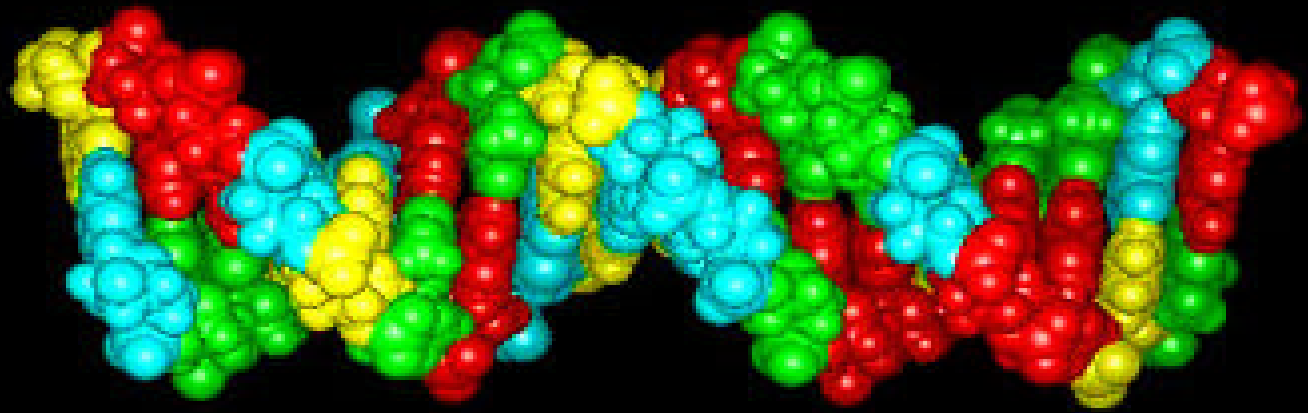
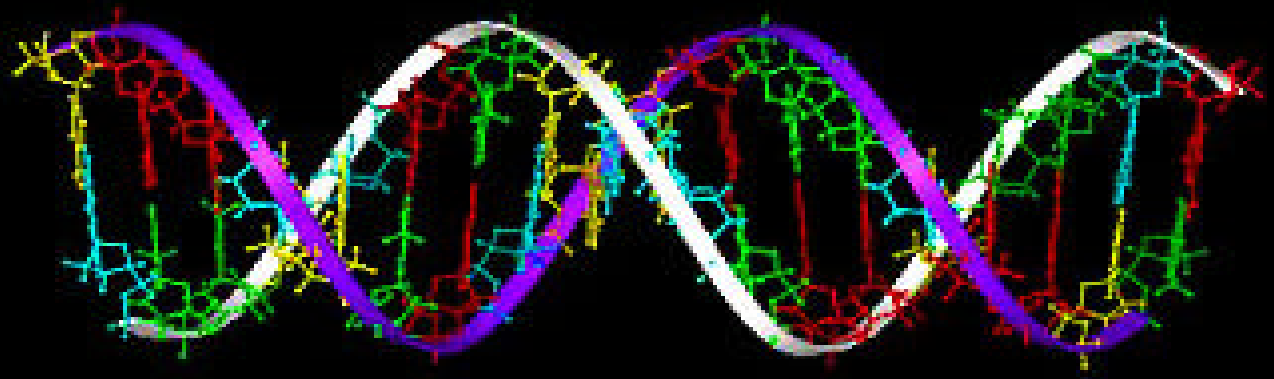
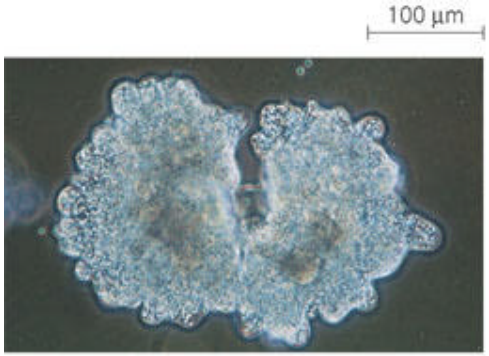
DNA Structure and DNA Replication

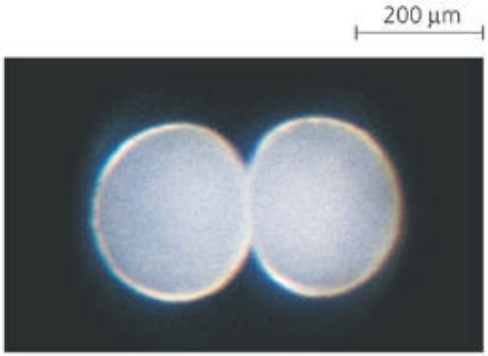




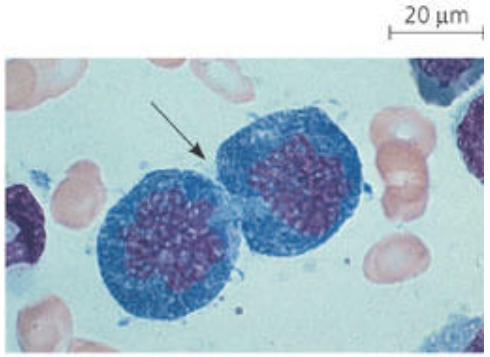
Why Do Cells Divide?



(a) Reproduction. An amoeba, a single-celled eukaryote, is dividing into two cells. Each new cell will be an individual organism (LM).



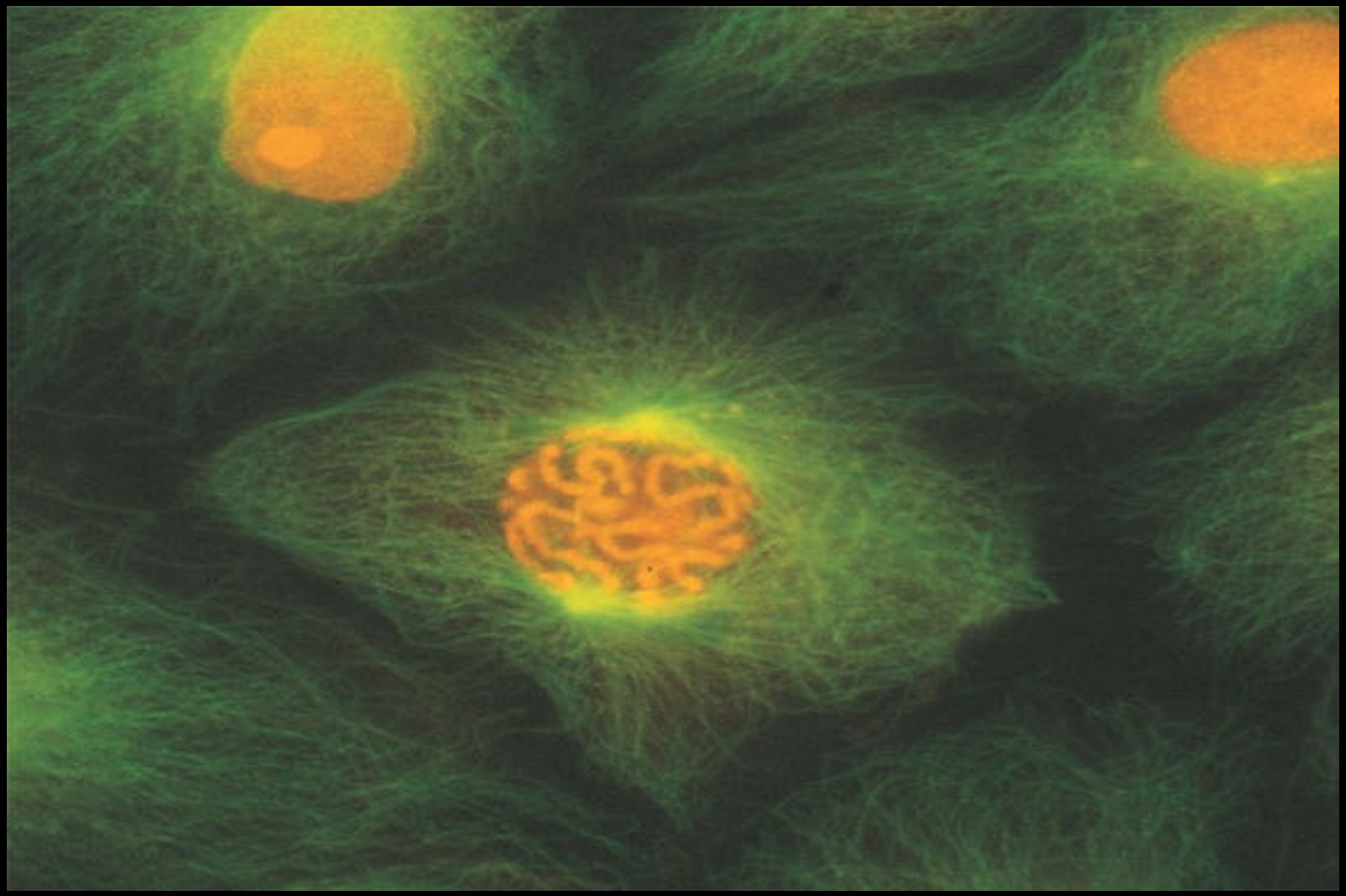
(b) Growth and development. This micrograph shows a sand dollar embryo shortly after the fertilized egg divided, forming two cells (LM).



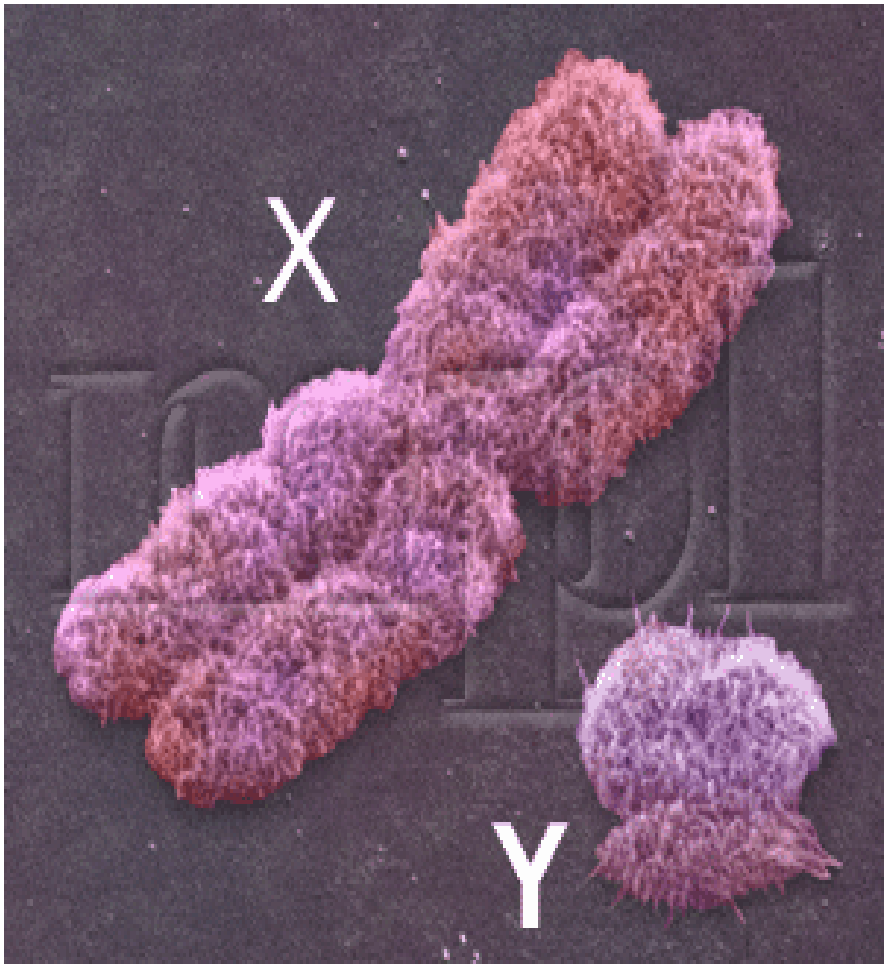
(c) Tissue renewal. These dividing bone marrow cells (arrow) will give rise to new blood cells (LM).

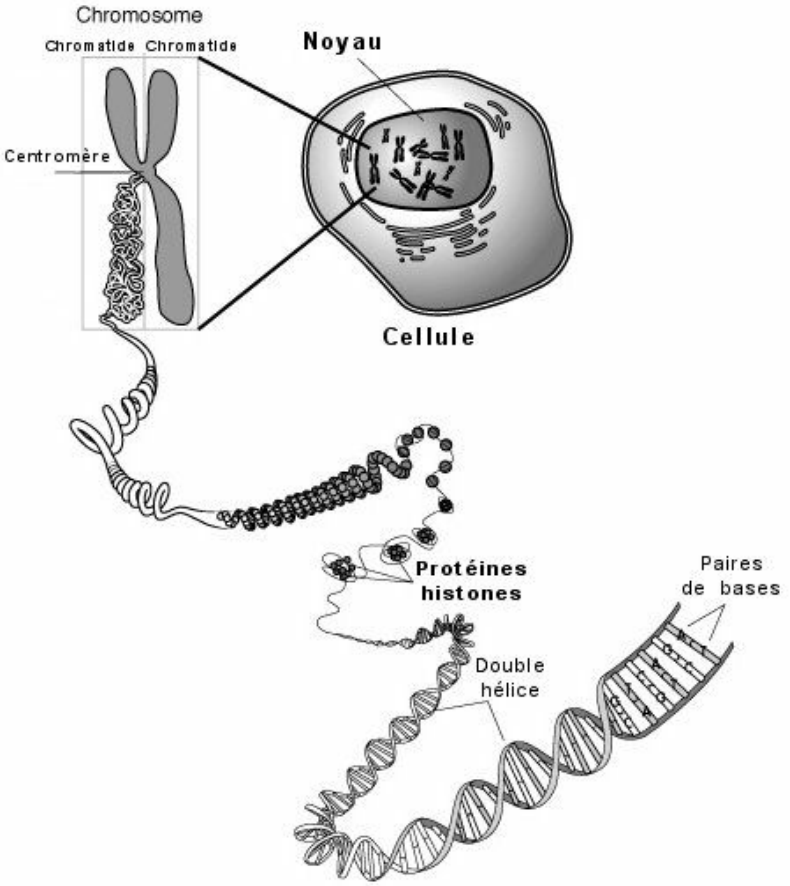
- Reproduction
- Growth and Development
- Tissue Renewal

What Structures Do Divide When The Cell Divides?

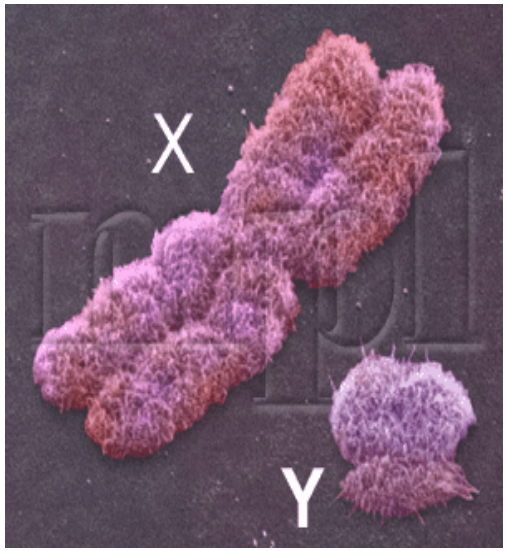


What is a Chromosome?

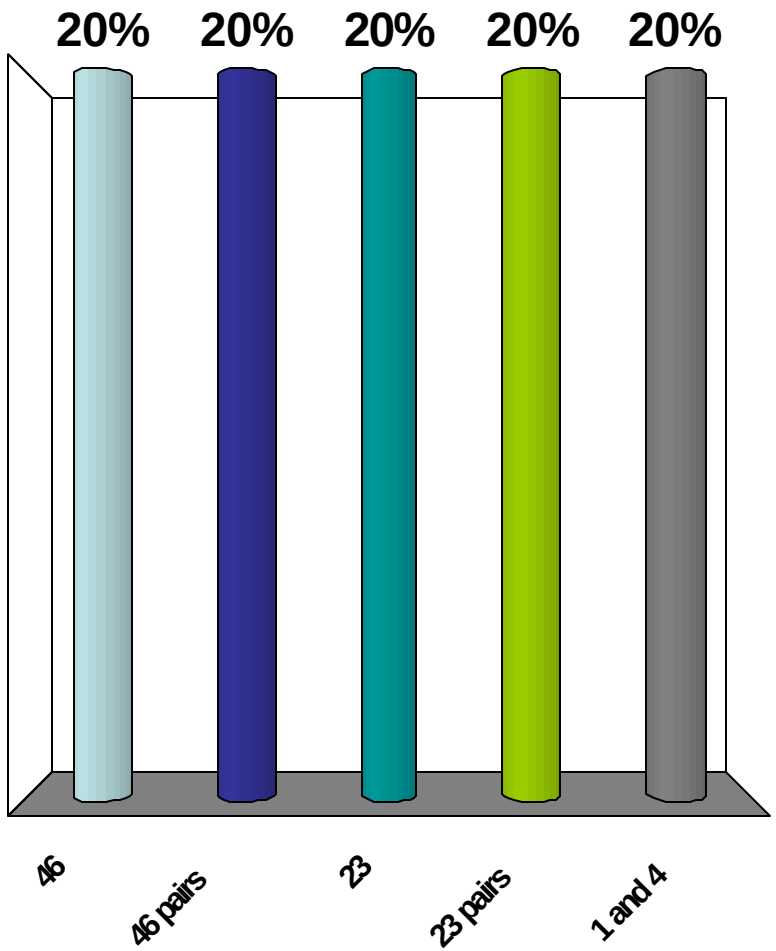




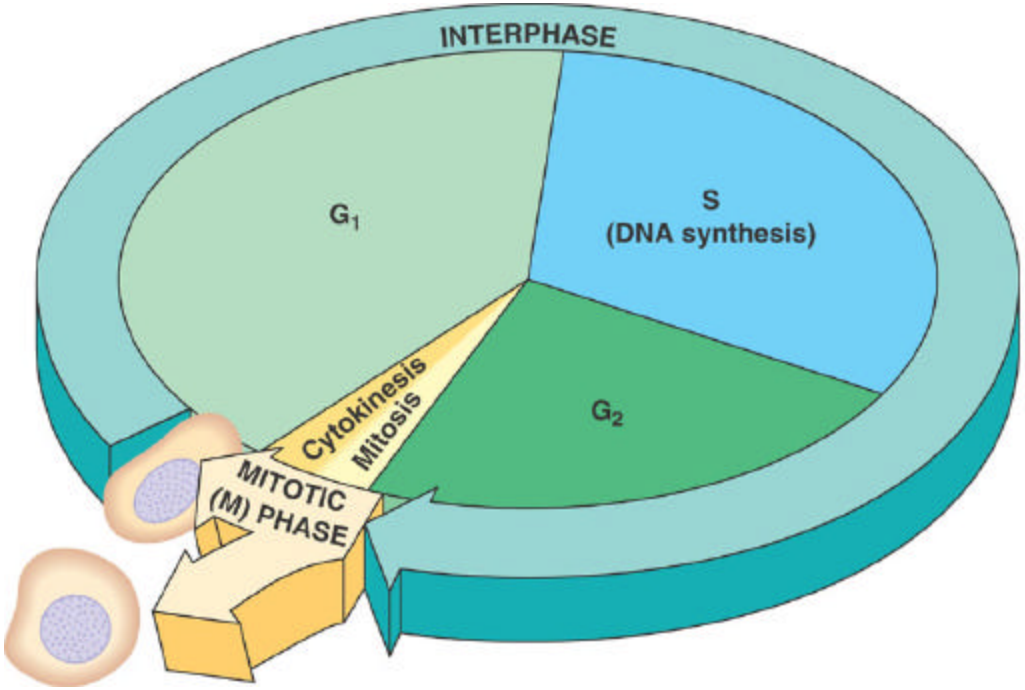
How many chromosomes do humans have?



1. 46
2. 46 pairs
3. 23
4. 23 pairs
5. 1 and 4



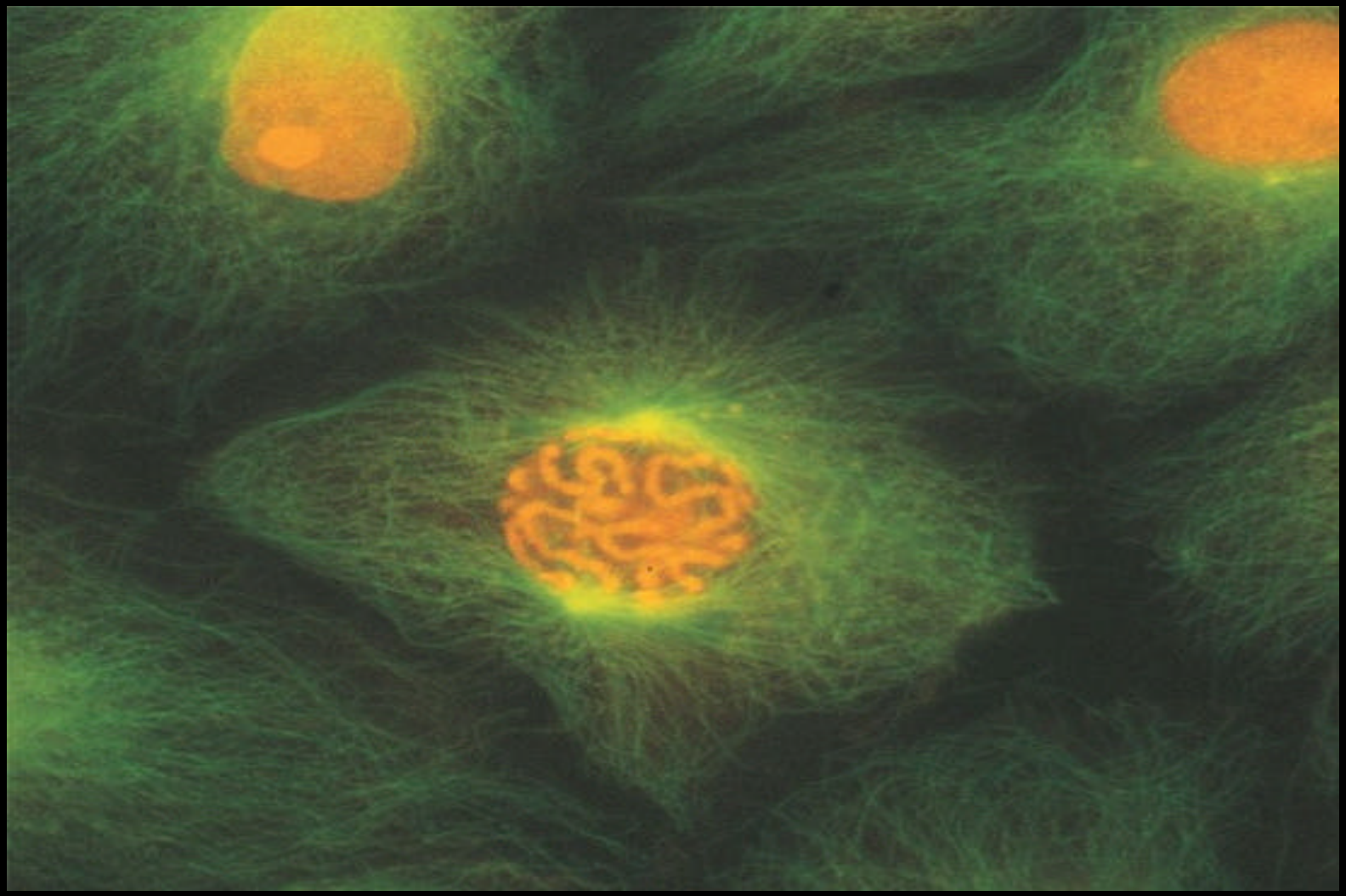
DNA Replication: When Does It Happen?



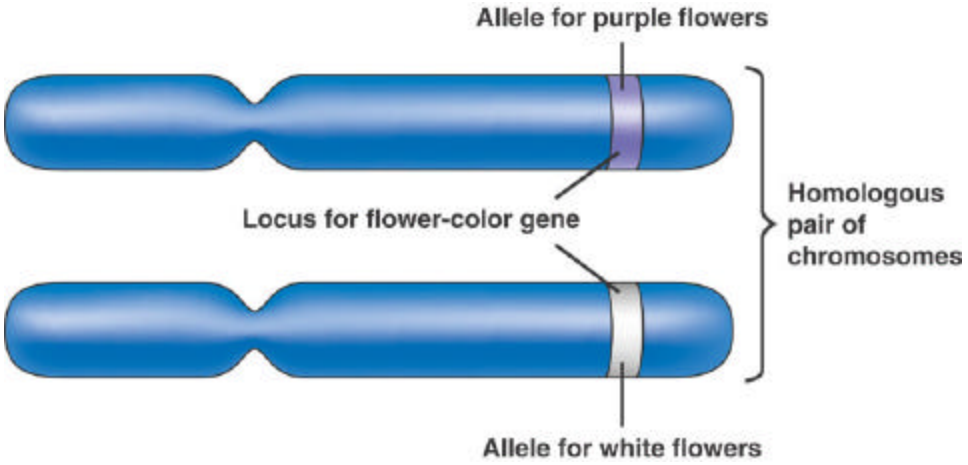
How Are Features Passed Along?

Mendel and The Idea of Gene

Where Are Genes Located?

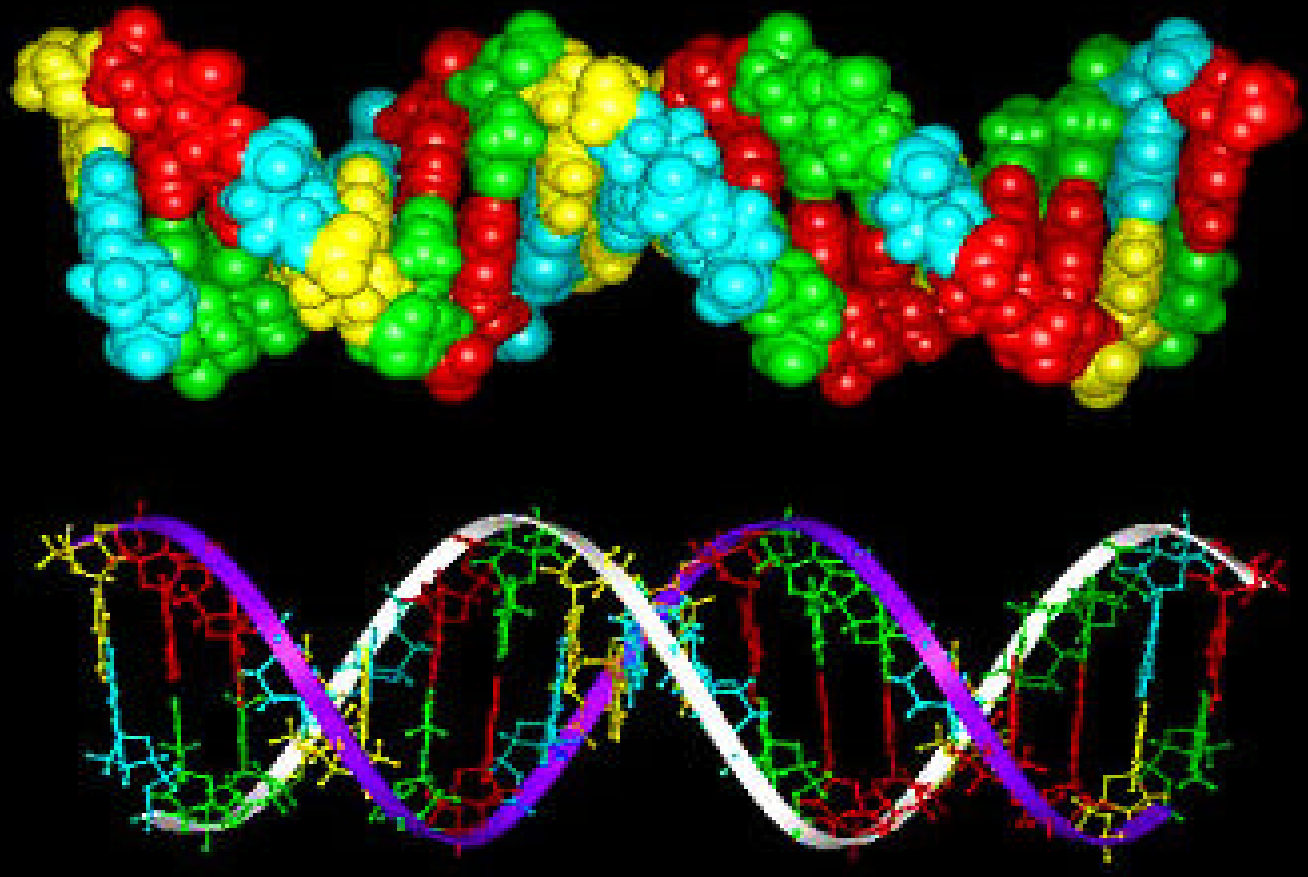


Genes Are Stretches of DNA (deoxyribonucleic acid)

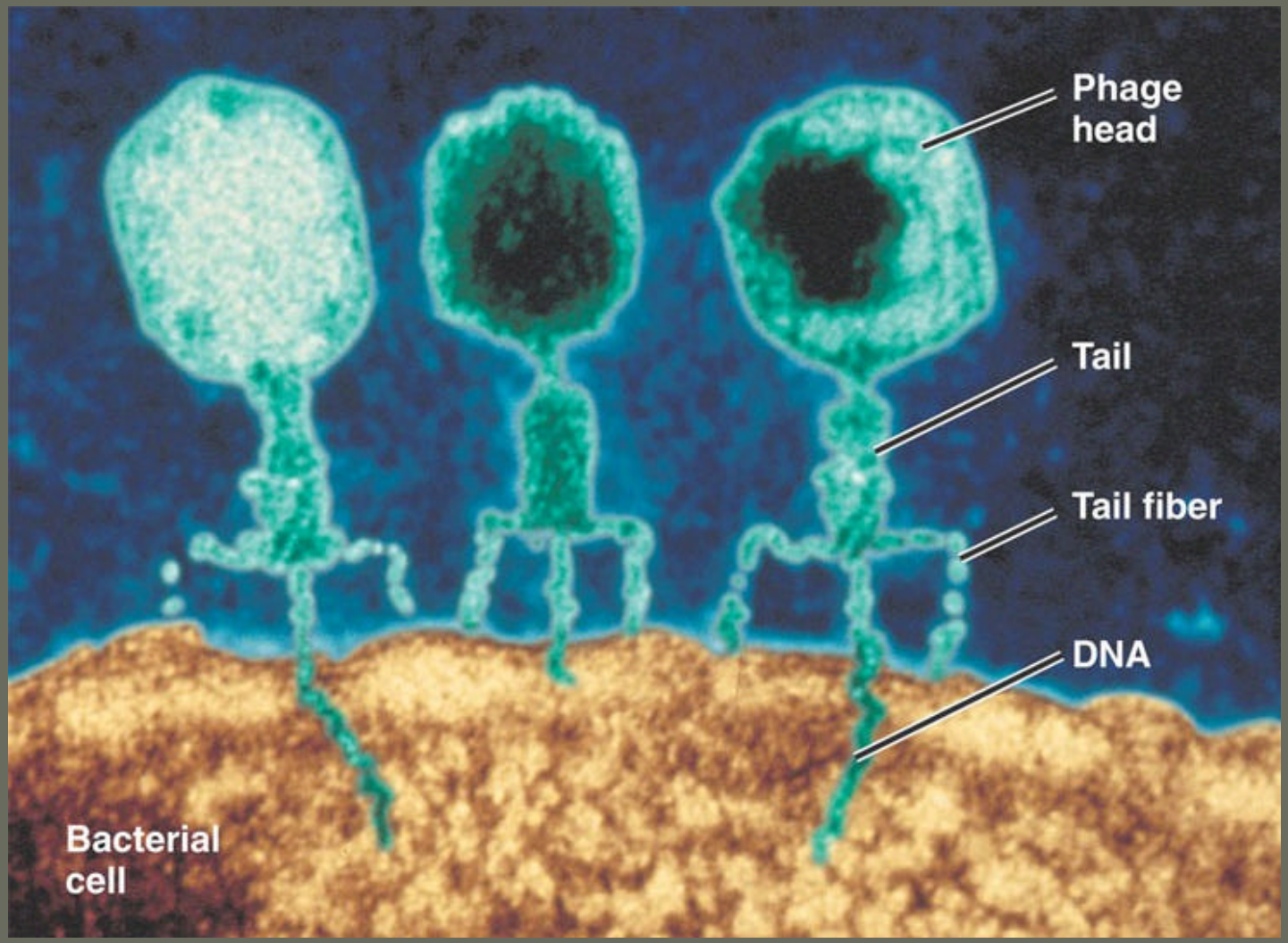


- Genes are instructions for producing a trait
- Locus is the spot each genes has on a chromosome
- A gene is a stretch of DNA

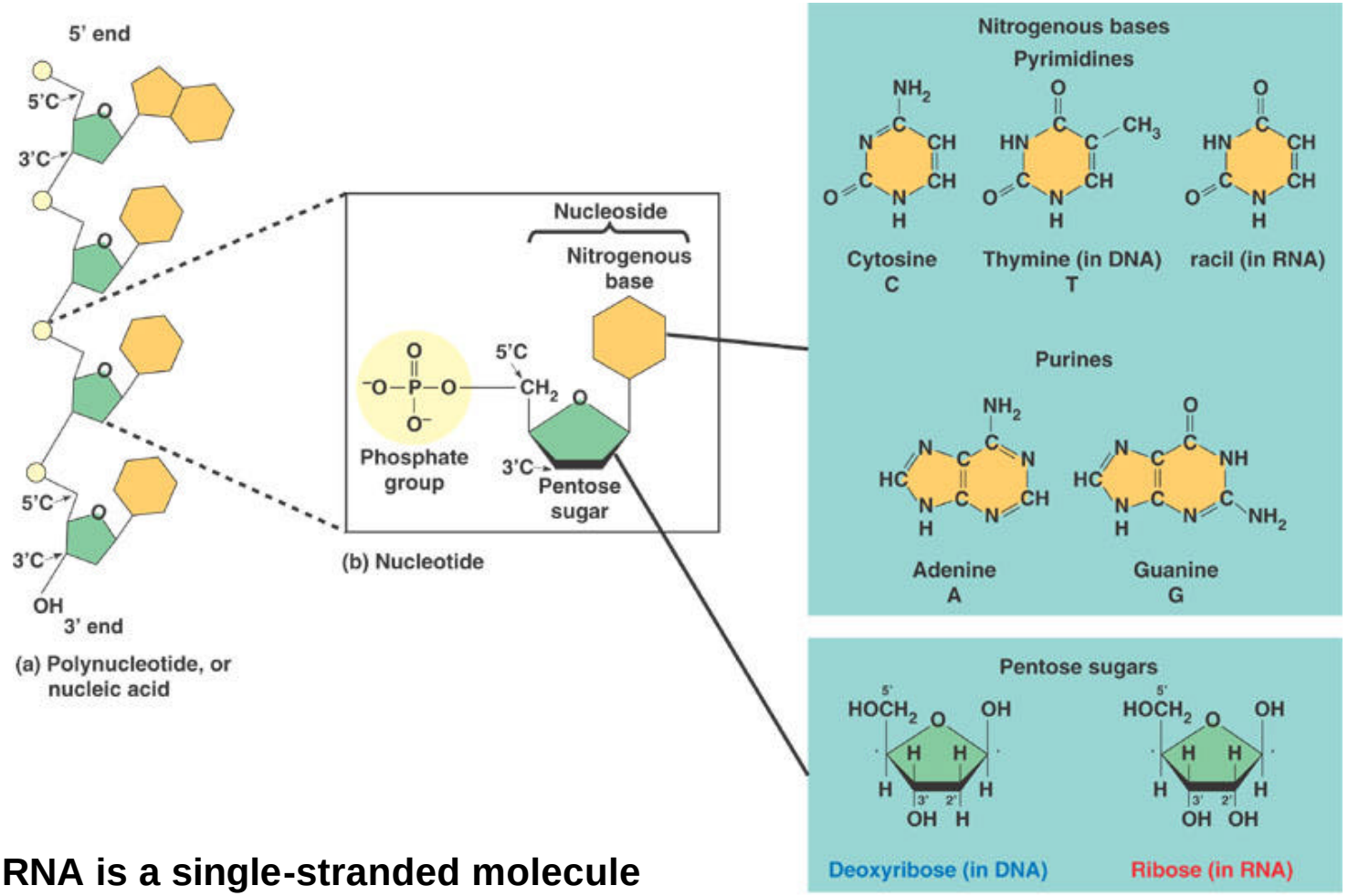
DNA Structure: The Double Helix



DNA as Hereditary Material



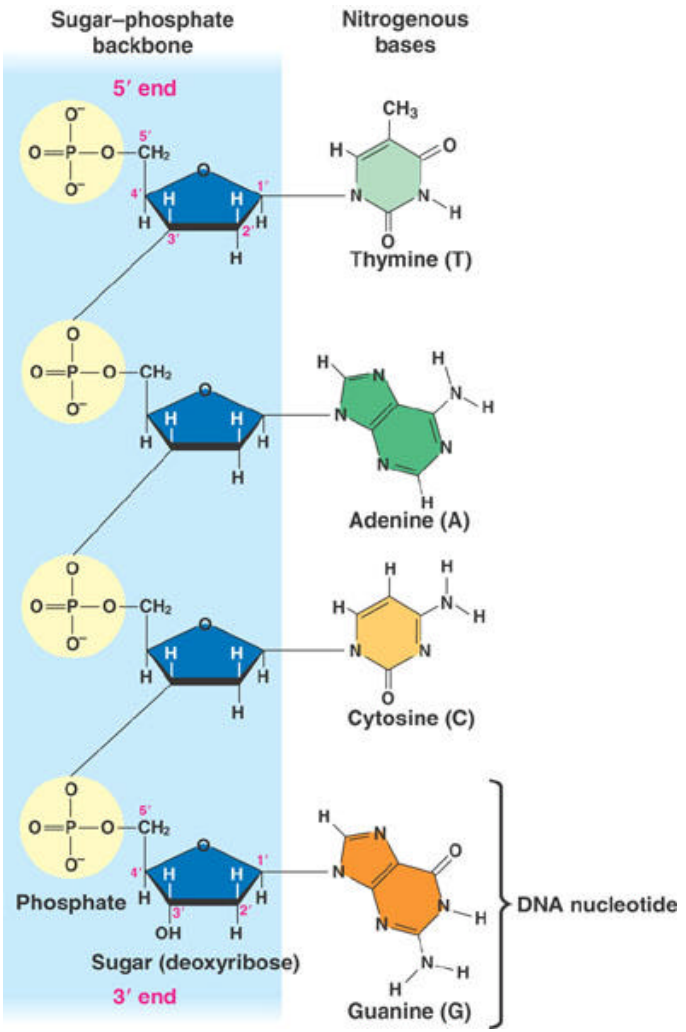
DNA is a Nucleic Acid: Nucleic Acids Are Made of Nucleotides



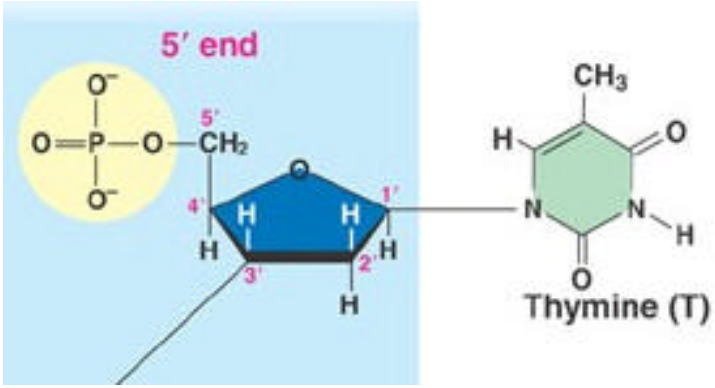
RNA is a single-stranded molecule
DNA is a double-stranded molecule

DNA Structure

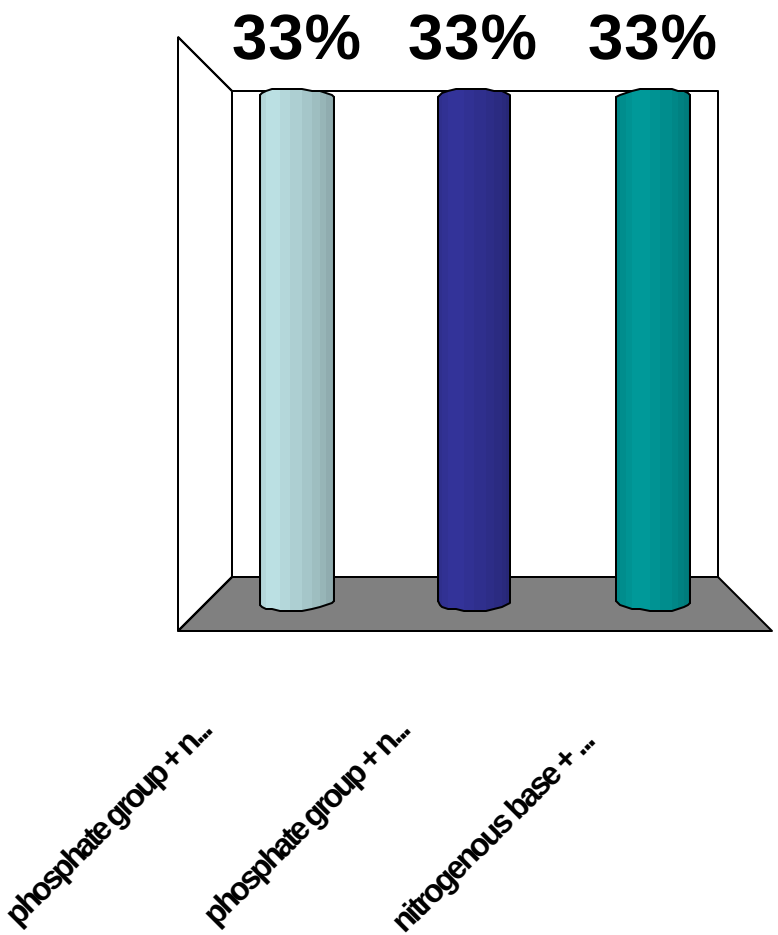
- DNA is a stretch of nucleotides made each of a deoxyribose, a nitrogen containing base (A, T, G, C), and a phosphate group
- The molecule is structured as a double helix constituted by **two** strands.



A nucleotide is made of:

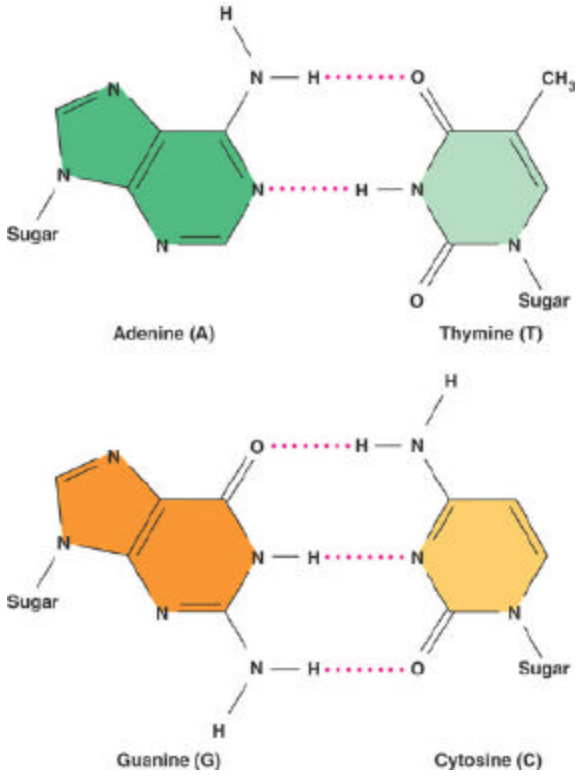


1. phosphate group + nitrogenous base
2. phosphate group + nitrogenous base + sugar
3. nitrogenous base + sugar



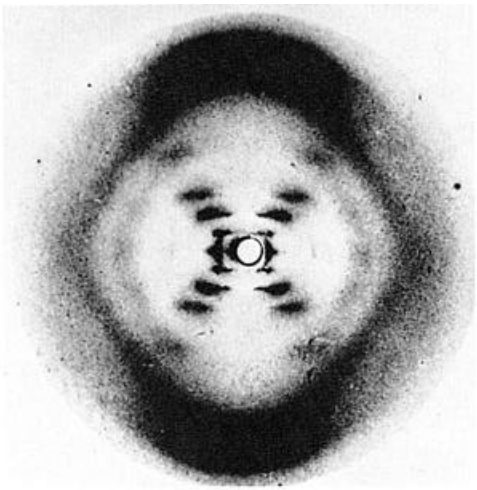
How Is the Helix Held?

- Hydrogen bonds establish between complementary nitrogen containing bases (A-T, C-G)
- Purines (A, G) bond to pyrimidines (T, C)
- A establishes two hydrogen bonds with T
- G establishes three hydrogen bonds with C



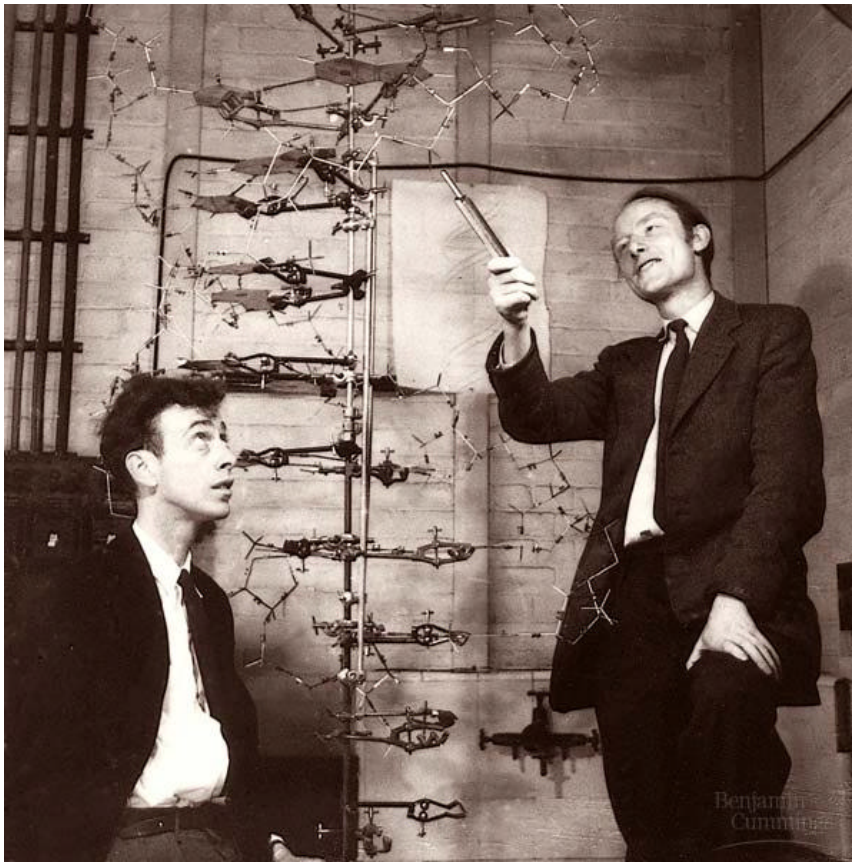
The Structure of DNA Is Revealed

(a) Rosalind Franklin



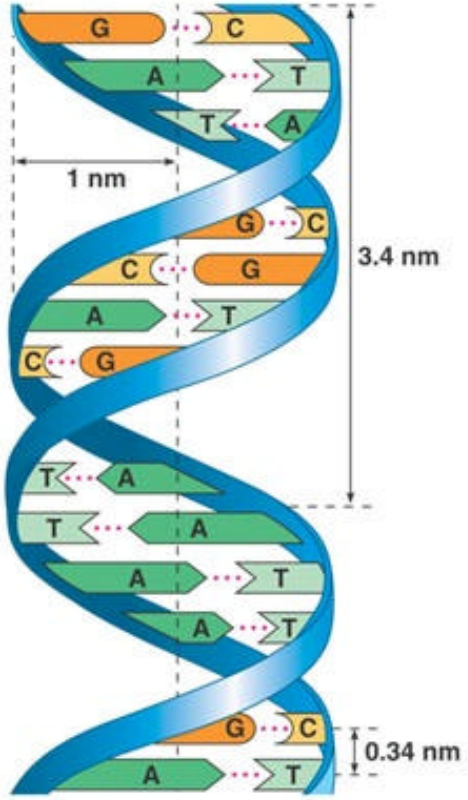
(b) Franklin's X-ray diffraction photograph of DNA

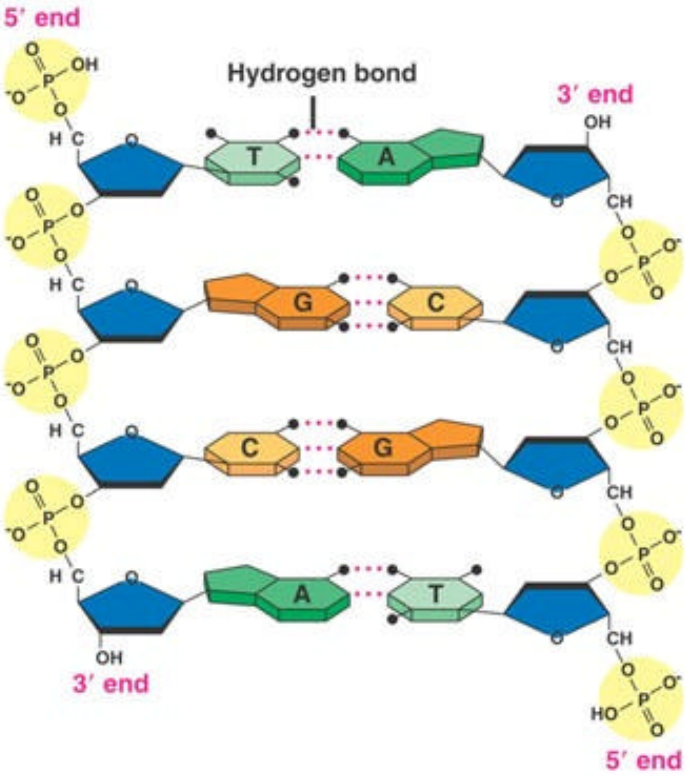
Rosalind Franklin

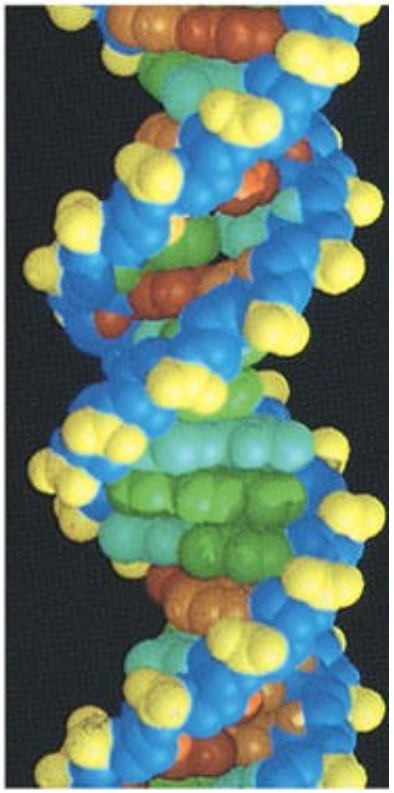


James Watson and Francis Crick

DNA Structure: The Double Helix







Let’s Do the Complementary Strand To:

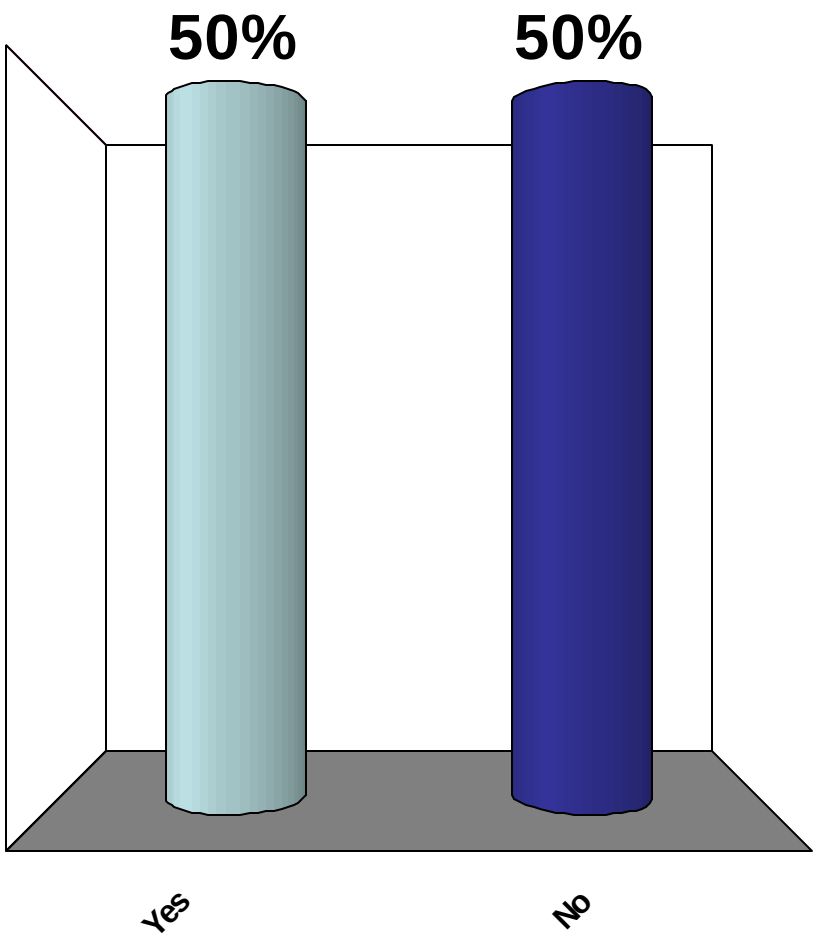
5’ AATCGTAGTGCCATTAGTGTACACT 3’

A – T

G – C

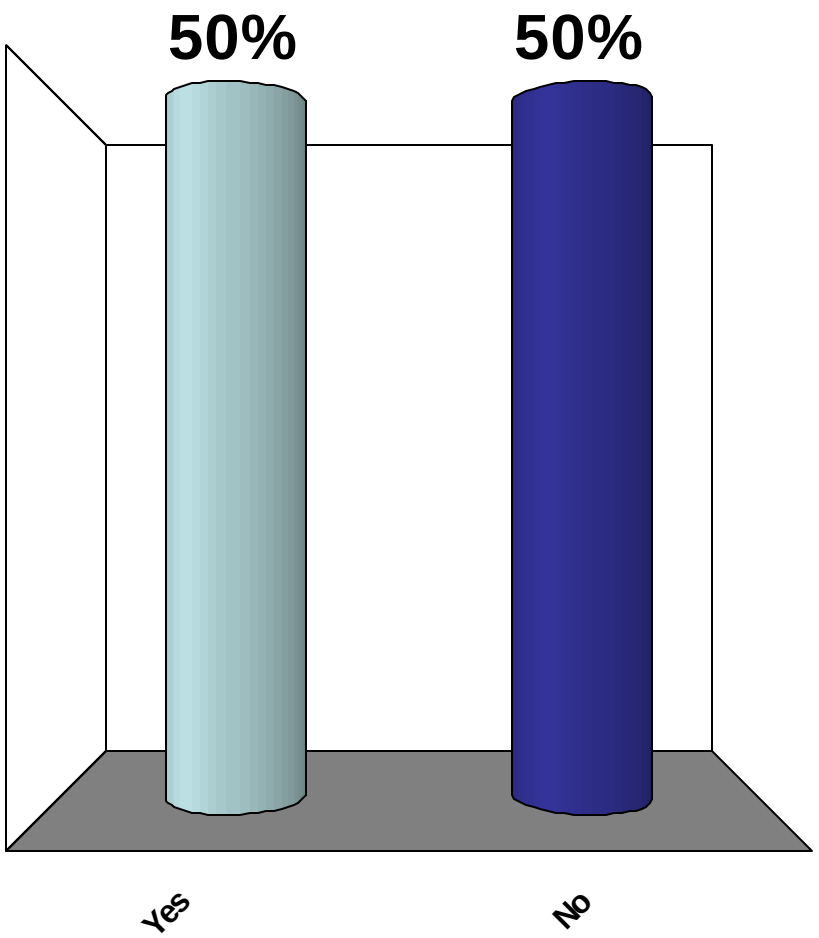
Adenine establishes two hydrogen bonds with thymine. Do you agree?

1. Yes
2. No

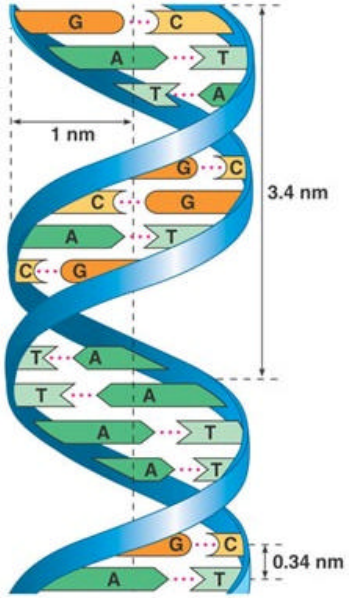


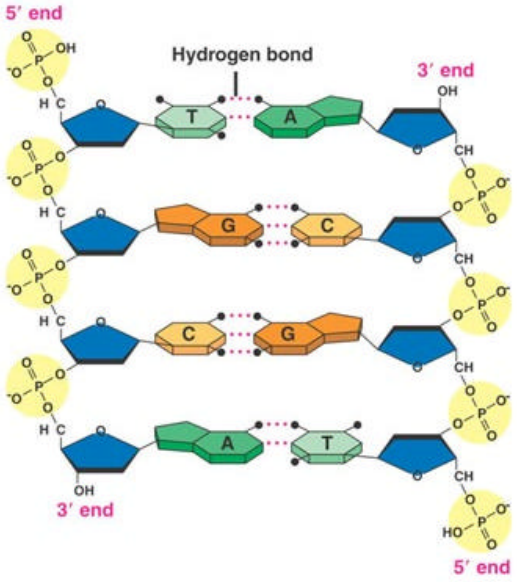
Guanine establishes three hydrogen bonds with thymine. Do you agree?

1. Yes
2. No

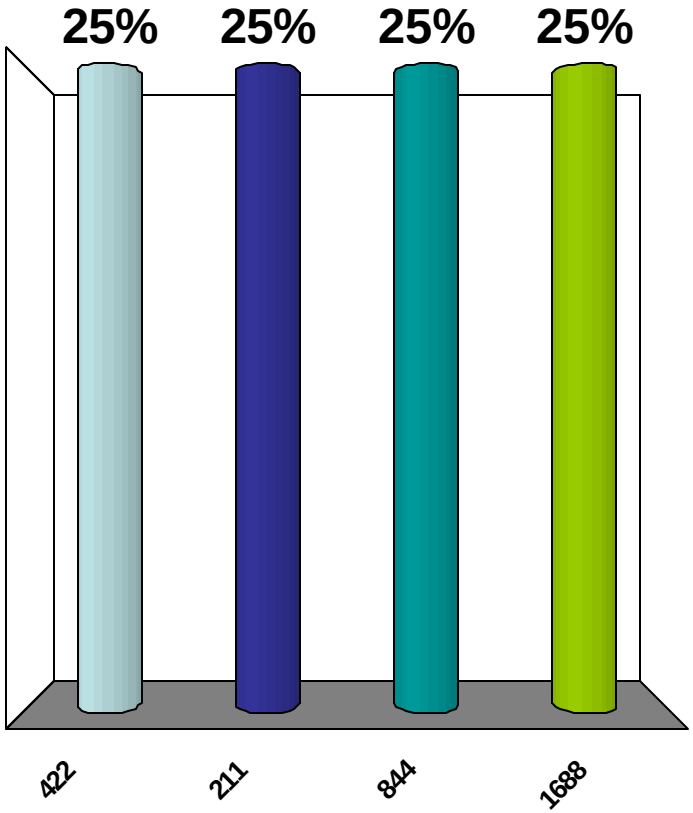


How many cytosines will be found in a molecule of DNA that has 422 guanines?

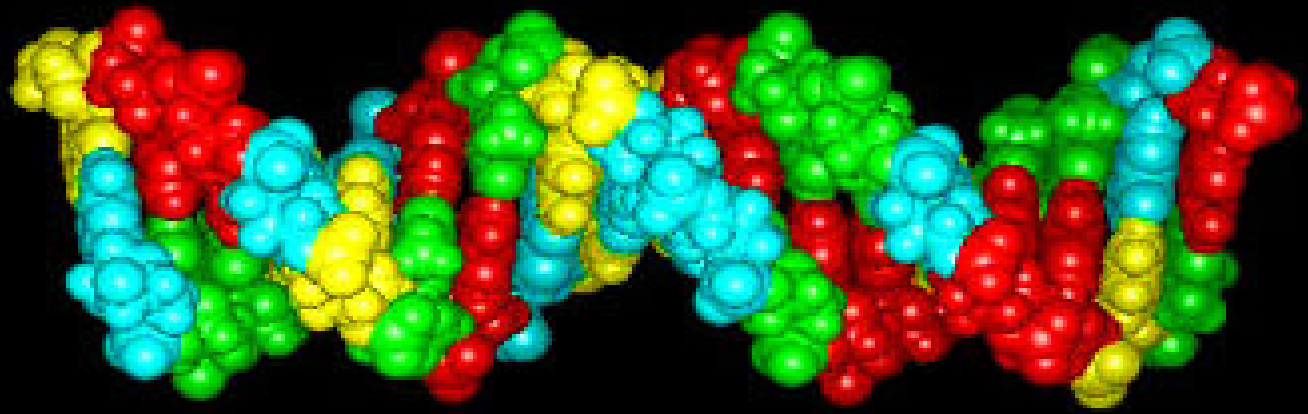


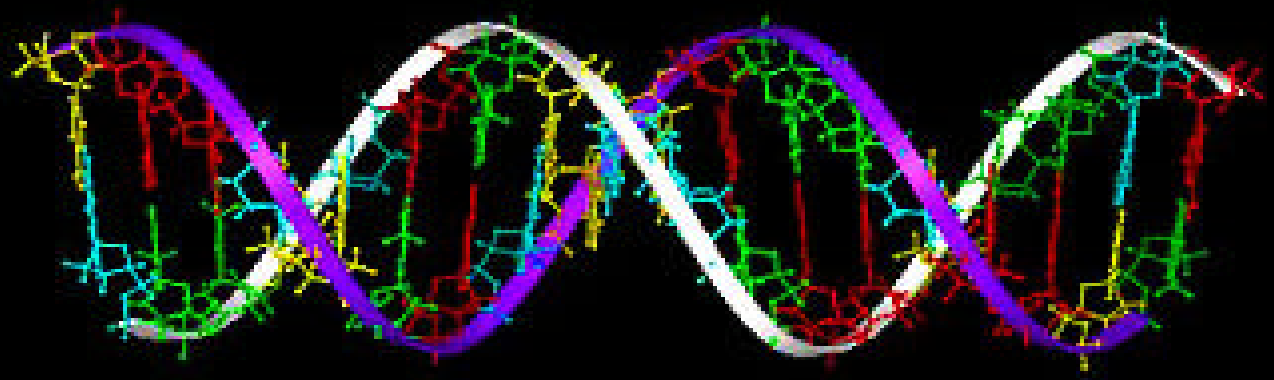


1. 422
2. 211
3. 844
4. 1,688

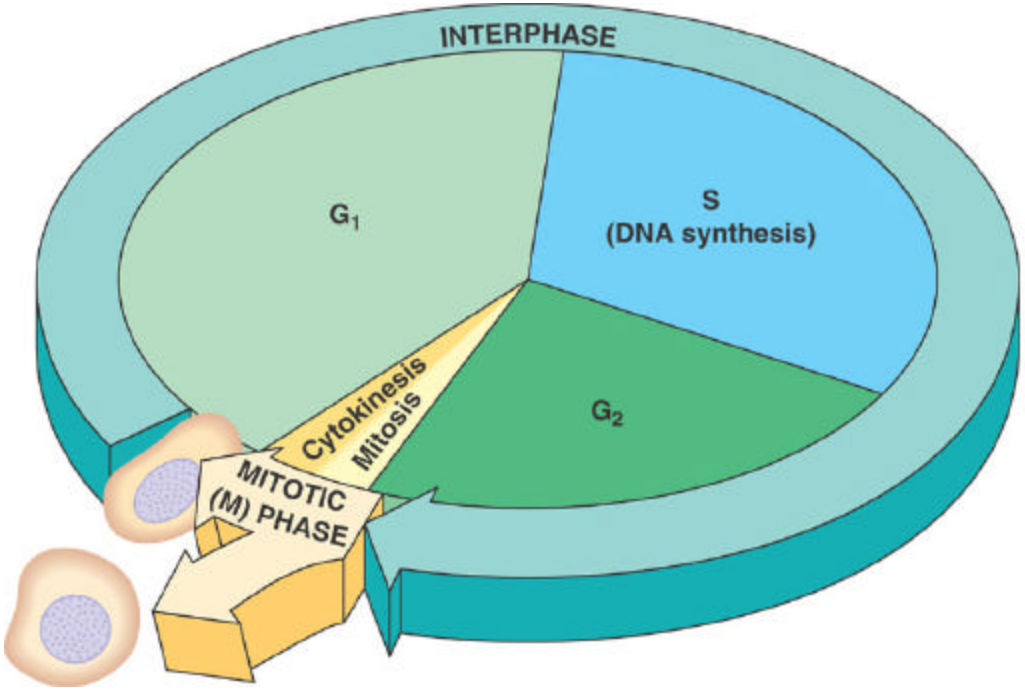


DNA Replication

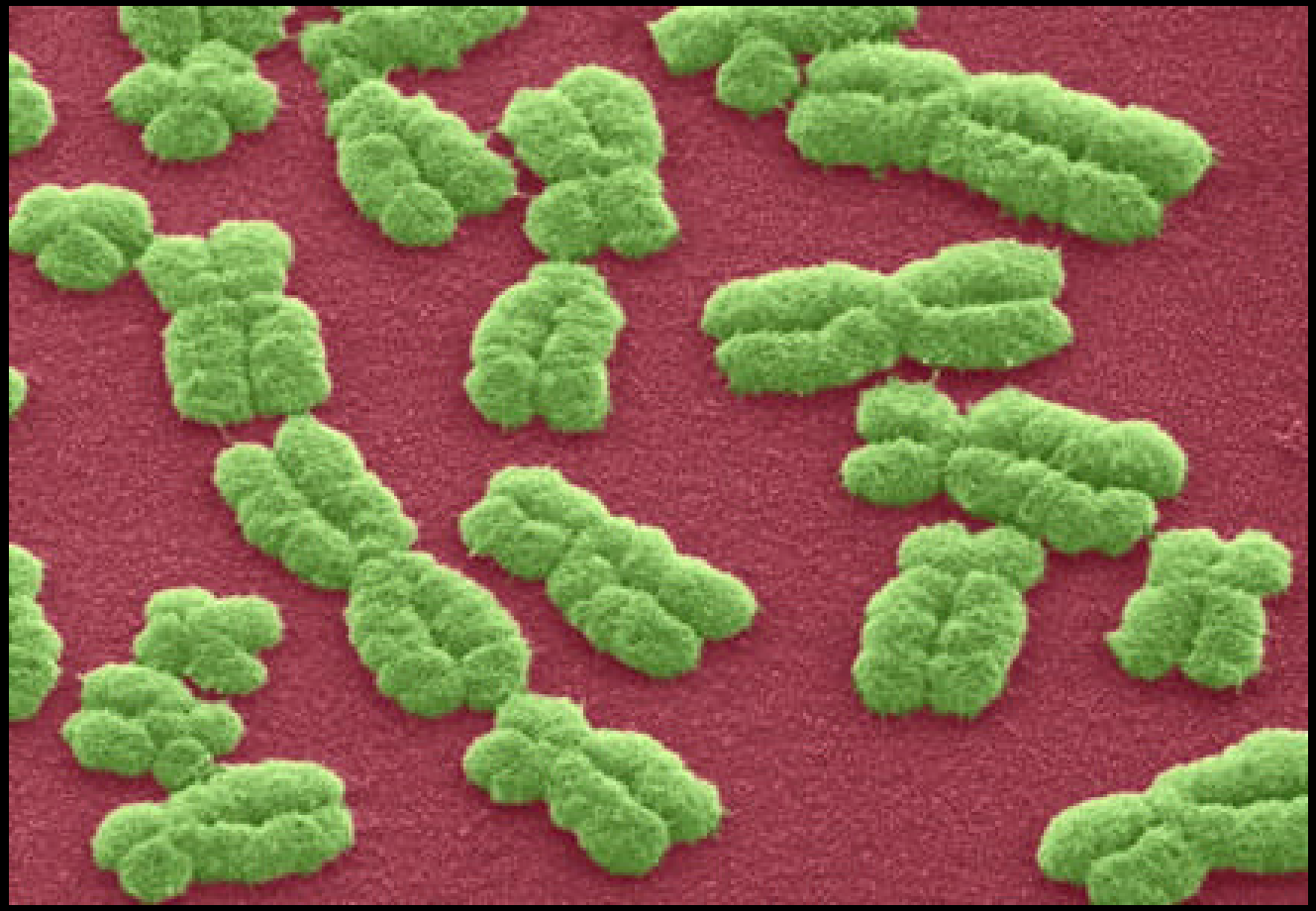




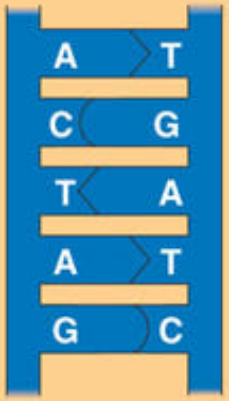
DNA Replication: When Does It Happen?



During S Phase Chromosomes Duplicate (DNA Replication)

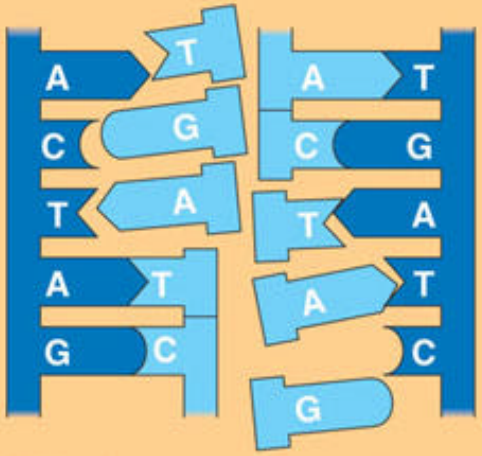


DNA Replication



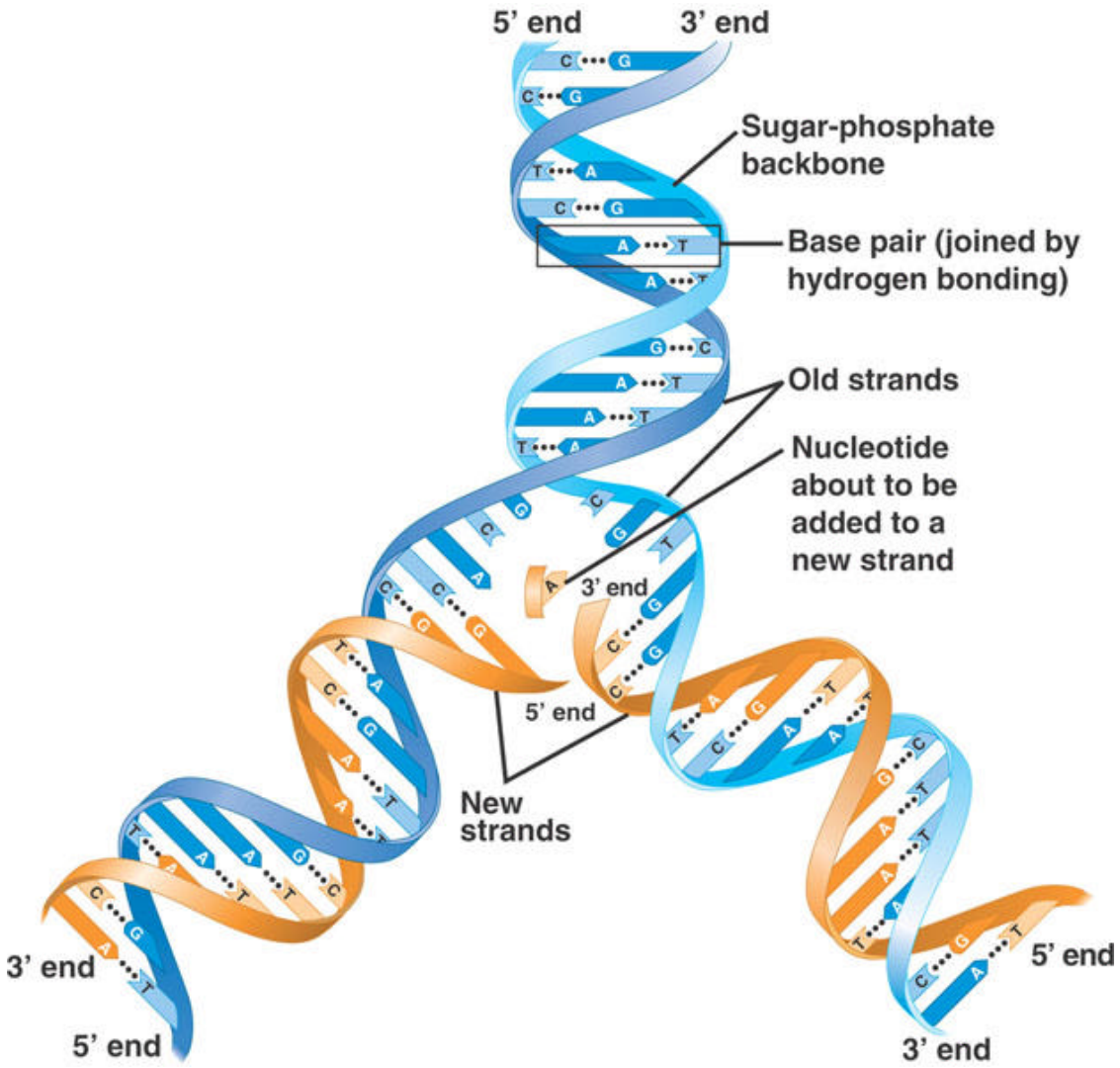
(a) The parent molecule has two complementary strands of DNA. Each base is paired by hydrogen bonding with its specific partner, A with T and G with C.

(b) The first step in replication is separation of the two DNA strands.



(c) Each parental strand now serves as a template that determines the order of nucleotides along a new, complementary strand.

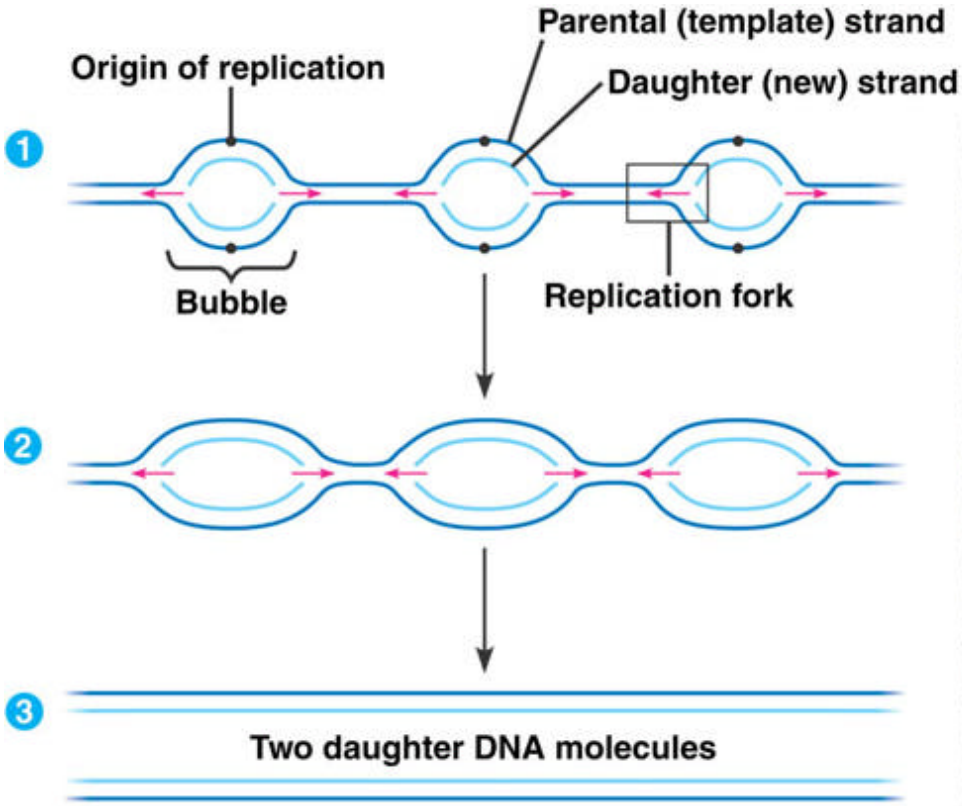
DNA Replication



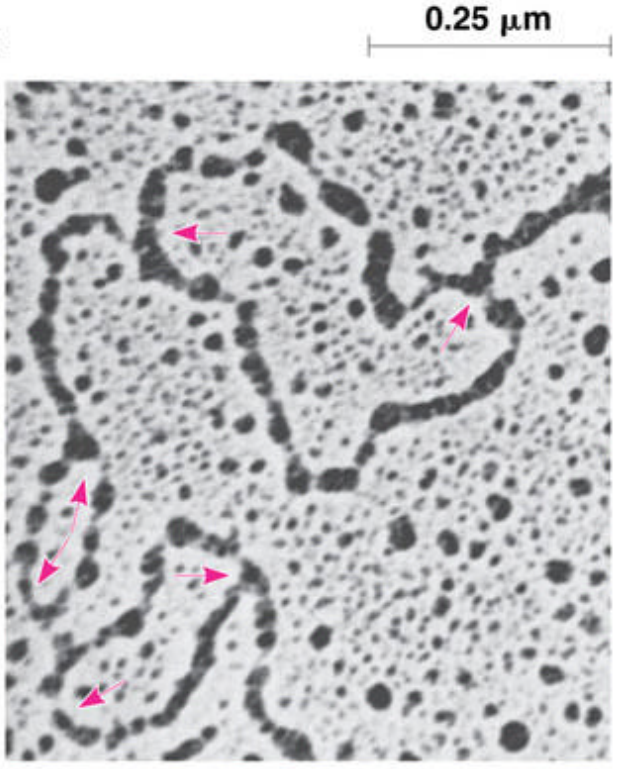
Let’s Replicate DNA

5’ AATCGTAGTGCCATTAGTGTACACT 3’

DNA Replication: Replication Forks

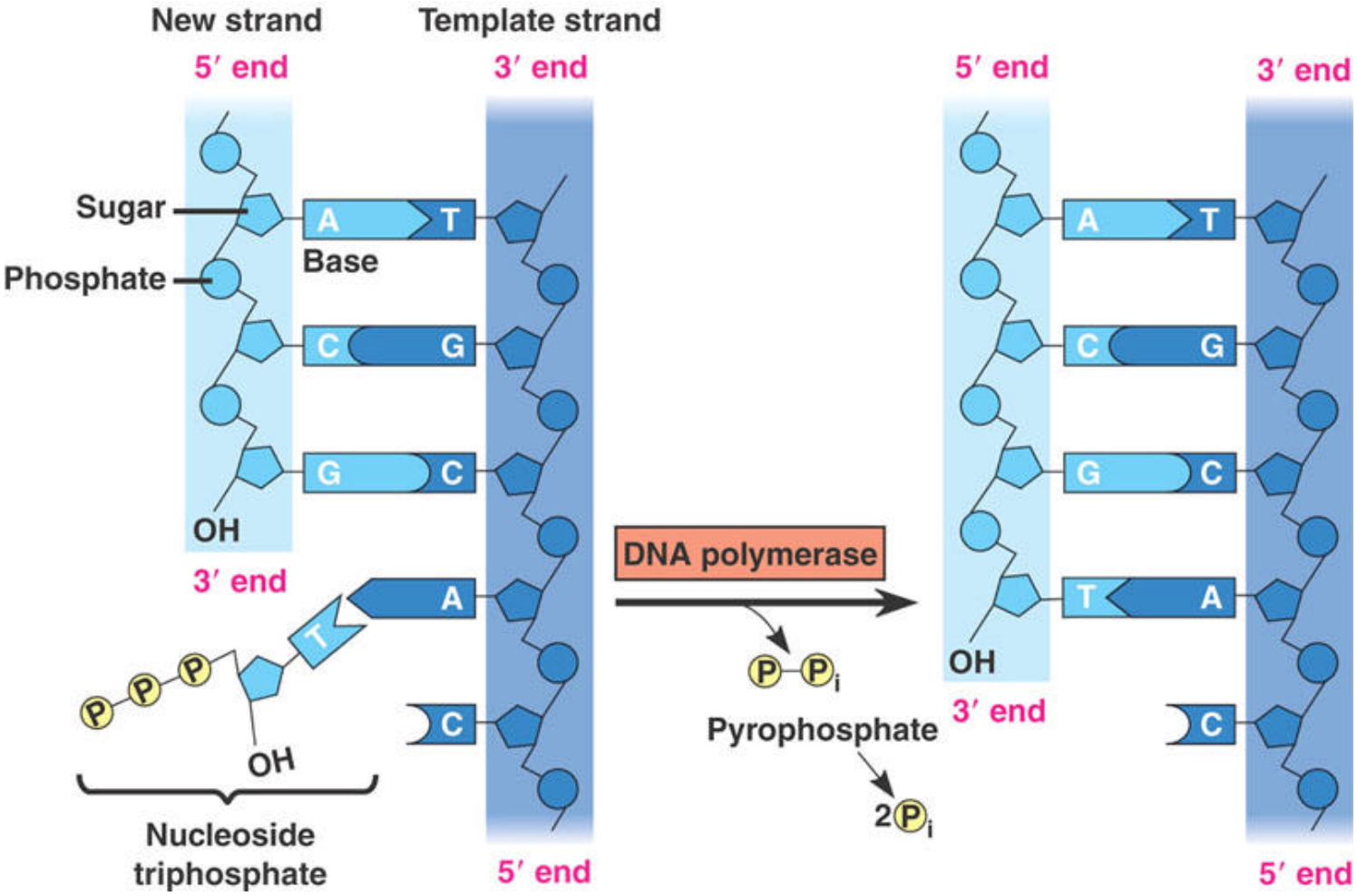


(a) In eukaryotes, DNA replication begins at many sites along the giant DNA molecule of each chromosome.



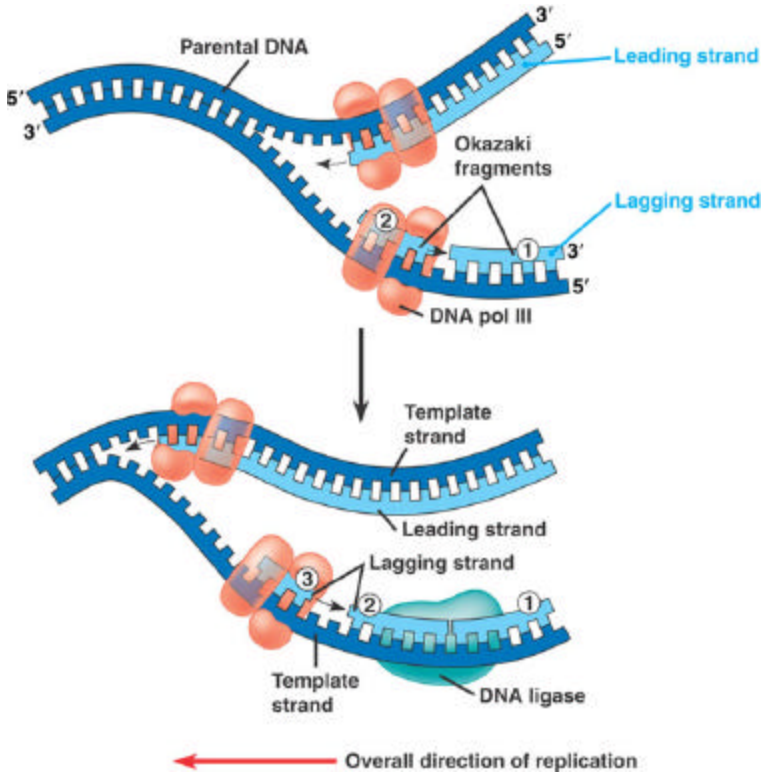
(b) In this micrograph, three replication bubbles are visible along the DNA of a cultured Chinese hamster cell (TEM).

DNA Replication: How Does It Happen?



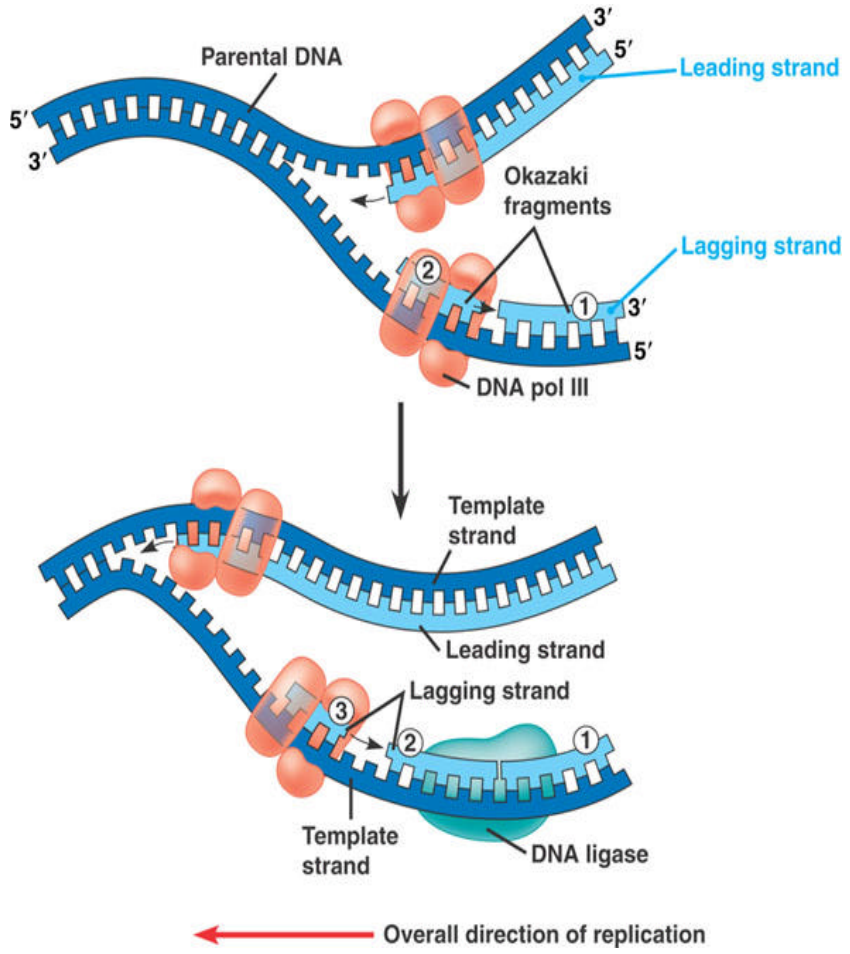
Enzymes and Proteins Involved in DNA Replication

- Helicase: unwind double helix
- Single-strand binding proteins
- Primase: adds RNA primer
- DNA Polymerase: adds nucleotides 5’ to 3’
- DNA Ligase: joints Okazaki fragments



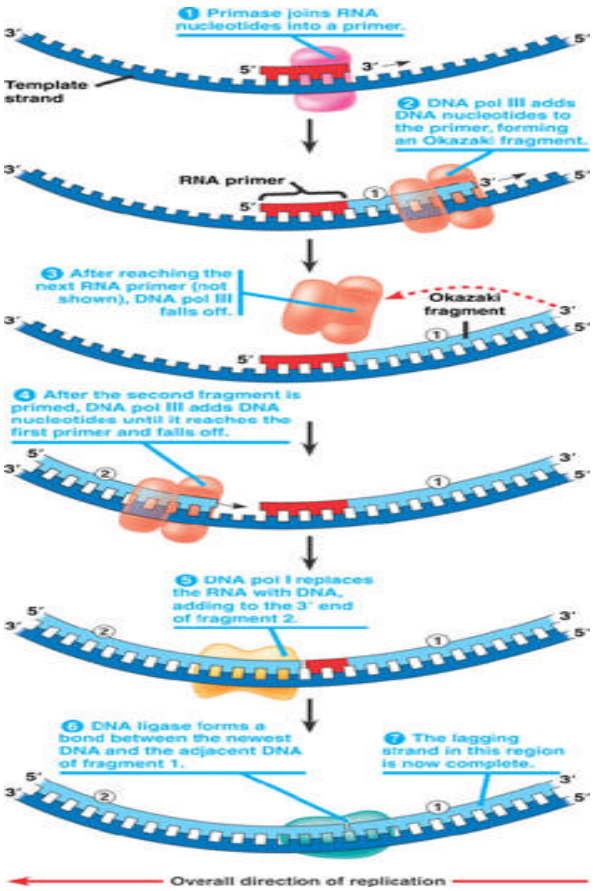
Replication of The Leading Strand

- DNA polymerase copy the leading strand in a 5’ to 3’ direction
- The elongation of the leading strand is continuous, and towards the direction of opening of the replication fork



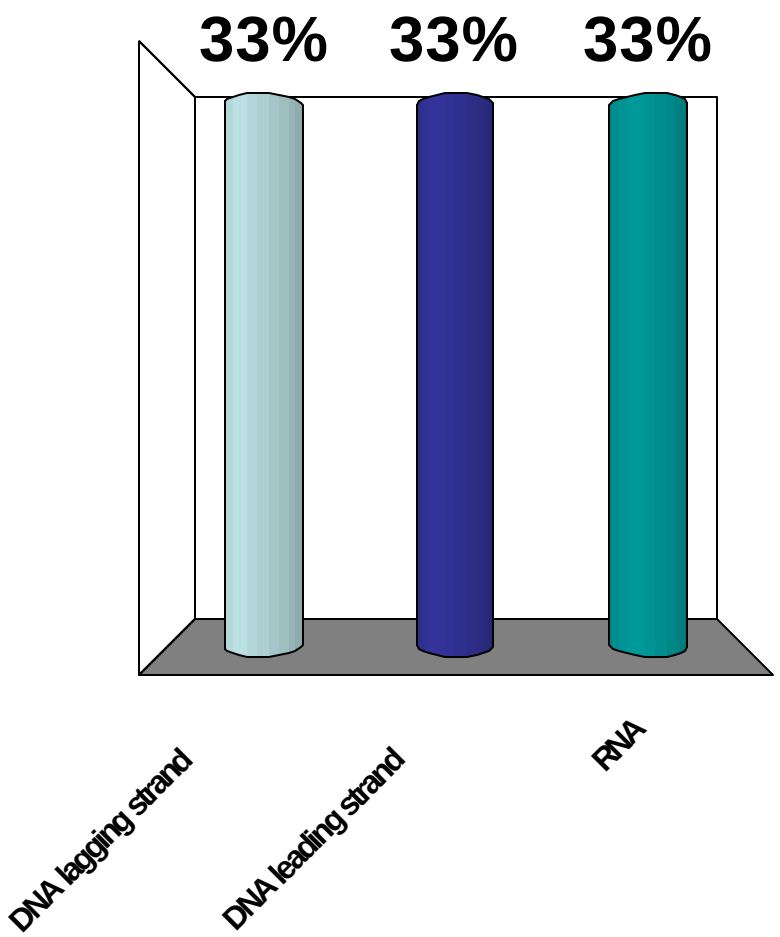
Replication of The Lagging Strand

- Primase initiates multiple RNA primers in order to duplicate the entire lagging strand
- The replication of the lagging strand is discontinuous, through multiple segments (Okazaki fragments). It proceeds away from the direction of opening of the replication fork
- DNA ligase joints Okazaki fragments



continuous replication : 5’ to 3’: DNA

1. DNA lagging strand
2. DNA leading strand
3. RNA



discontinuous replication : 3’ to 5’: DNA: Okazaki fragments

1. DNA lagging strand
2. DNA leading strand
3. Replication does not occur 3’ to 5’