DNA + Replication

Slides by Slidesgo, presentation by Laurie

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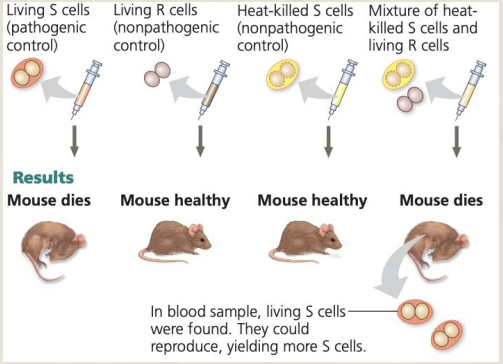
DNA Basics

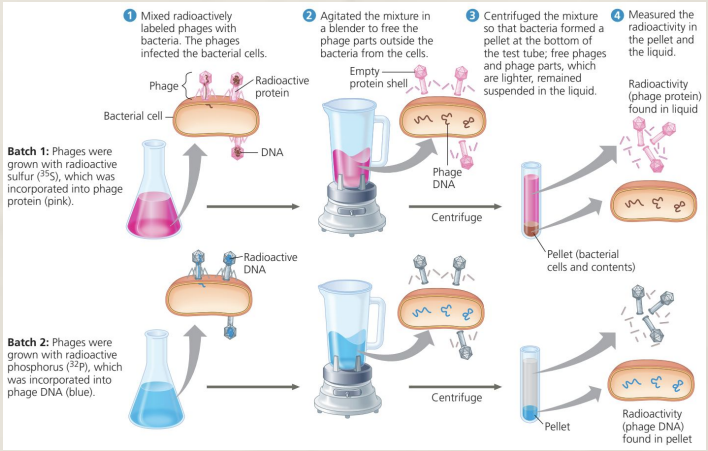
DNA Experiments



Background
- DNA vs. Proteins as the genetic material
    - Proteins were more familiar and DNA seemed too simple

Griffith (1928)
- Transformation by <u>something</u>
    - Transformation = bac-bac, Transduction - bac-virus
- Avery, McCarty, MacLeod identified it as DNA

Hershey and Chase (1952)
- Bacteriophages = DNA + protein, reprogram bacteria
- Batch 1: Protein tagged with radioactive sulfur
- Batch 2: DNA tagged with radioactive phosphorus
- Centrifuge! → based on where the radioactivity was, it was determined that DNA was injected into the bacteria



Chargaff's Rules (1950)
- % A = % T, % C = % G
- Different species have different DNA composition

Watson + Crick, Wilkins, Franklin
- Franklin - X-ray crystallography
- Watson + Crick usually given credit for first complete structure

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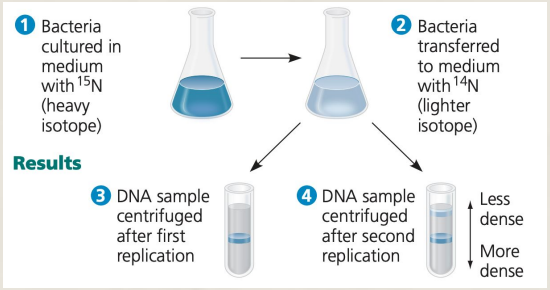
DNA Replication

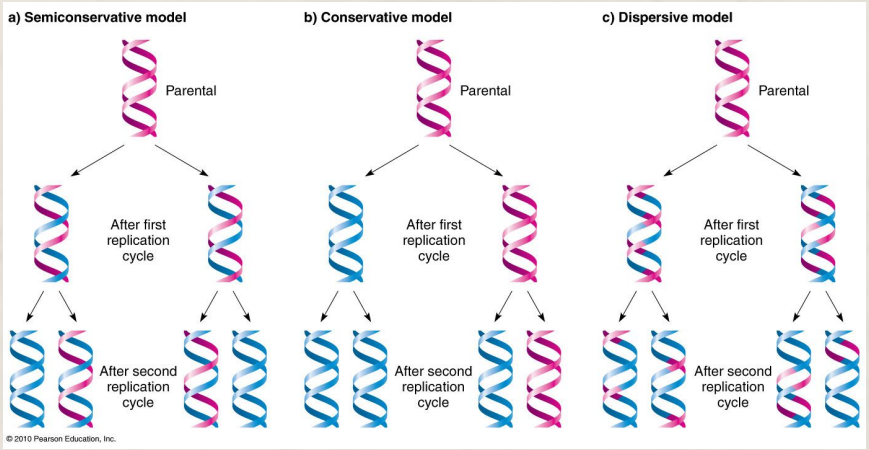
Experiments

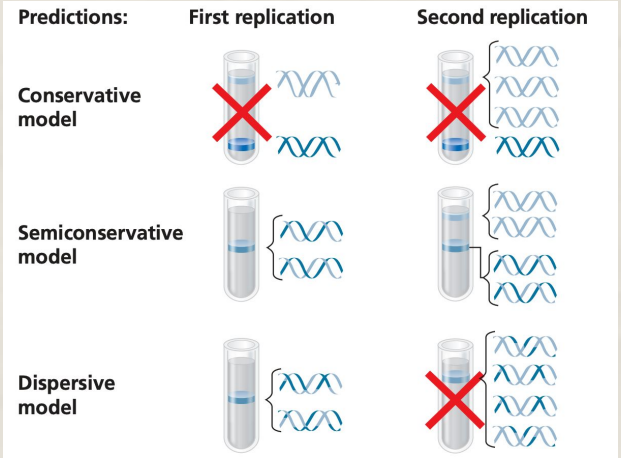
3 models

- Conservative
- Semiconservative
- Dispersive

Meselson and Stahl



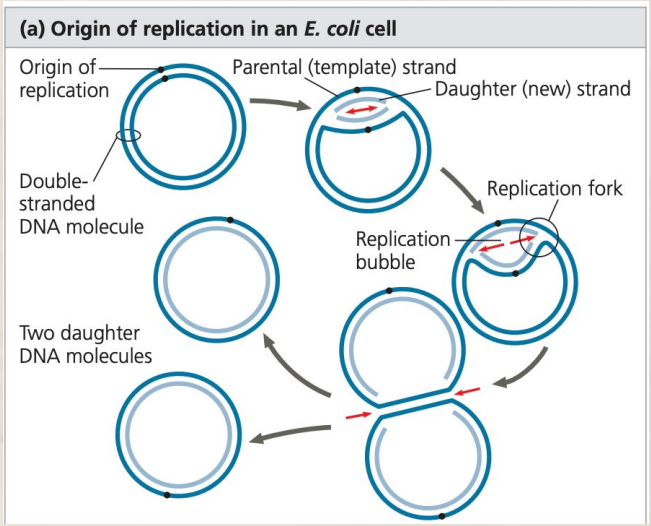


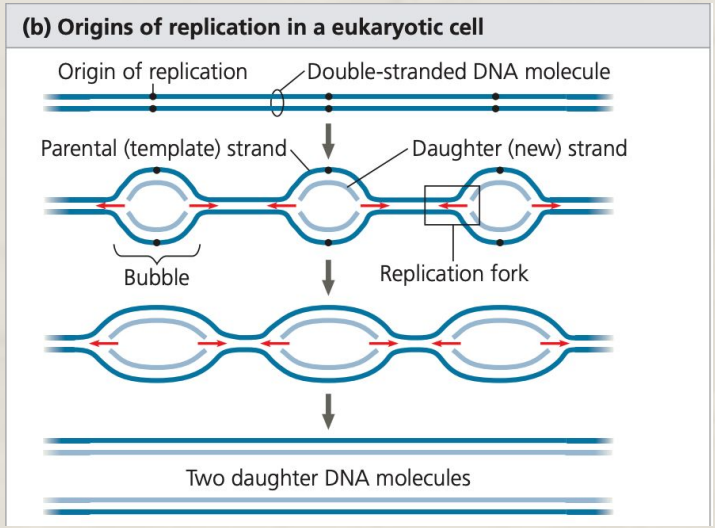


https://www.mun.ca/biology/scarr/iGen3_03-01_Figure-L.jpg

DNA Replication

- Origin of Replication
  - Have a specific nucleotide sequence
  - Bacteria – circular chromosomes – one replication bubble
  - Euk – A lot of oris
- Replication fork
  - Where replication is going





Replication Proteins

Helicase – unwind the two strands

Single-strand binding proteins (SSBs) – prevent DNA from joining together by binding to individual strands

Topoisomerase – relieves supercoiling (when the DNA coils tightly because you're pulling it apart)

Primase – makes RNA primers on the separated DNA strands

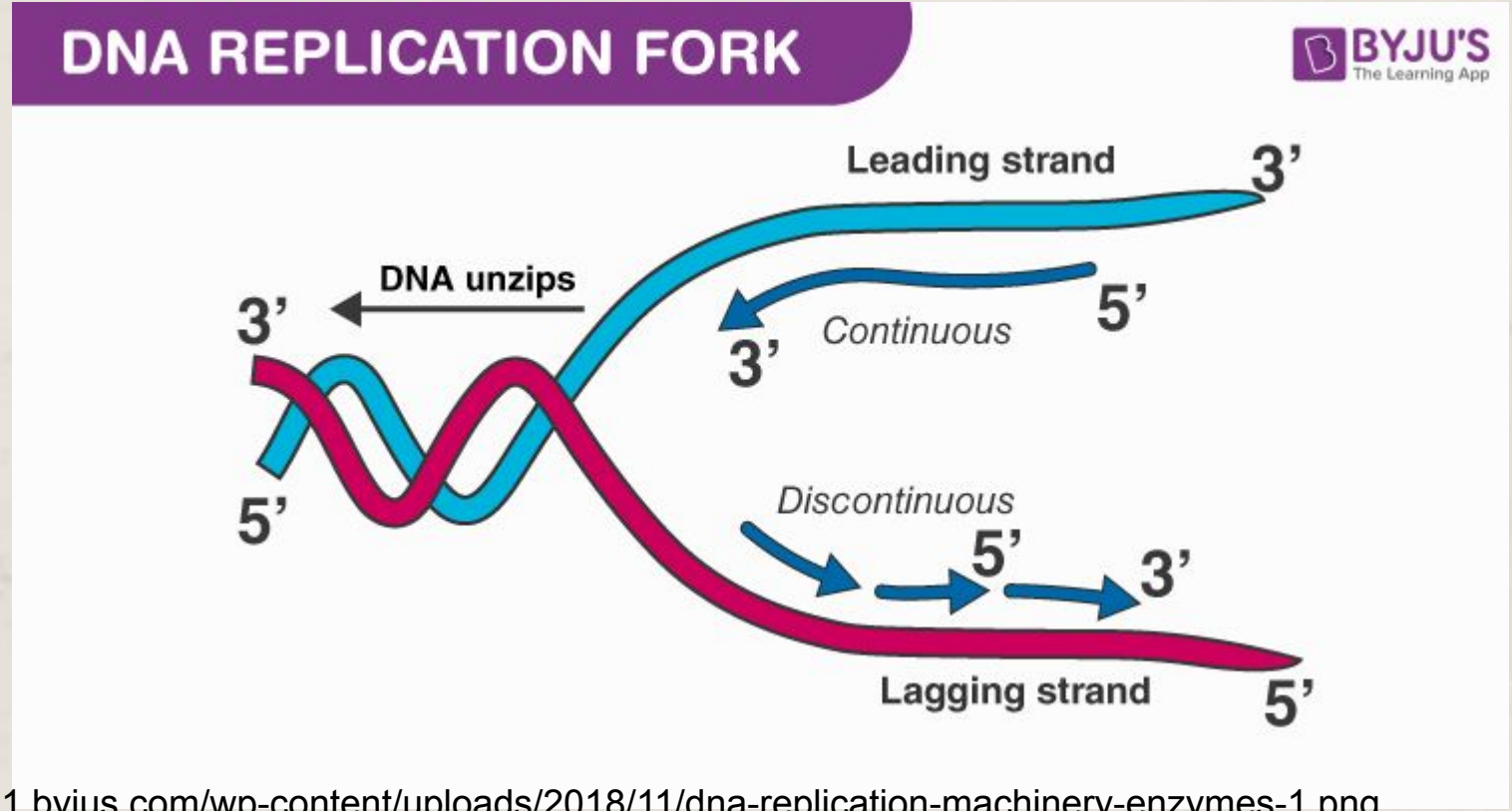
DNA pol III – adds nucleotides

DNA pol I – Replaces RNA primers with DNA

DNA Ligase – Joins DNA fragments (Okazaki, gap after primer on leading strand

Leading and Lagging Strand

- DNA Polymerase only adds nucleotides on the 3' end
- Leading strand synthesized in the direction the DNA is unzipping
- Lagging strand is going backwards, but overall is still going the direction of the replication fork



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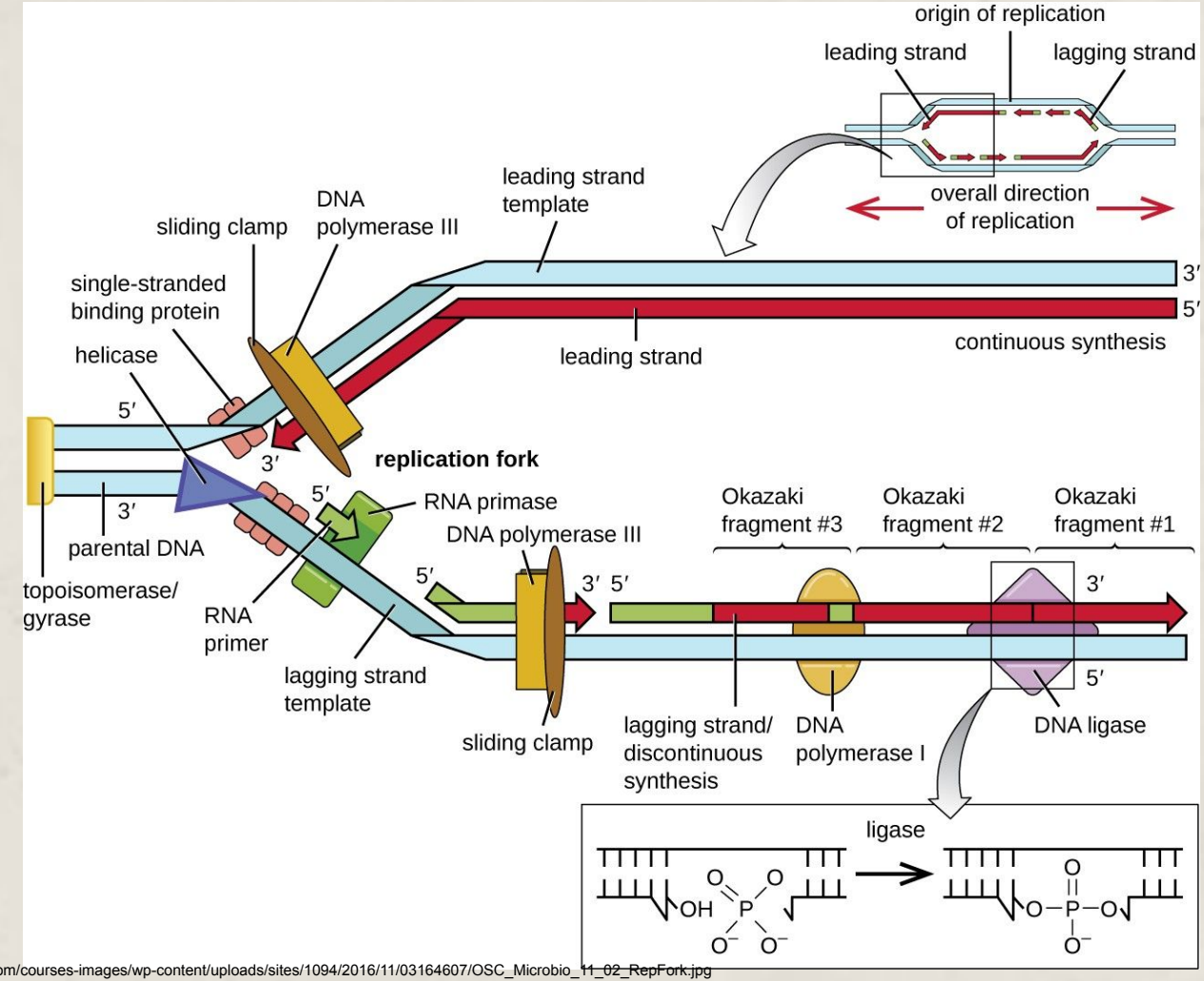
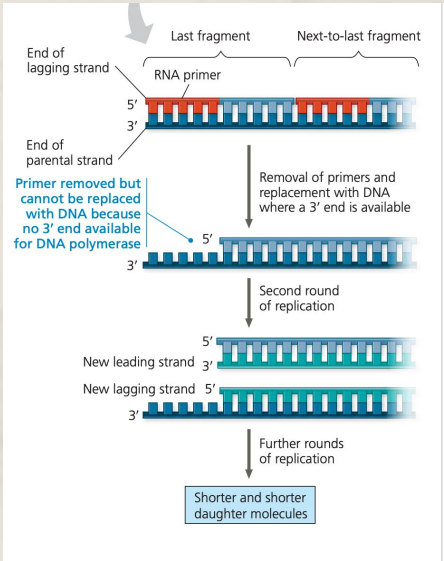


https://s3-us-west-2.amazonaws.com/courses-images/wp-content/uploads/sites/1094/2016/11/03164607/OSC_Microbio_11_02_RepFork.jpg

Telomeres

- DNA has telomeres at the ends w/ a repeated sequence (TTAGGG in humans)
- 2 functions
  - Prevents the DNA from appearing damaged to the cell's defenses because the ends of DNA are usually staggered
  - Slows down the disappearance of genes
- Telomerase helps with lengthening of telomeres in gametes
- Cancer
  - Shortening is a defense
  - Telomerase active in a lot of cancer cells



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Proofreading

Mistakes and Damage

Dna doesn't mess up a lot!

- 1 in 10 billion in completed DNA

Issues

- Nucleotides paired wrong in replication
- DNA damaged
  - X-rays
  - UV light - thymine dimers
  - Chemicals

Repair Mechanisms

Mismatch Repair

- Enzymes swap out wrong nucleotides for right ones

Nucleotide Excision Repair

- Nuclease excises damage and DNA polymerase and ligase fill the gap

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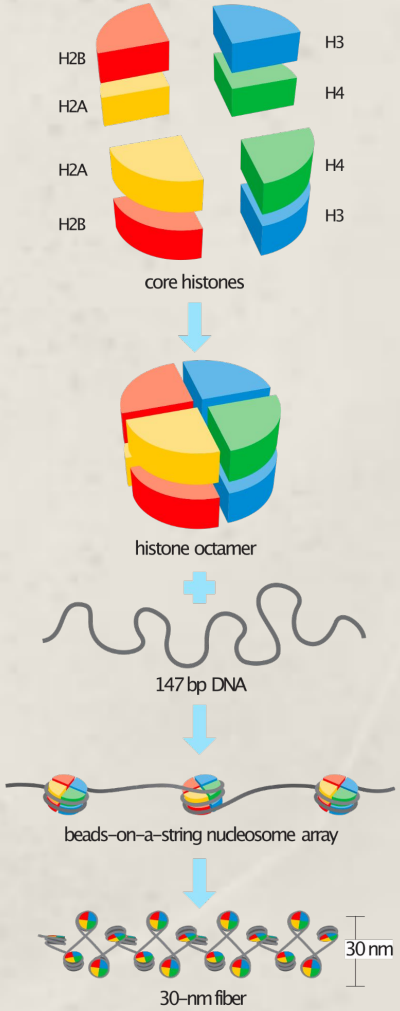
DNA Packing

Chromatin

- Chromosome – how DNA is during mitosis
- Chromatin – how DNA is normally

- Nucleosomes and Histones

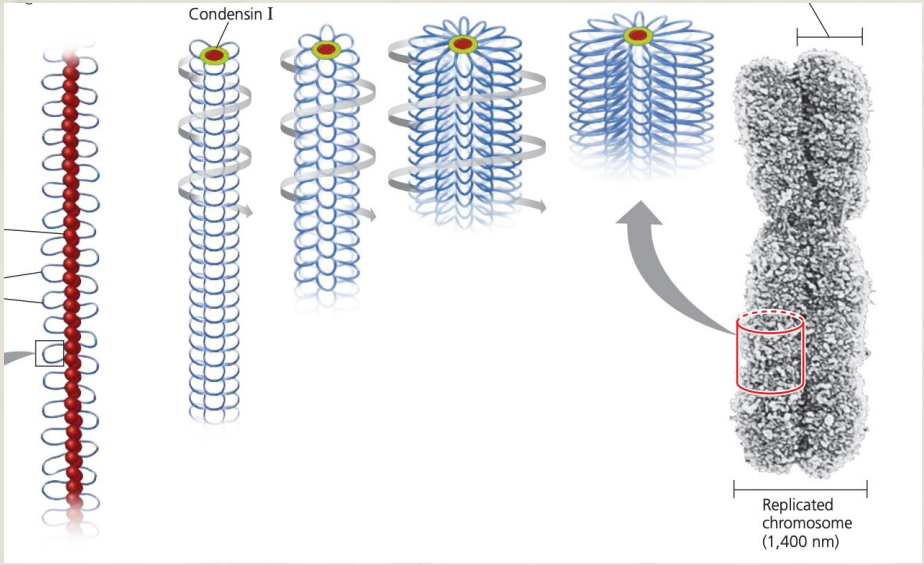
- Euchromatin – looser
- Heterochromatin – tighter



https://upload.wikimedia.org/wikipedia/commons/thumb/a/a9/Basic_units_of_chromatin_structure.svg/1200px-Basic_units_of_chromatin_structure.svg.png

During Mitosis

- Prophase – starts condensing
  - Condensin II makes DNA loops that bigger, making the chromosomes wider and shorter
- Prometaphase – larger loops
  - Condensin I makes larger loops from previous loops of DNA
- Metaphase – fully condensed, has a lot of loops



Thanks!!!

Slides by Slidesgo, presentation by Laurie Wang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