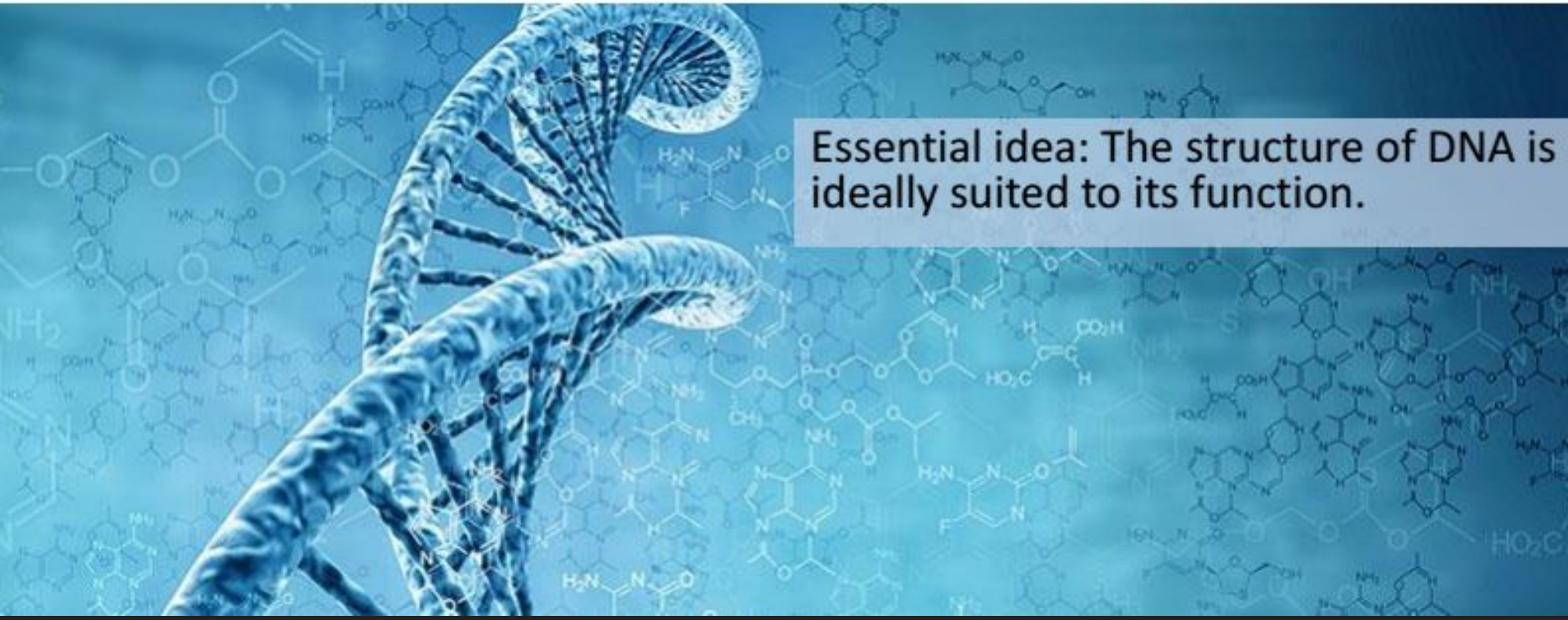
7.1 DNA


Essential idea: The structure of DNA is ideally suited to its function.

Understandings:

- DNA structure suggested a mechanism for DNA replication
- DNA replication is carried out by a complex system of enzymes
- DNA polymerase can only add nucleotides to the 3' end of a primer
- DNA replication is continuous on the leading strand and discontinuous on the lagging strand
- Some regions of DNA do not code for proteins but have other important functions
- Nucleosomes help to supercoil the DNA

Applications:

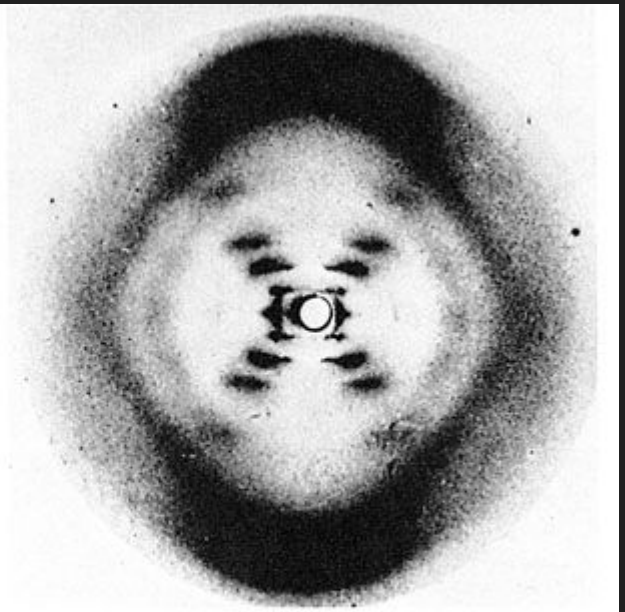
- Rosalind Franklin's and Maurice Wilkins' investigation of DNA structure by X-ray diffraction
- Use of nucleotides containing dideoxyribonucleic acid to stop DNA replication in preparation of samples for base sequencing
- Tandem repeats are used in DNA profiling

Skills:

- Analysis of results of the Hershey and Chase experiment providing evidence that DNA is the genetic material
- Utilisation of molecular visualisation software to analyse the association between protein and DNA within the nucleosome

7.1A1 Rosalind Franklin and Maurice Wilkins investigation of DNA structure by X-ray diffraction

(a) Rosalind Franklin



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

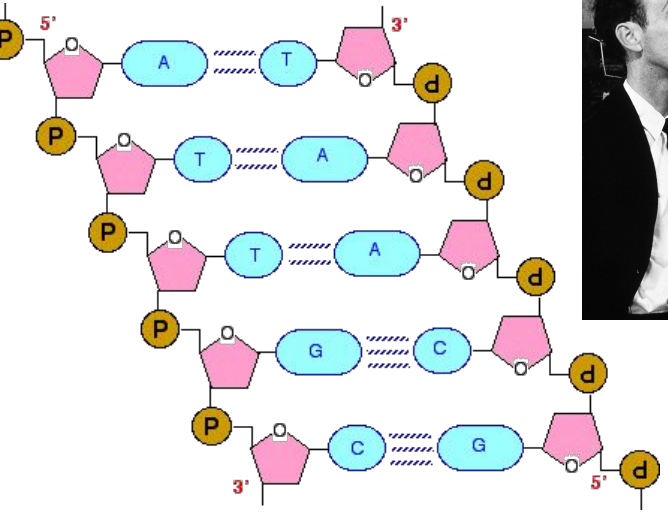
X-ray waves become scattered waves bounce off particles

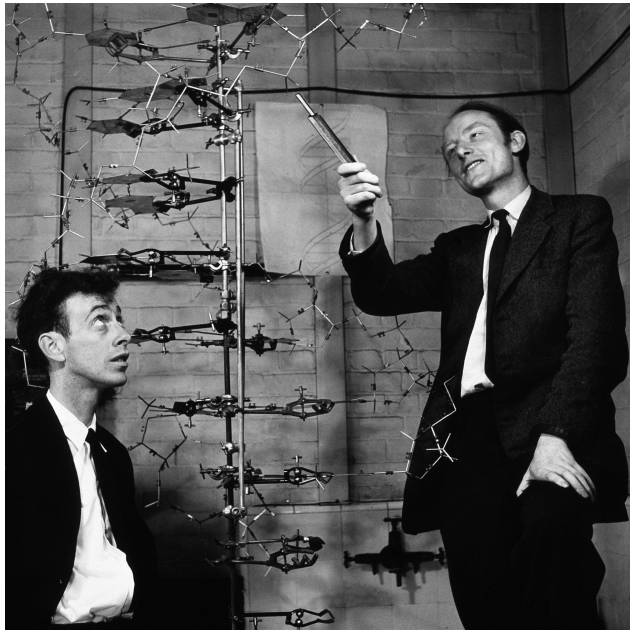
Crystal structures produced patterns of diffraction

Franklin took pictures of DNA using diffraction to discover structure

https://www.dnalc.org/view/15874-Franklin-s-X-ray.html

7.1U1: DNA structure suggested a mechanism for DNA replication



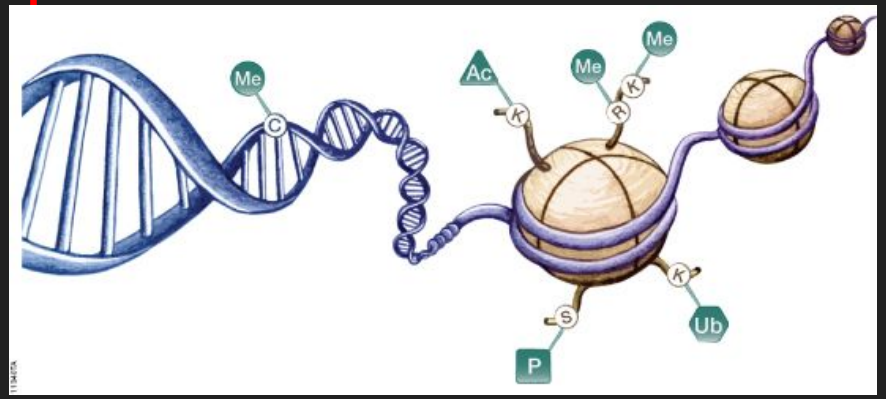


- Phosphate backbone outside
-
- Hydrogen bonds
-
- Double helix is tightly packed and regular
-
- Complementary base pairs in middle (A -T, C-G)
  Purines (A and G)
  Pyrimidines (C and T)
- Bi-directional (5'-3')

7.1U2 Nucleosomes help to supercoil DNA

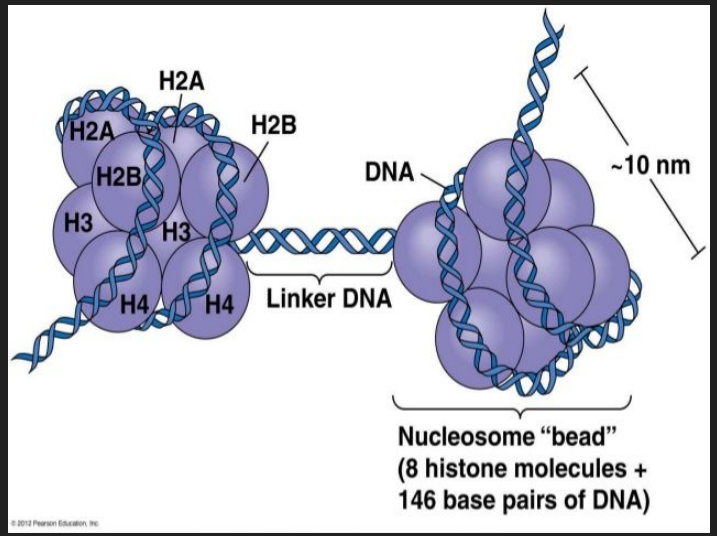
X ray diffraction showed super tight, regular coils

Clothes fit better in a suitcase when rolled = DNA supercoiling to fit inside cell

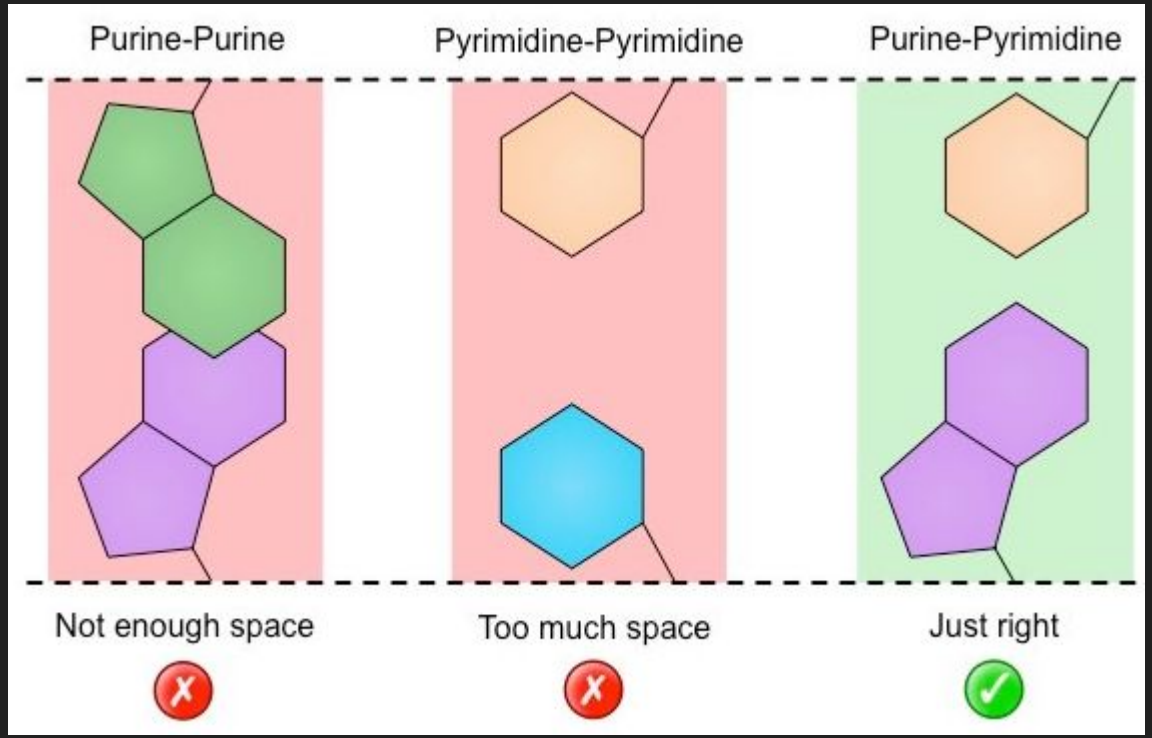


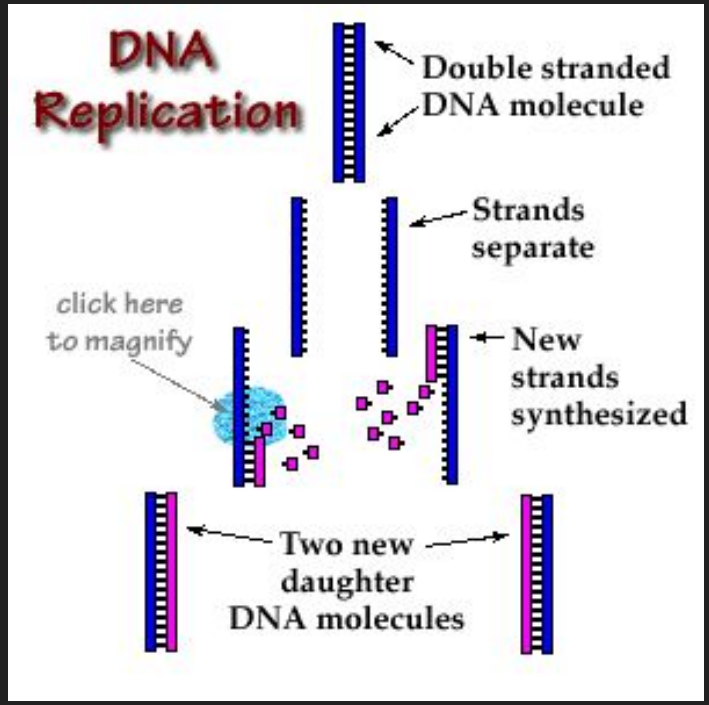
Nucleosomes = histones and linker DNA

Histones= proteins used to package DNA tightly



Base pairing suggests semiconservative replication





7.1U3 DNA replication is continuous on the leading strand and discontinuous on the lagging strand

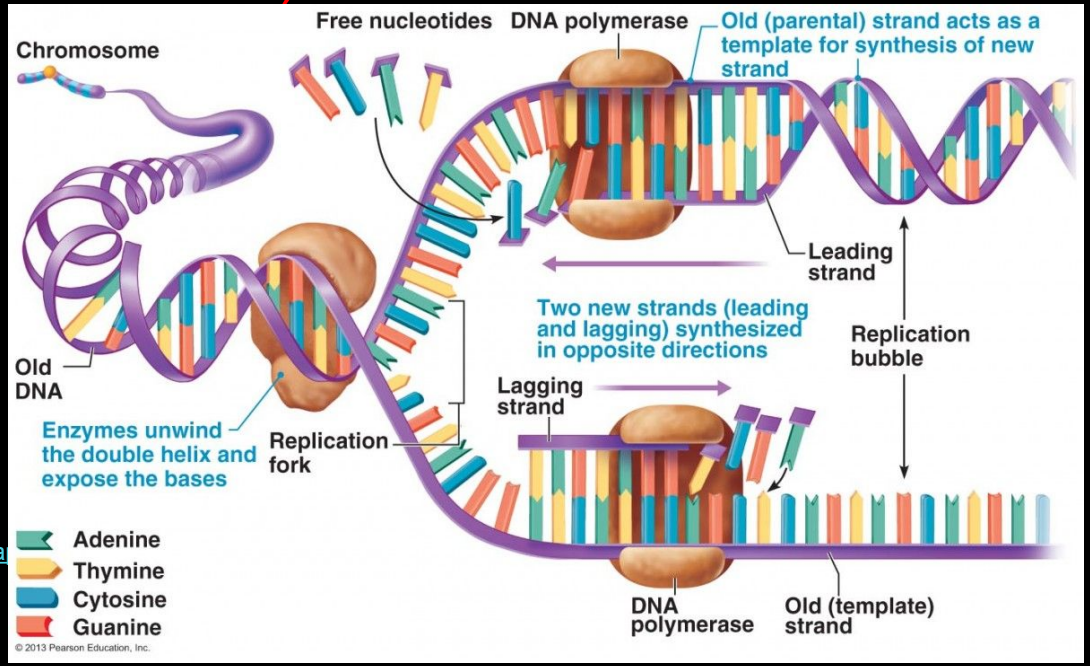
Anti parallel structure (5’-3’ and 3’-5’) causes differences in replication

5’-3’ end is continuous

3’-5’ end is discontinuous

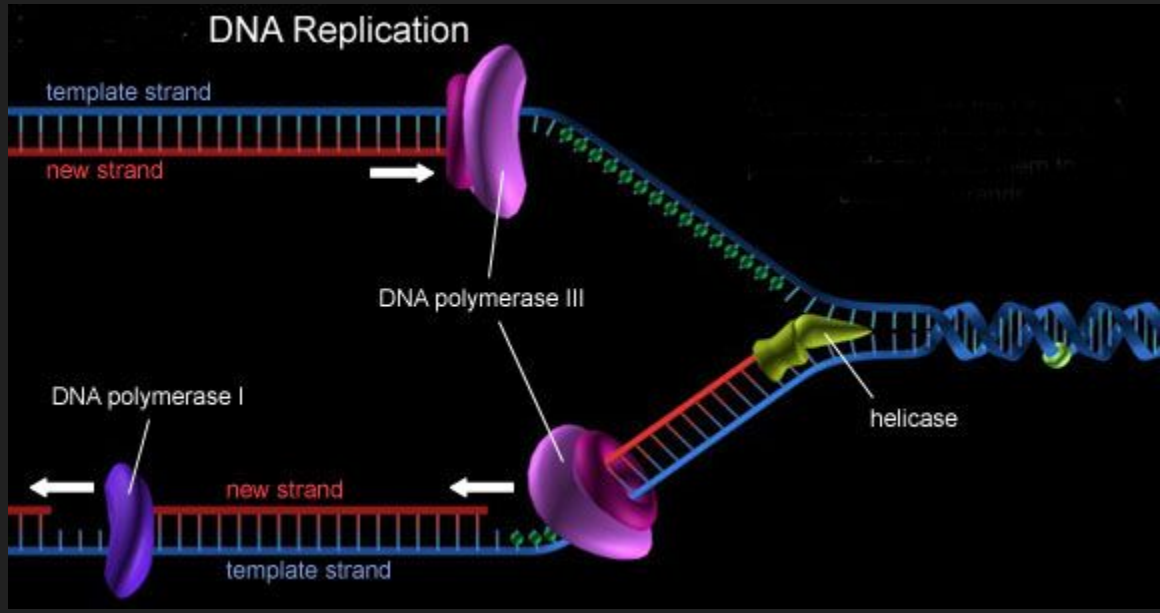
Why? Efficiency!

http://highered.mheducation.com/sites/0072943696/student_view0/cha

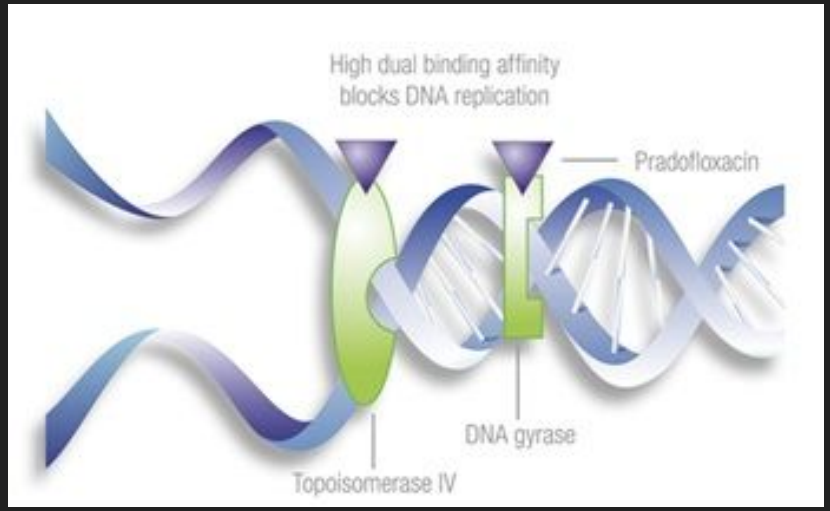


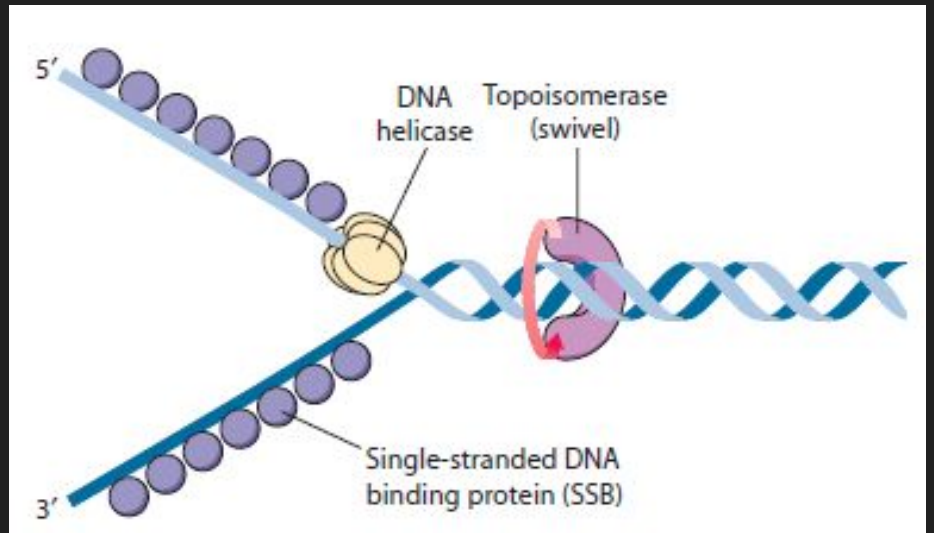
7.1U4: DNA replication is carried out by a complex of system enzymes

1. Helicase
2. Gyrase
3. Single Stranded Binding Proteins
4. Primase
5. DNA polymerase III
6. DNA polymerase I
7. Ligase



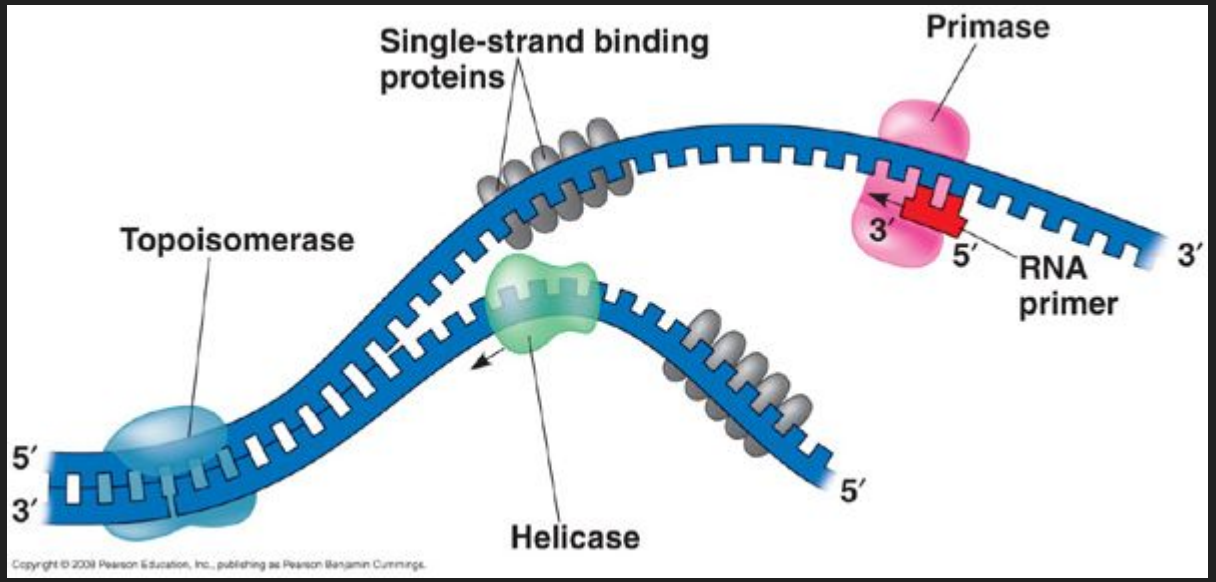
1. Helicase- unzips DNA helix (sight of replication)
2. Gyrase - prevents torsion from the unwinding from helicase





3. Single Stranded Binding Proteins (SSBP)- prevent helix strands from reannealing

4. Primase- makes RNA primer so Polymerase III has a place to attach



5. DNA polymerase III- adds nucleotides to new chain (continuous)

6. DNA polymerase I - replaces RNA primer lagging strand (non continuous)

7. Ligase- joins Okazaki fragments from lagging strand

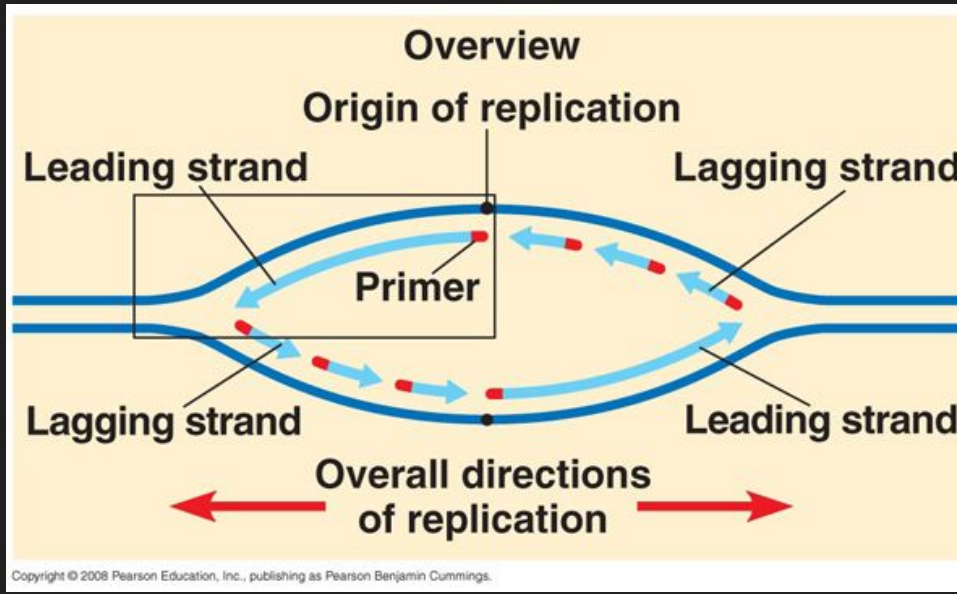
Bell ringer

1. Which 7 enzymes are involved in DNA replication?
2. What is the relationship between a histone and a nucleosome?
3. Explain why there is a ‘leading’ and a ‘lagging’ strand?

7.1U5 DNA polymerases can only add nucleotides to the 3' end of primer

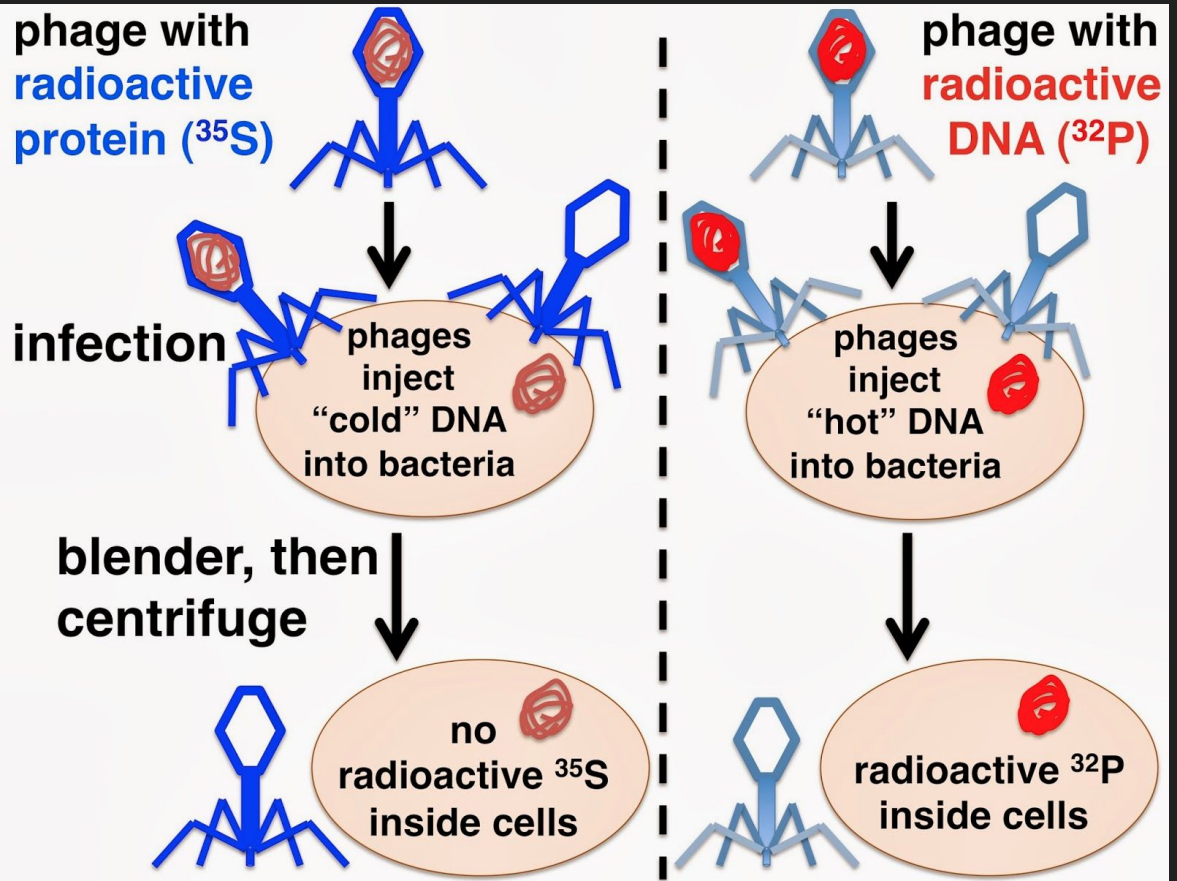
Eukaryotes have many sites of replication along DNA

Replication occurs on all strands at origin site



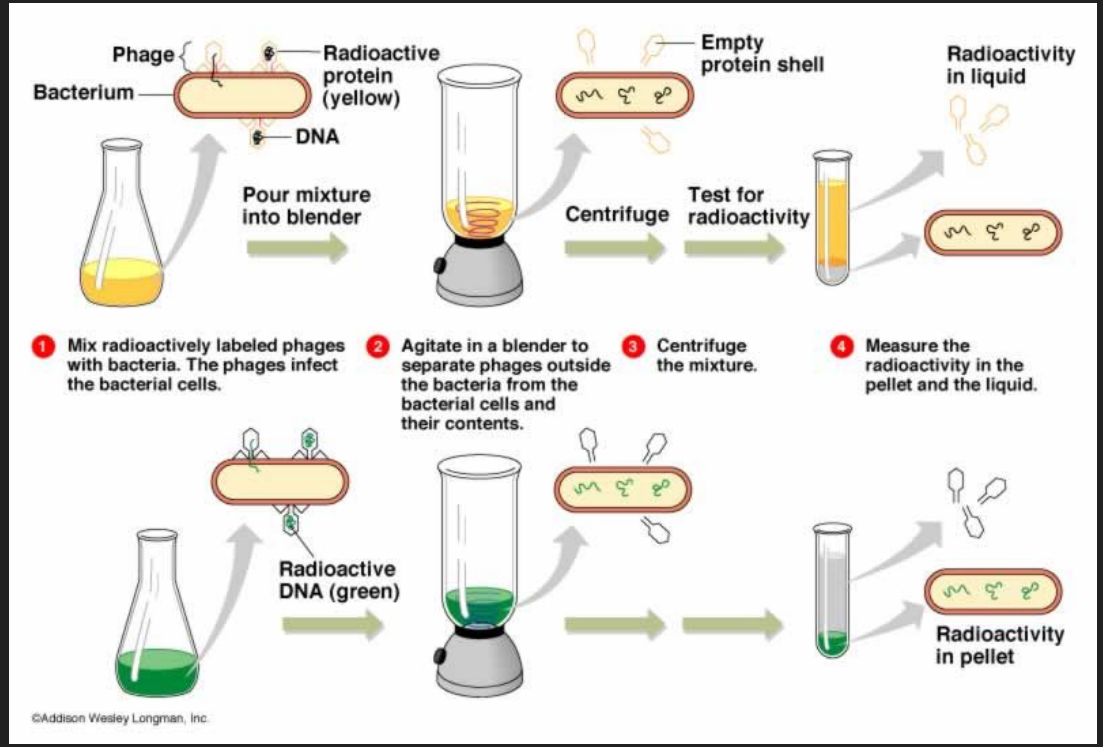
Nucleotides can only be zipped up 3' direction which is why there is a leading and lagging strand

7.1S1 Hershey and Chase experiment provides evidence that DNA is the genetic material



- Radioactively tagged protein coat and nucleic acid of phage

- Which one is transferred to bacteria host?

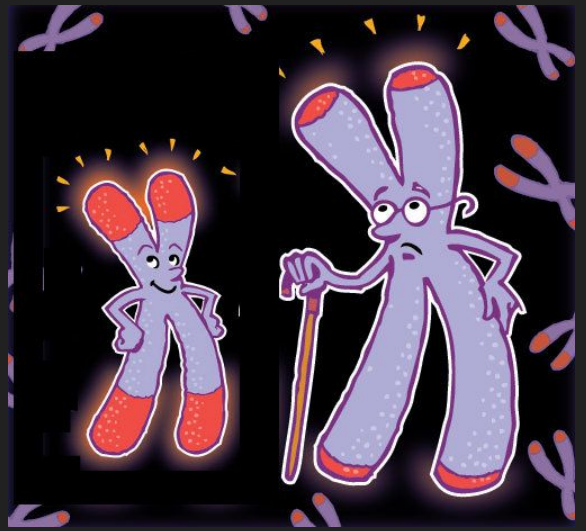


Only the radioactive nucleic acid treatment appeared in the infected bacteria

Proof that nucleic acid is the genetic information transferred

http://highered.mheducation.com/olc/dl/120076/bio21.swf

7.1U6: Some regions of DNA do not code for proteins but have other important functions



Genes only make up ~1.5 % of DNA

Noncoding regions include : Satellite DNA, Telomeres, Introns, Non-Coding RNA genes, Gene regulatory systems

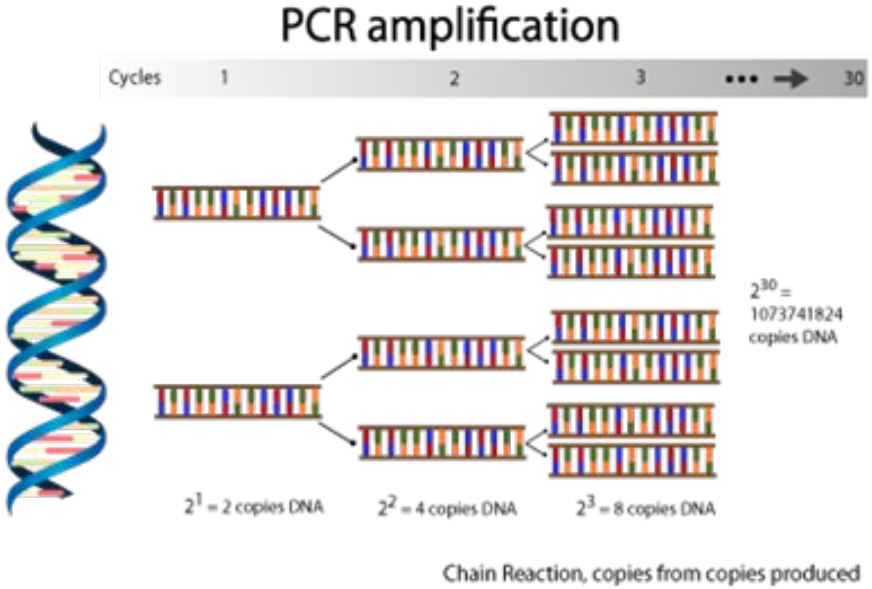
Acronym: STING

9.1A2 Tandem repeats are used in DNA profiling

Tandem Repeats (TR) - short, non-coding sections of DNA (2-5 bp)

Use for maternal, paternal DNA profiling

Use PCR to cut up repeat sequences and compare lengths between two individuals



7.1S2 Molecular visualization software to analyse the association between protein within a nucleosome