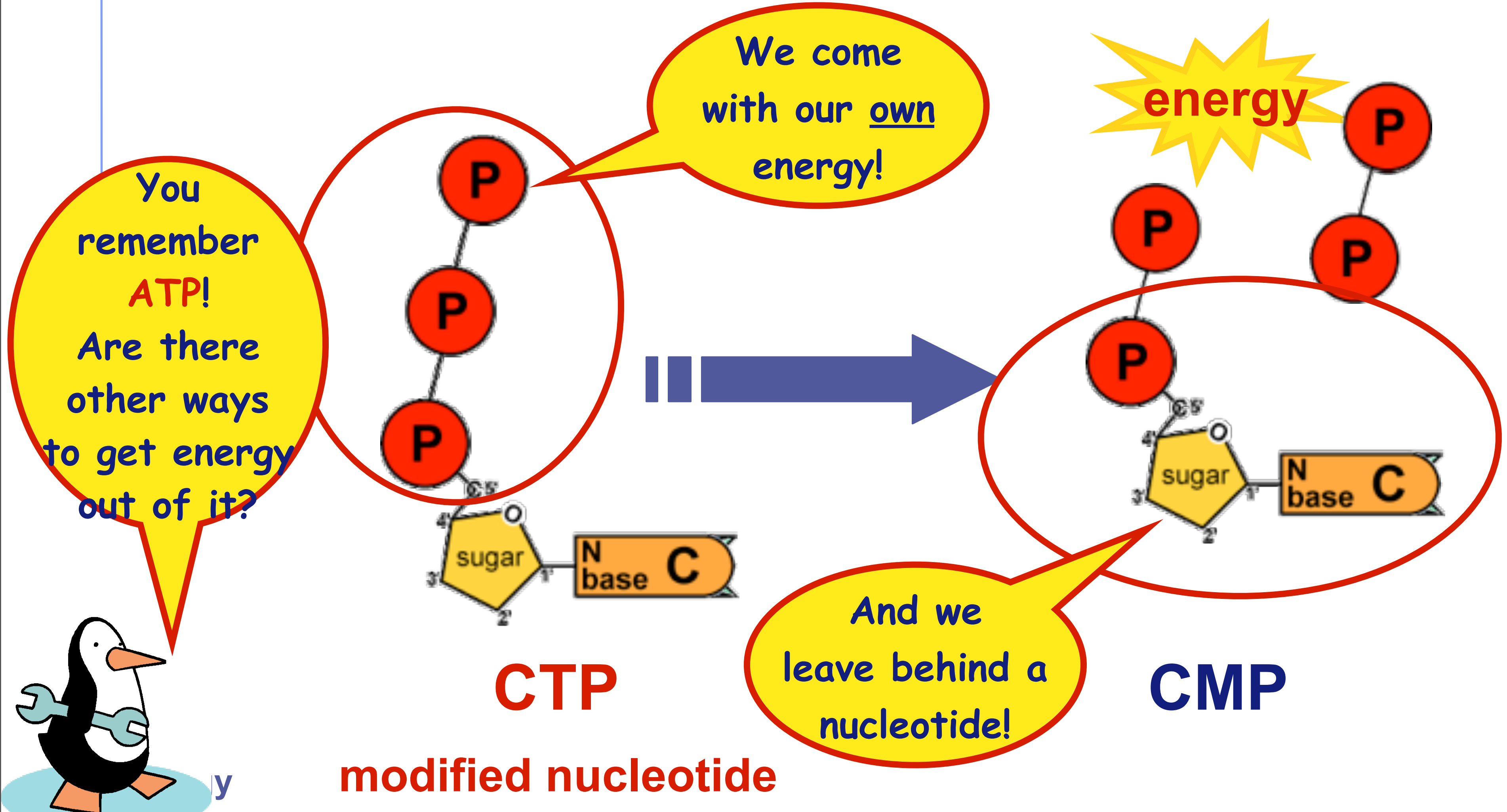
- Build daughter DNA strand
  - add new complementary bases
  - <u>DNA polymerase III</u>



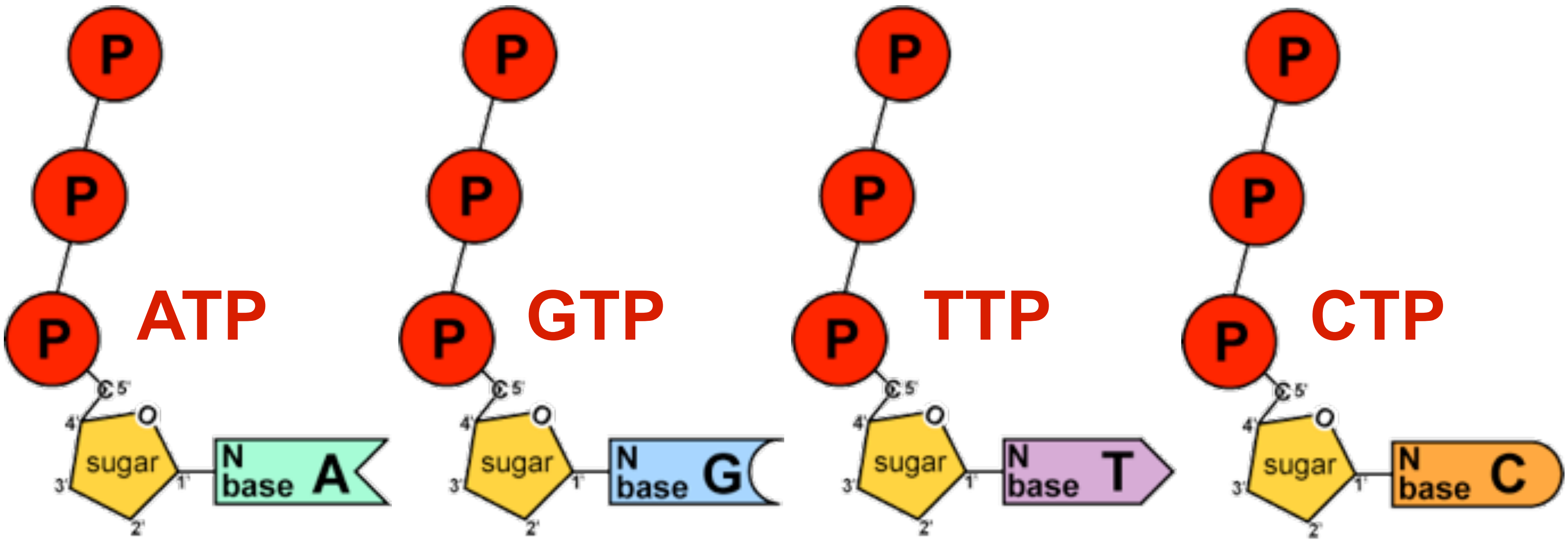
# Energy of Replication

## Where does energy for bonding *usually* come from?



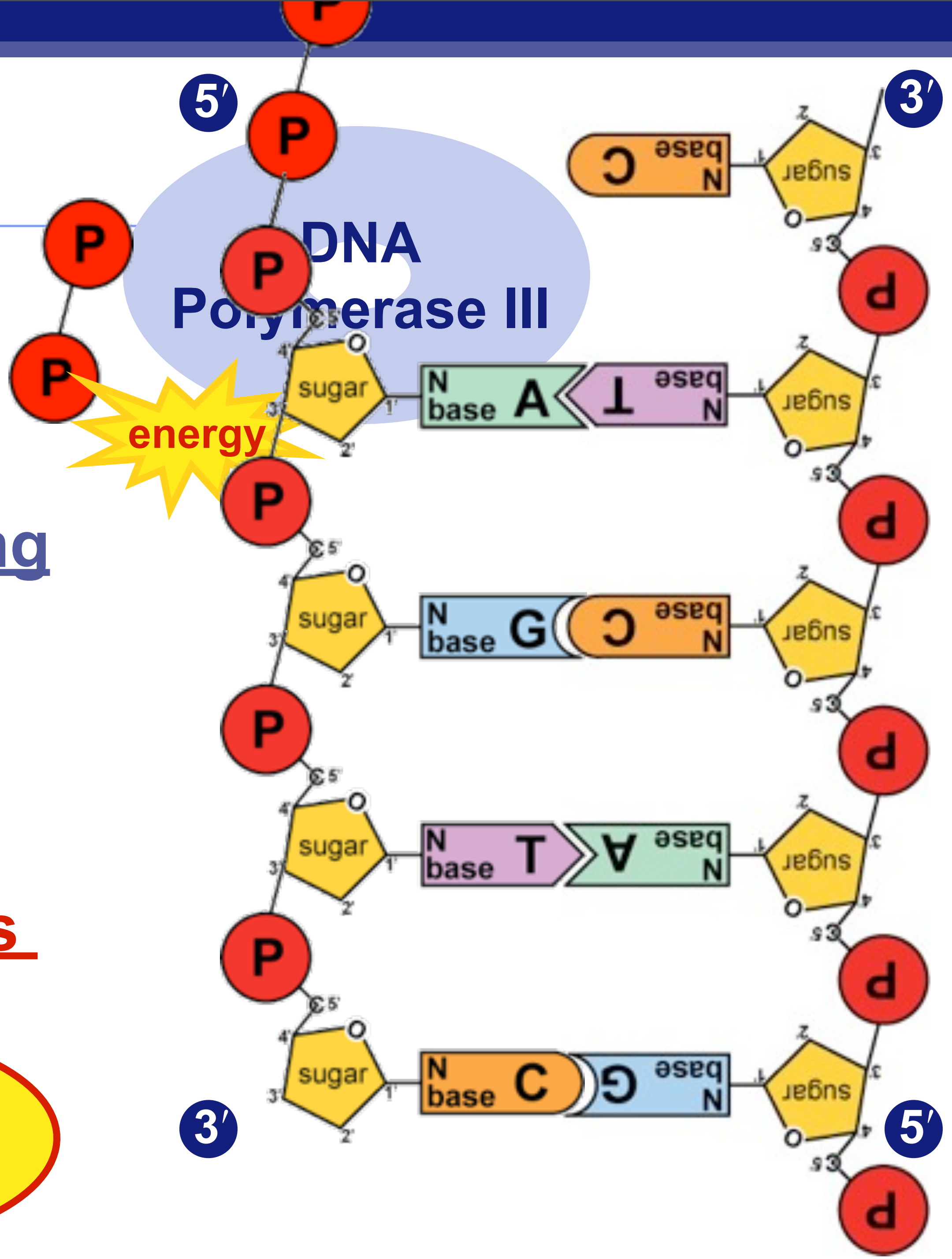
# Energy of Replication

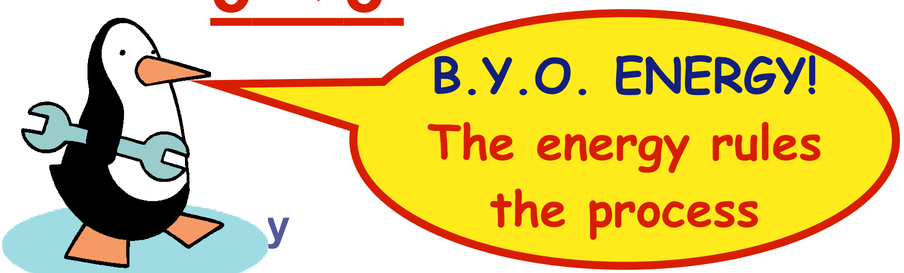
- **The nucleotides arrive as nucleosides**
  - DNA bases with P–P–P
    - P-P-P = energy for bonding
  - DNA bases arrive with their own energy source for bonding
  - bonded by enzyme: DNA polymerase III



# Replication

- **Adding bases**
  - can only add nucleotides to **3′ end** of a growing DNA strand
    - need a “starter” nucleotide to bond to
  - **strand only grows 5′→3′**

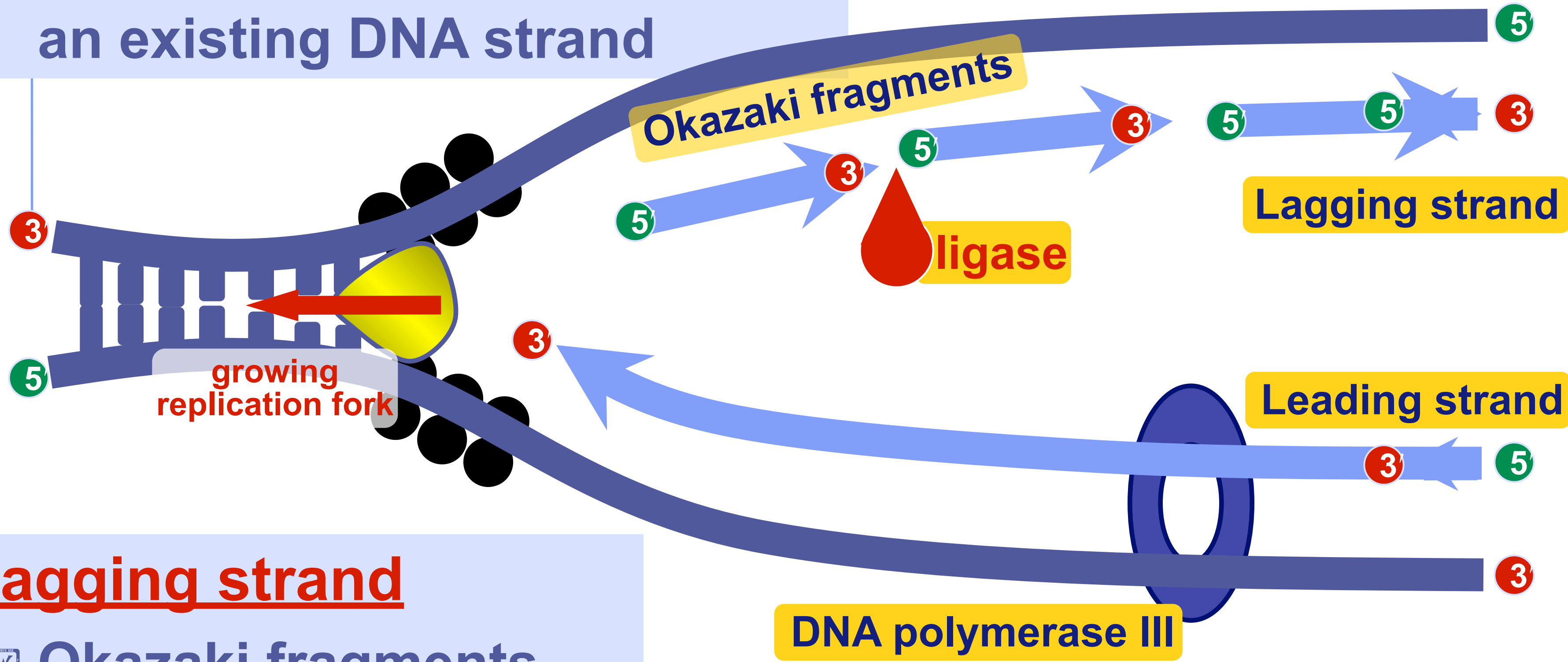


# Leading & Lagging strands

## Limits of DNA polymerase III

- can only build onto 3′ end of an existing DNA strand




## Lagging strand

- Okazaki fragments
- joined by ligase
  - "spot welder" enzyme

## Leading strand

- continuous synthesis

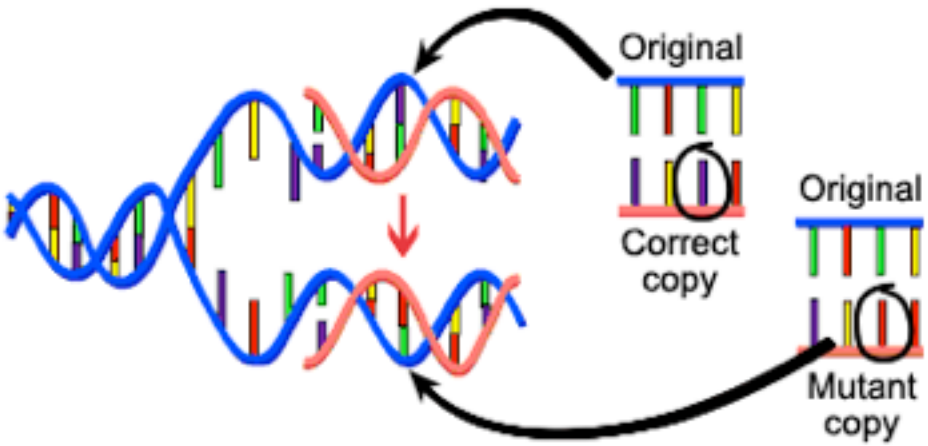
# Replication: 3rd Step

## Error Correction

Polymerase double checks the new DNA sequence and corrects any errors if present.

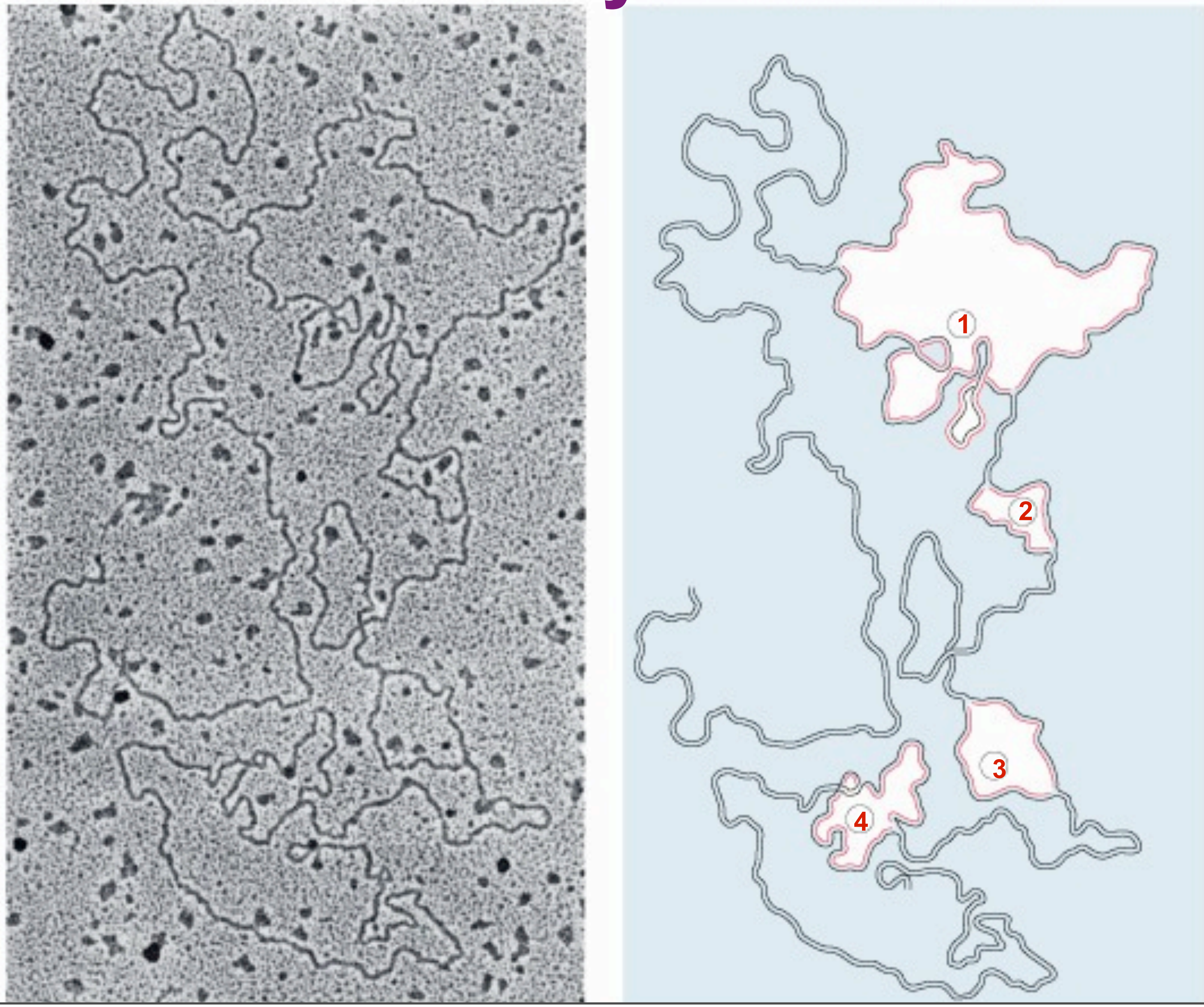
## Mutations

occur if there is an incorrect sequence o bases.

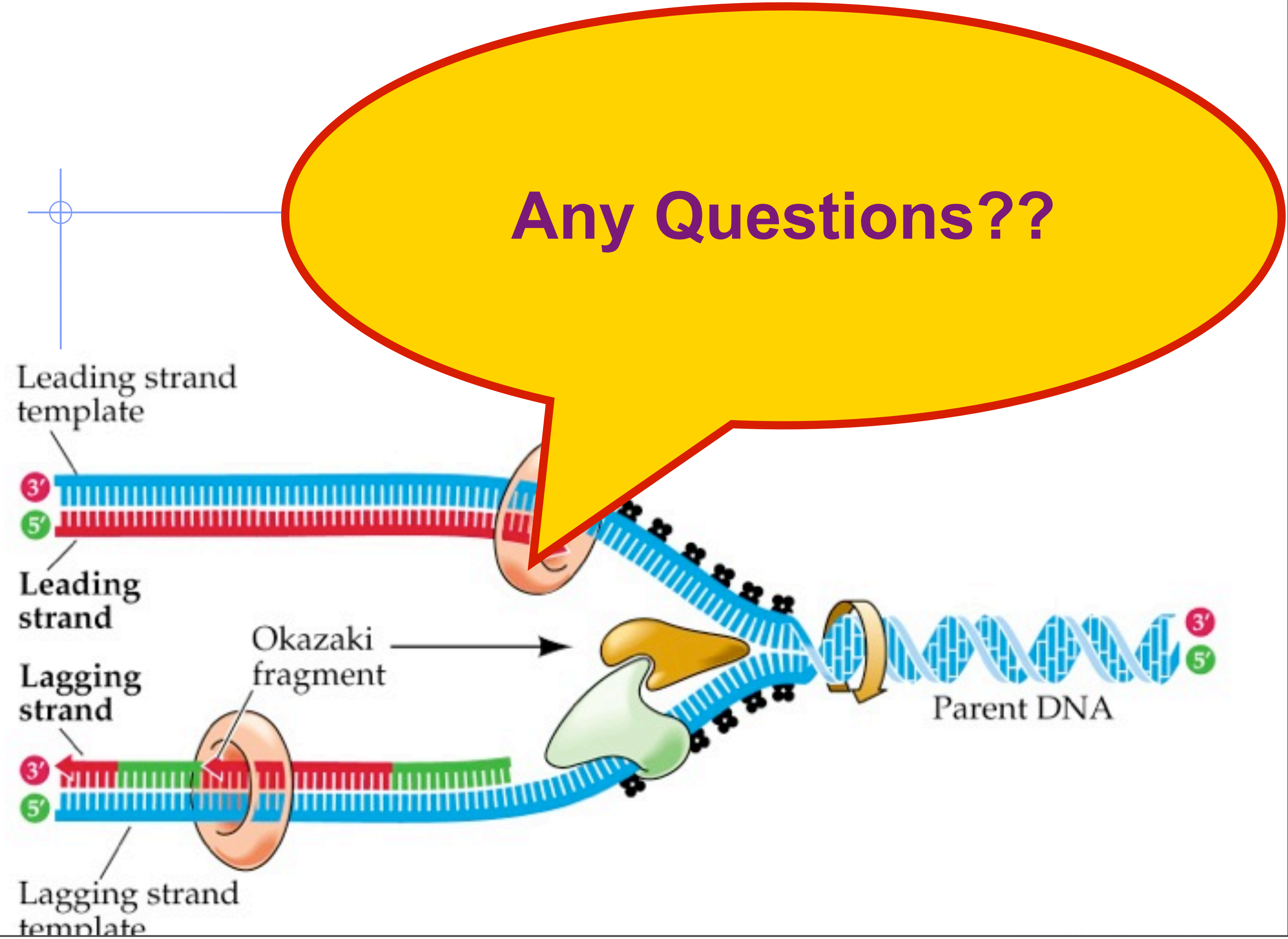


# What does it really look like?

-




AF



Any Questions??
Leading strand template
3′
5′
Leading strand
Lagging strand
Okazaki fragment
3′
5′
Lagging strand template
Parent DNA
3′
5′