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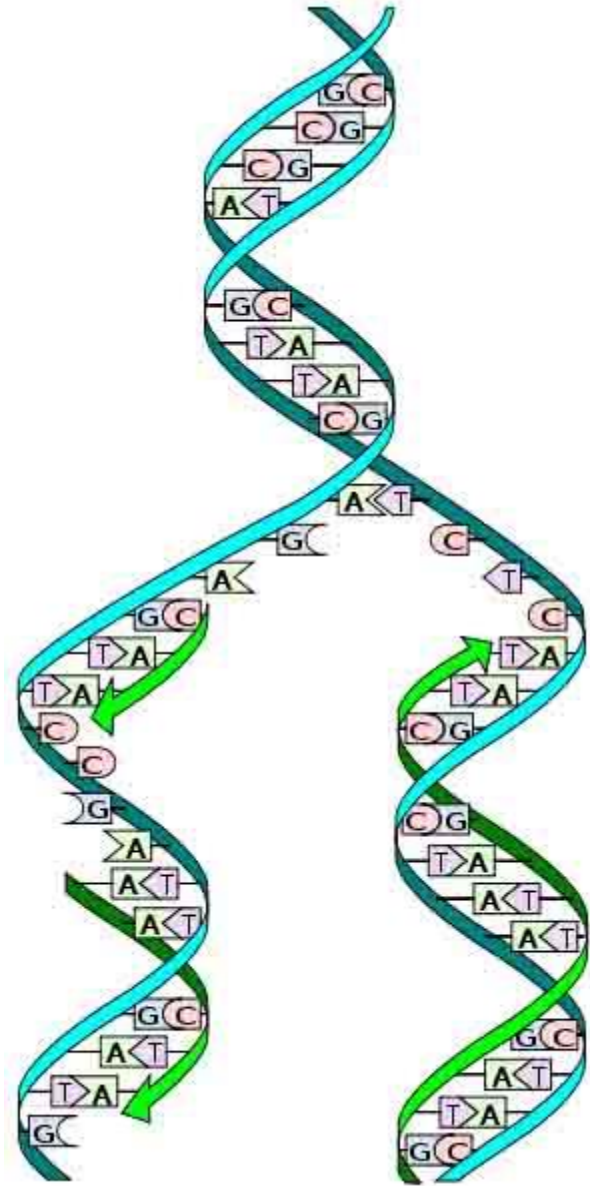
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- Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.
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Alicia Cepaitis, MS
Chief Creative Nerd
Science Prof Online
Online Education Resources, LLC
alicia@scienceprofonline.com

Tami Port, MS
Creator of Science Prof Online
Chief Executive Nerd
Science Prof Online
Online Education Resources, LLC
info@scienceprofonline.com

Molecular Genetics

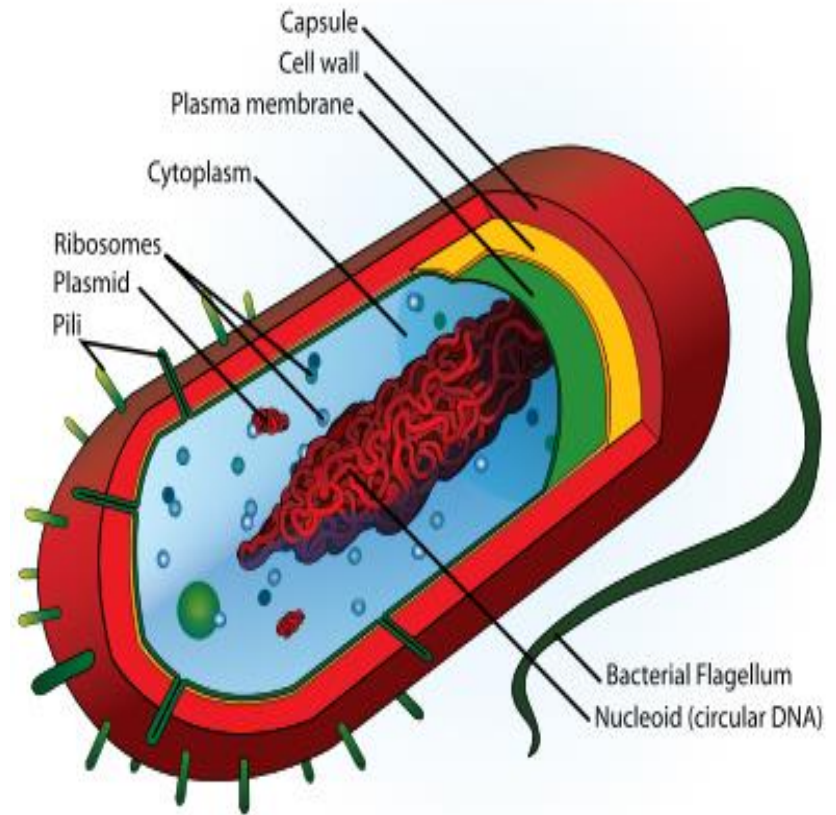
DNA Replication & Gene Expression



Prokaryotic Genomes

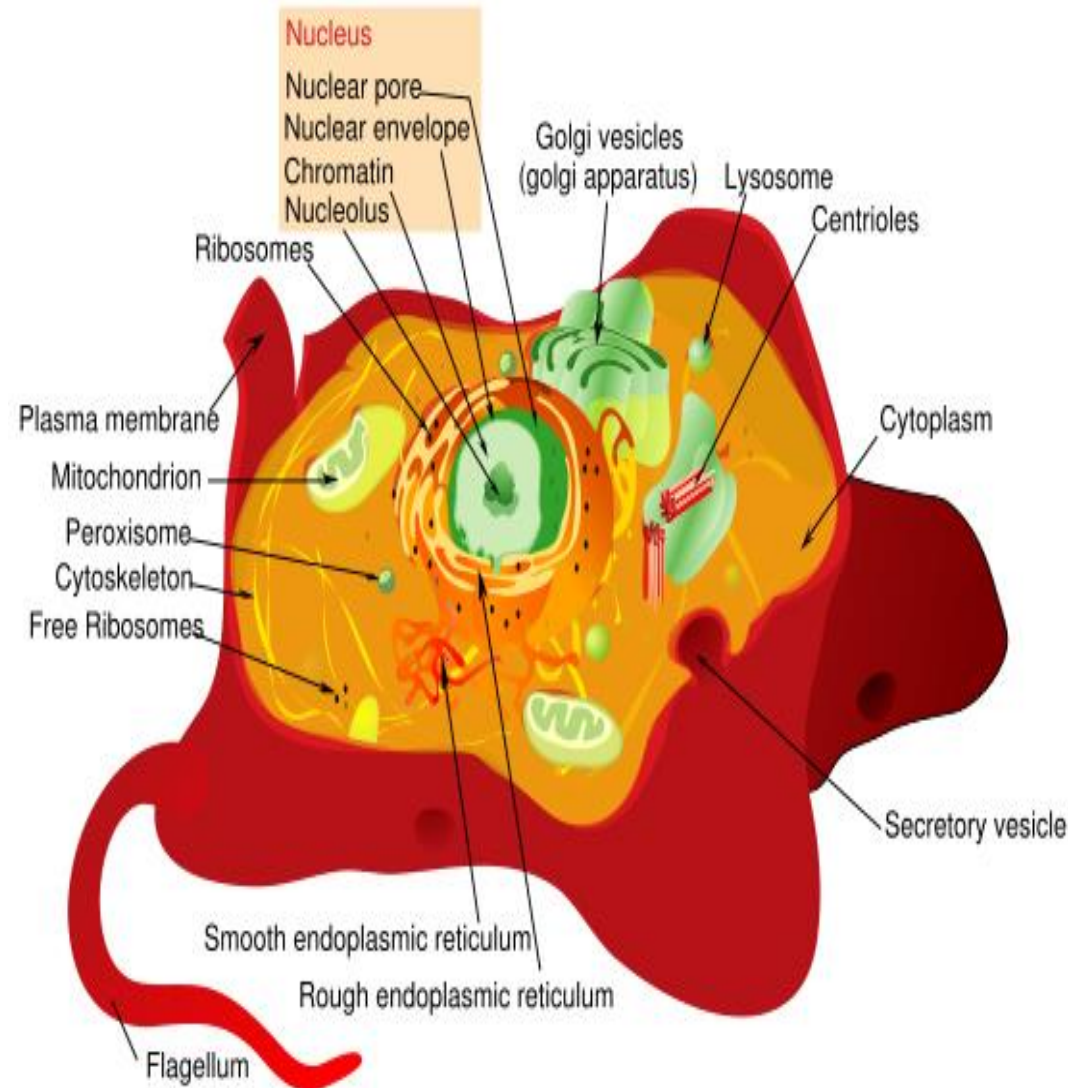
- Made of DNA
- Chromosomes can be circular or linear
- Genome floats freely within cytoplasm
- **Q:** Where is DNA found in prokaryotes?

- _____
- _____



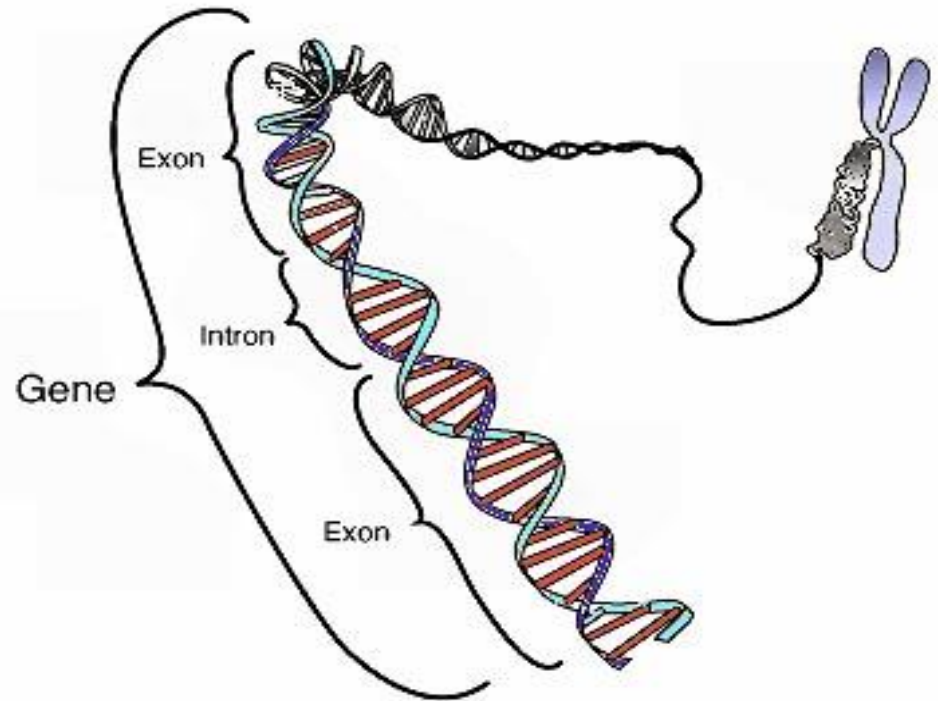
Eukaryotic Genomes

- Genomes of eukaryotic organisms made of DNA.
- Eukaryotic genomes frequently include many linear chromosomes within a membrane-bound nucleus
(Q: How many do we have?).
- Where is DNA found in eukaryotes?
 - Nuclear DNA
 - Extranuclear DNA(Q: What is extranuclear DNA?)

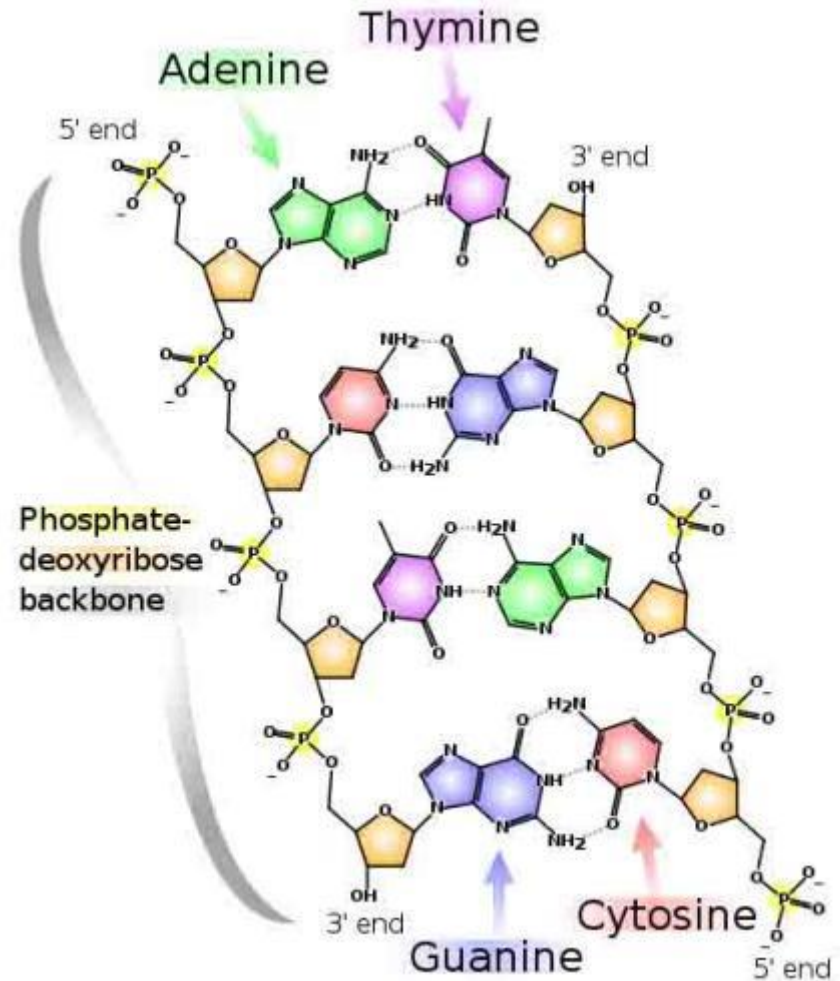


Chromosomes & Genes

- **Genome** - Complete complement of an organism's DNA.
- Cellular **DNA** is organized in **chromosomes**.
- **Genes** have specific places on chromosomes.

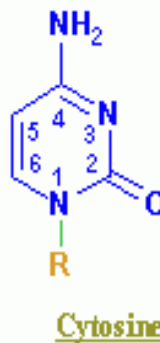
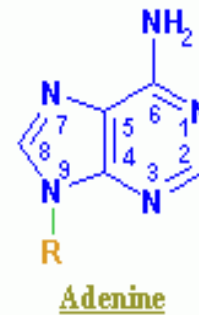
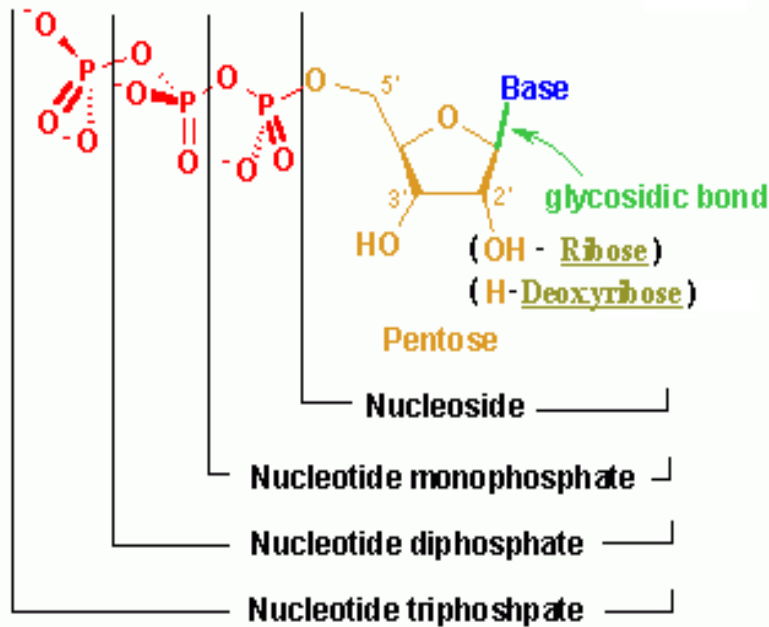


Nucleotides and Nucleic Acids

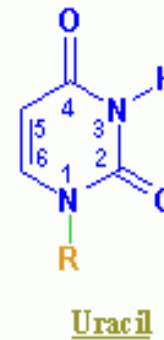


Nucleic Acids

Q: What type of monomer are nucleic acids made of?

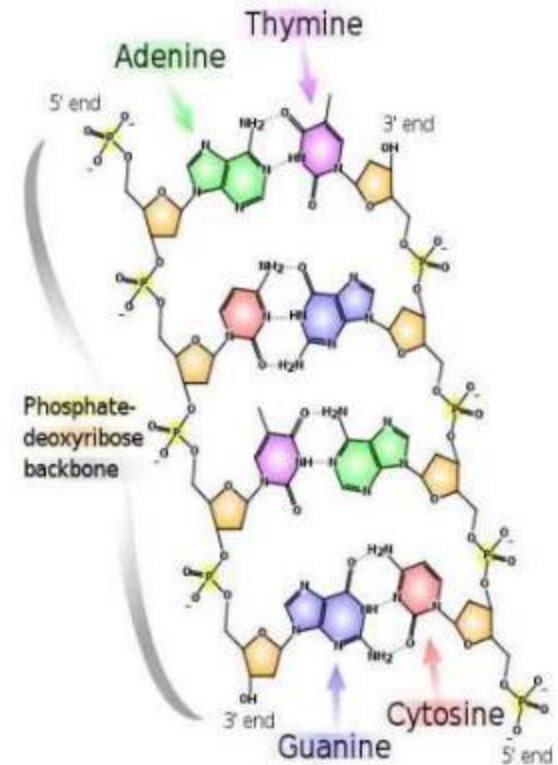
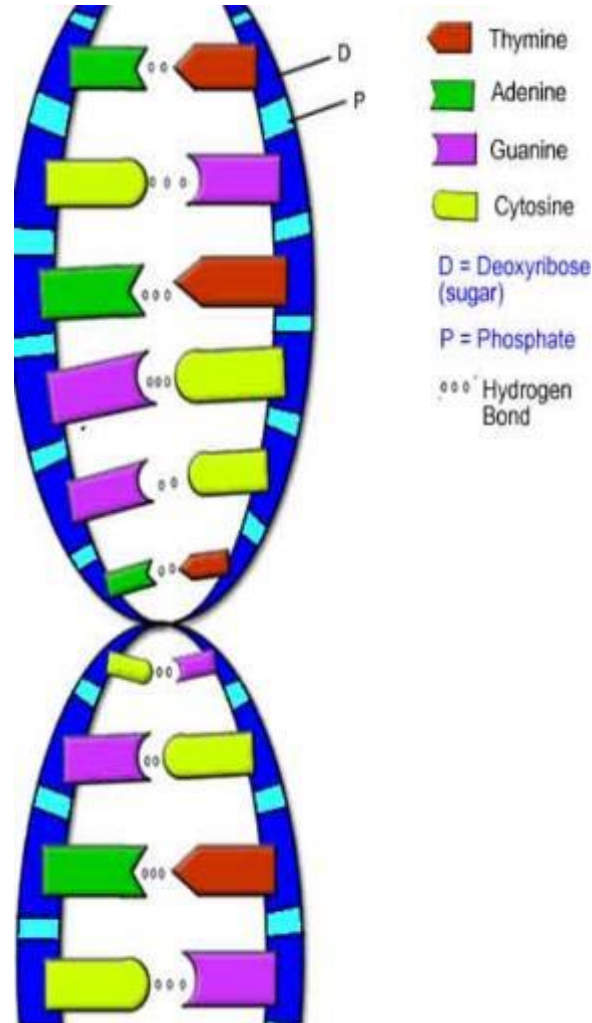


Pyrimidines



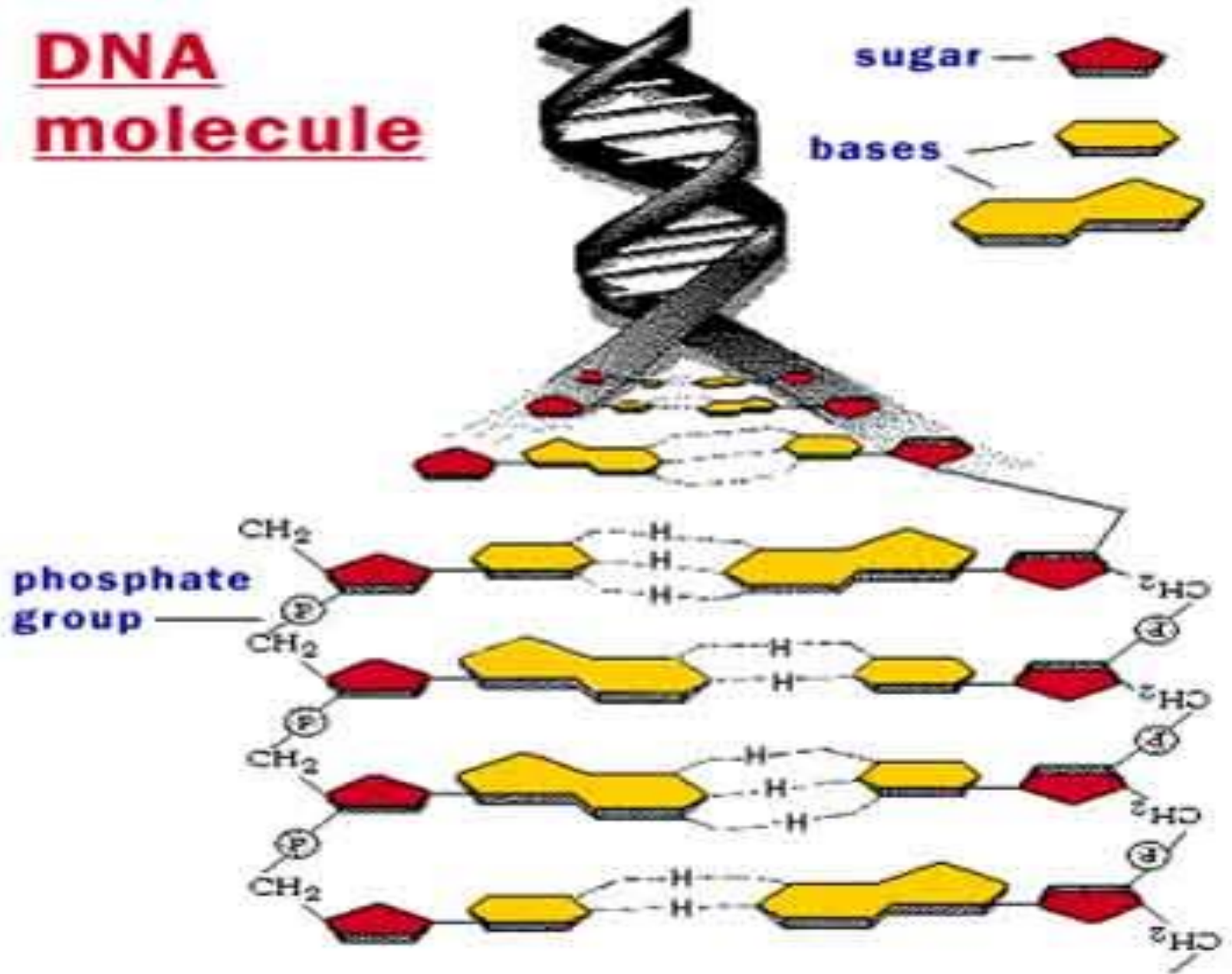
DNA Structure

- Double stranded molecule, analogous to a spiral staircase:
 - two deoxyribose-phosphate chains as the "side rails"
 - base pairs, linked by hydrogen bonds, are the "steps"
- **Purine Bases**
(double ring)
Adenine & Guanine
- **Pyrimidine Bases**
(single ring)
Cytosine & Thymine



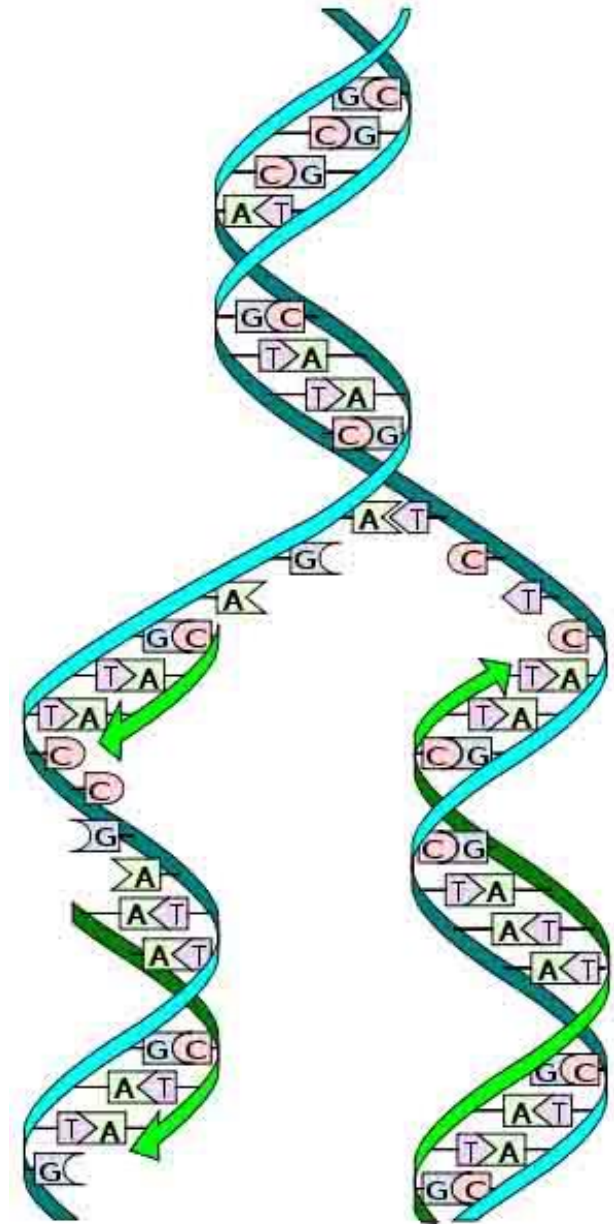
Images: [Model of DNA Molecule](#), Field Museum, Chicago, T. Port; [DNA Detail Diagram](#): Madprime; [DNA Molecule](#), Biology Corner

DNA molecule



DNA Replication

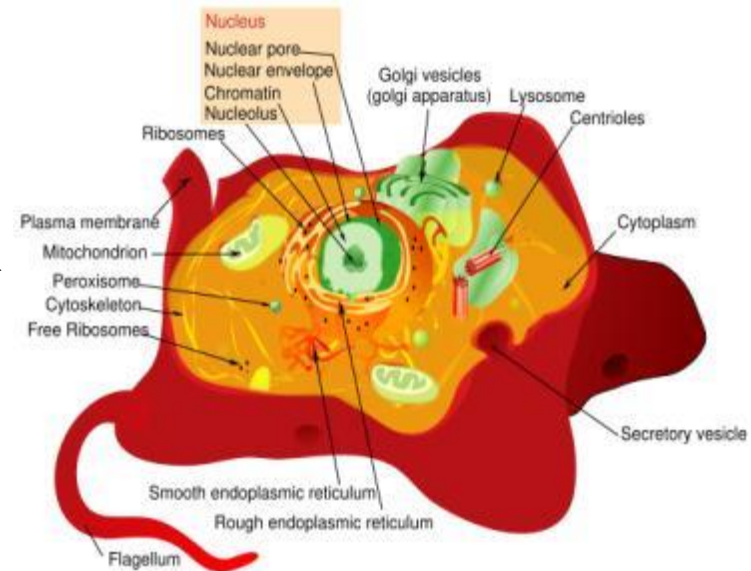
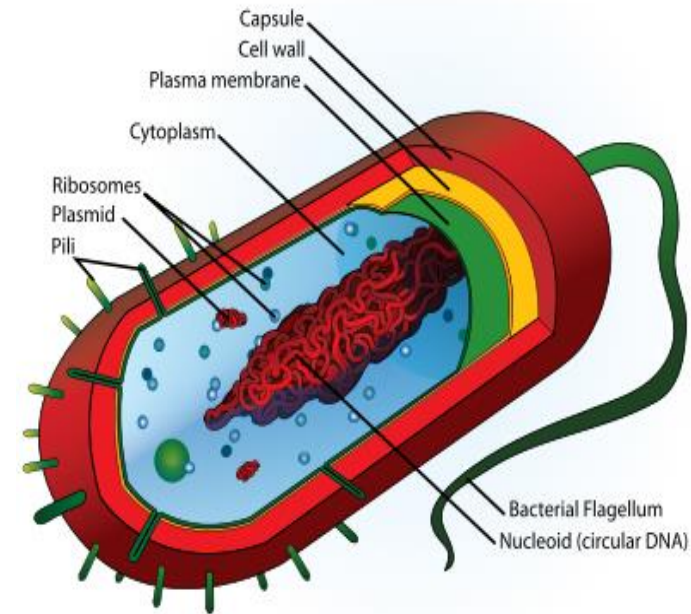
- **Copying** of a double-stranded DNA molecule.
- Each **DNA** strand holds the same genetic information, so each strand can serve as a template for the new, opposite strand.
- The **parent** (a.k.a. _____) strand is preserved and the **daughter** (a.k.a. _____) strand is assembled from nucleotides.
- This is called **semi-conservative** replication.
- Resulting double-stranded DNA molecules are identical.
- **Q: Why would a cell need to copy its DNA?**



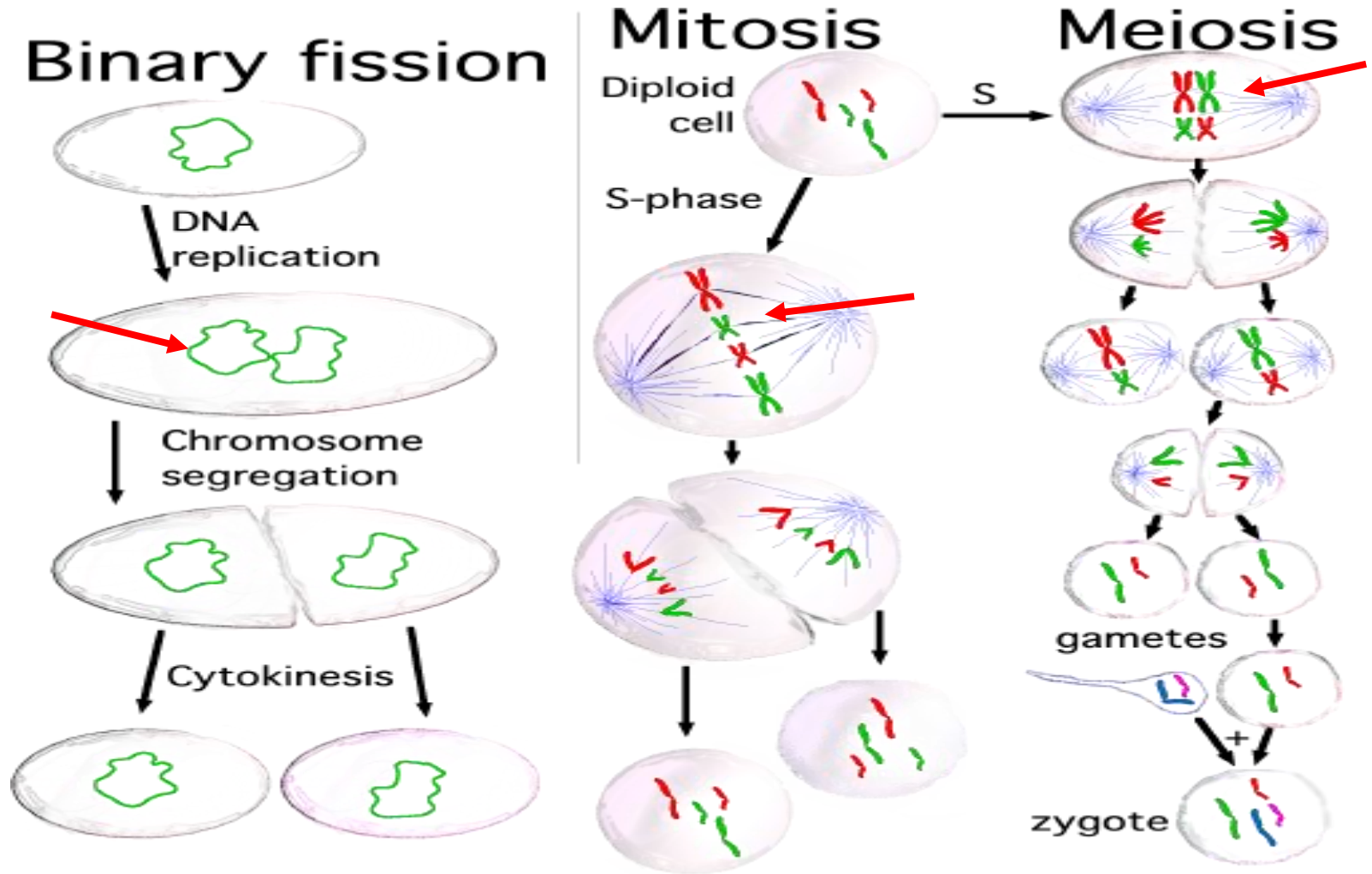
DNA Replication

In a cell, DNA replication must happen before cell division.

- **Prokaryotes** replicate their DNA throughout the interval between cell divisions.
- In **eukaryotes**, timing of replication is highly regulated.

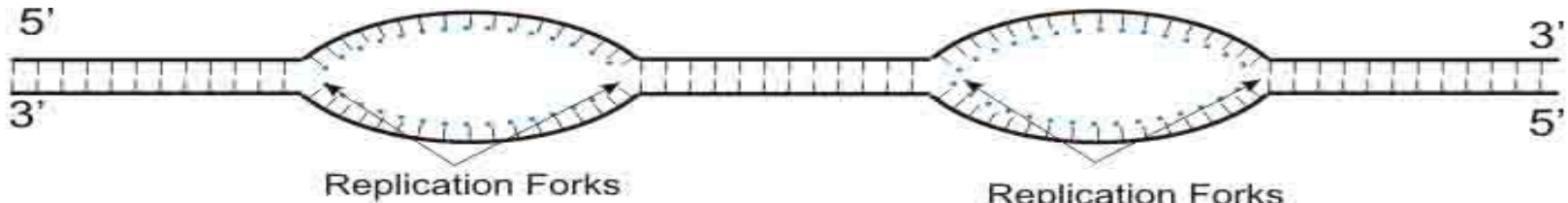
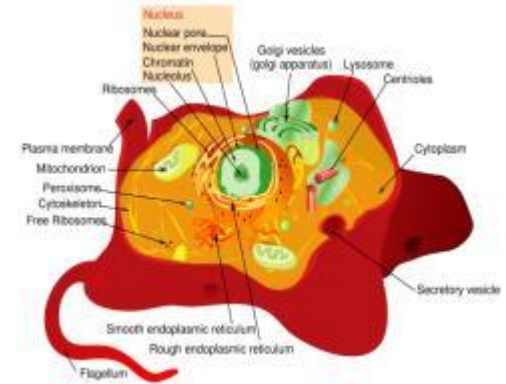


DNA Replication

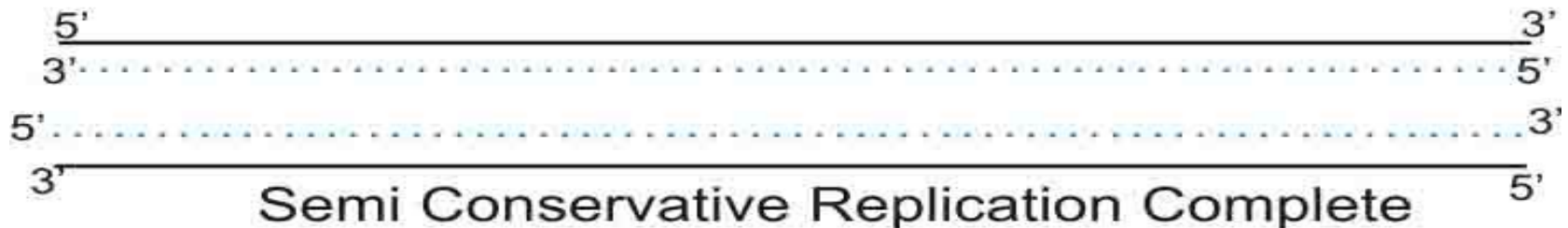


EUKARYOTIC DNA Replication: Replication "Bubbles"

- Multiple origins of replication > These "bubbles" are the start points of replication.
- Replication fork: 'Y'-shaped region where new strands of DNA are elongating.



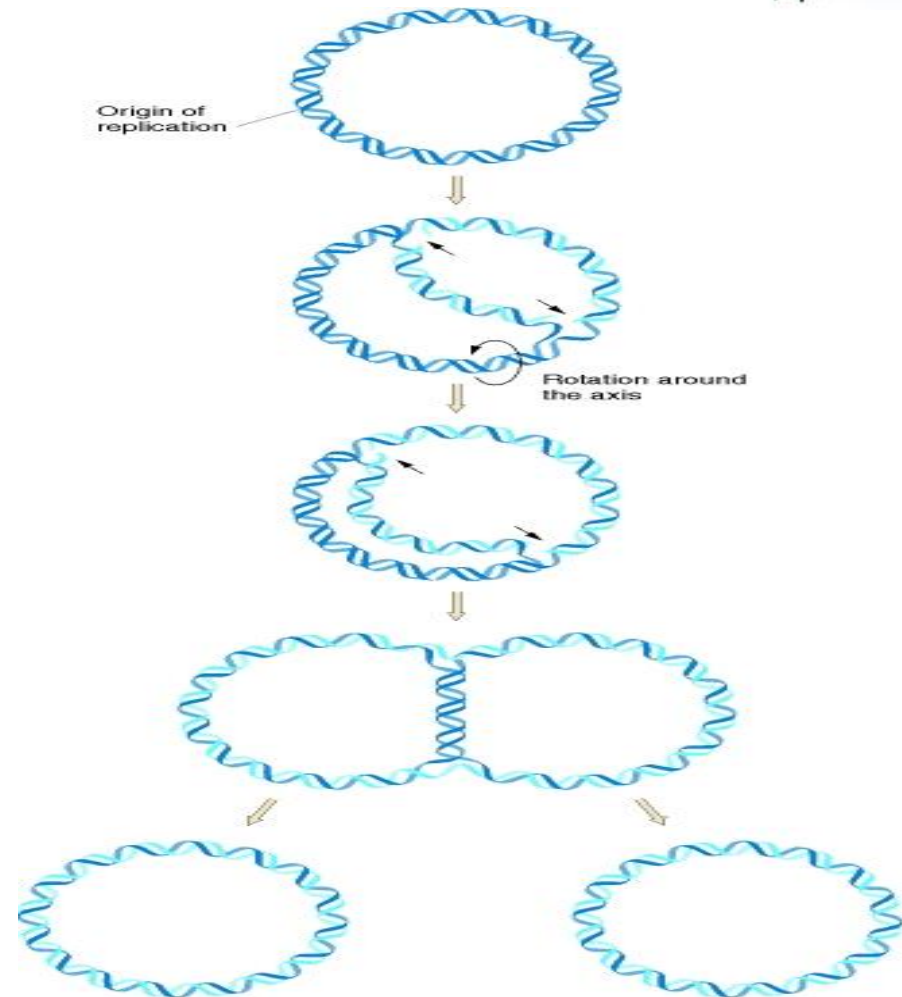
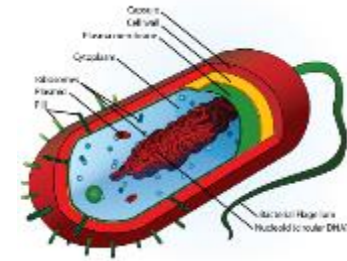
Replication bubbles form in DNA



PROKARYOTIC DNA Replication

One Origin

- Prokaryotic DNA is arranged in a circular shape, and there is only one replication origin.
- Despite these differences, the underlying process of replication is the same for both prokaryotic and eukaryotic DNA.



How Do Nucleotides Put Themselves Together Into Nucleic Acids?

- An **anabolic polymerization** process.

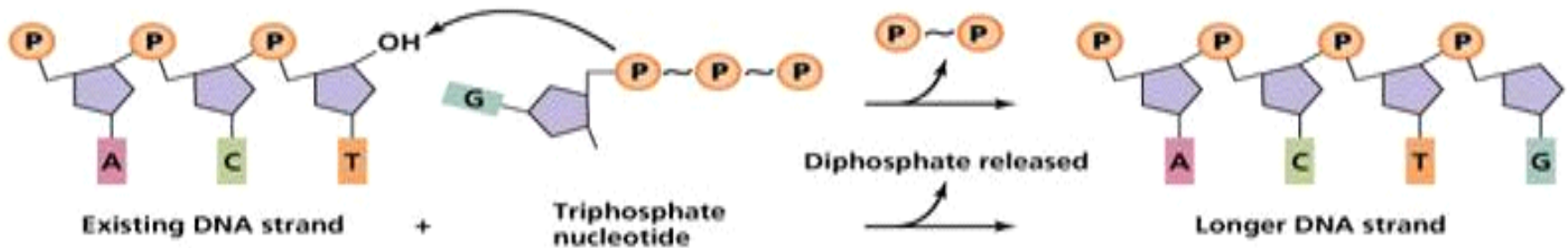
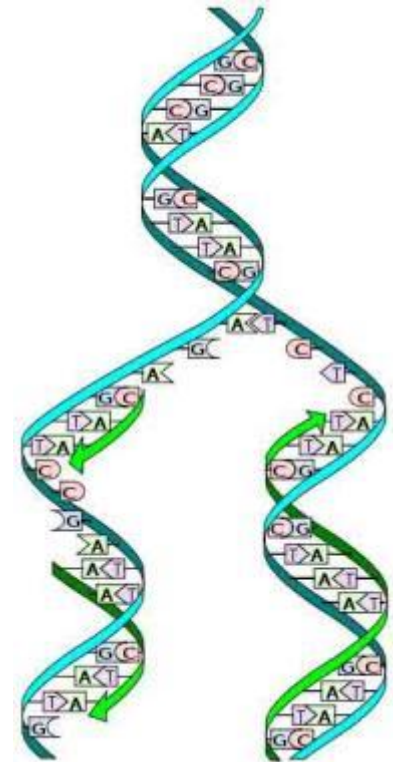
Q: Anabolic or Anabolism is....? _____

Q: Polymerization is ...? _____

- Polymerization requires **monomers** (building blocks) and **energy**.

- Triphosphate deoxyribonucleotides provide both.

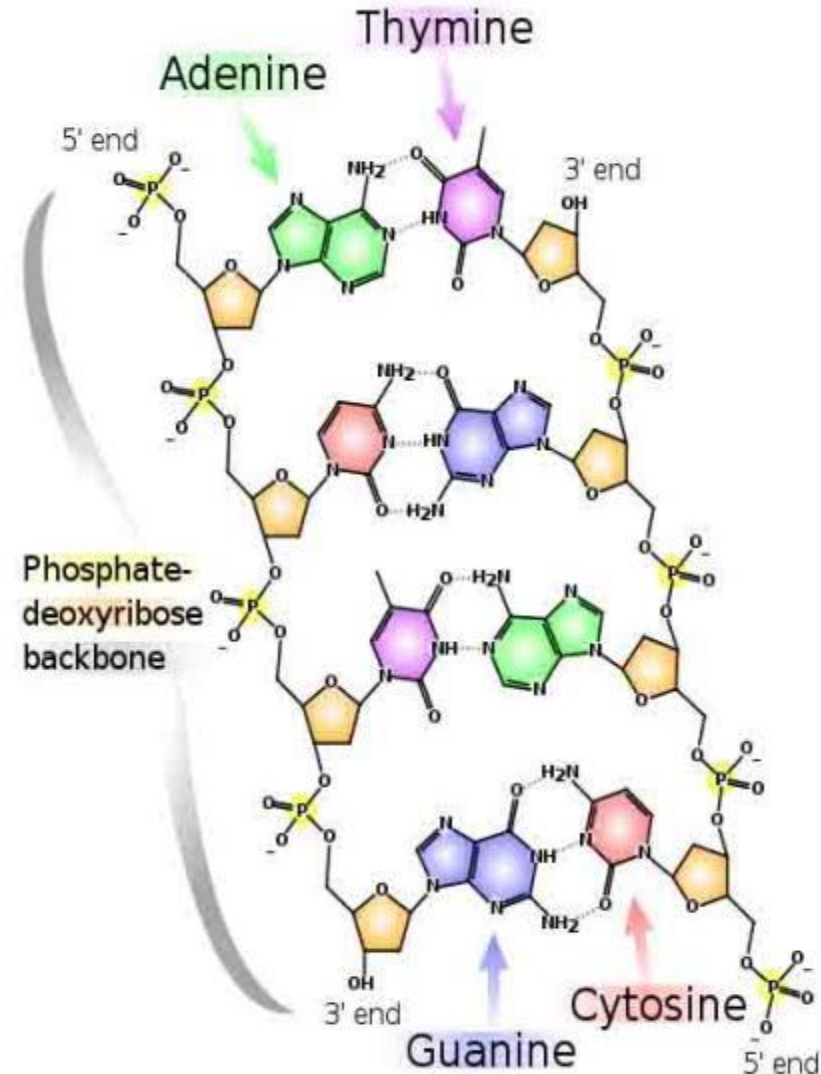
- These building blocks of DNA bring their own energy for polymerization.



DNA Replication: Anti-parallel Nature of DNA

- Sugar/phosphate backbone runs in opposite directions.
- One strand runs 5' to 3', while the other runs 3' to 5'.
- **DNA polymerase**: enzyme that facilitates addition of nucleotides in building the new DNA strand.
- Can only add nucleotides at the free 3' end.

Q: Why is this important?



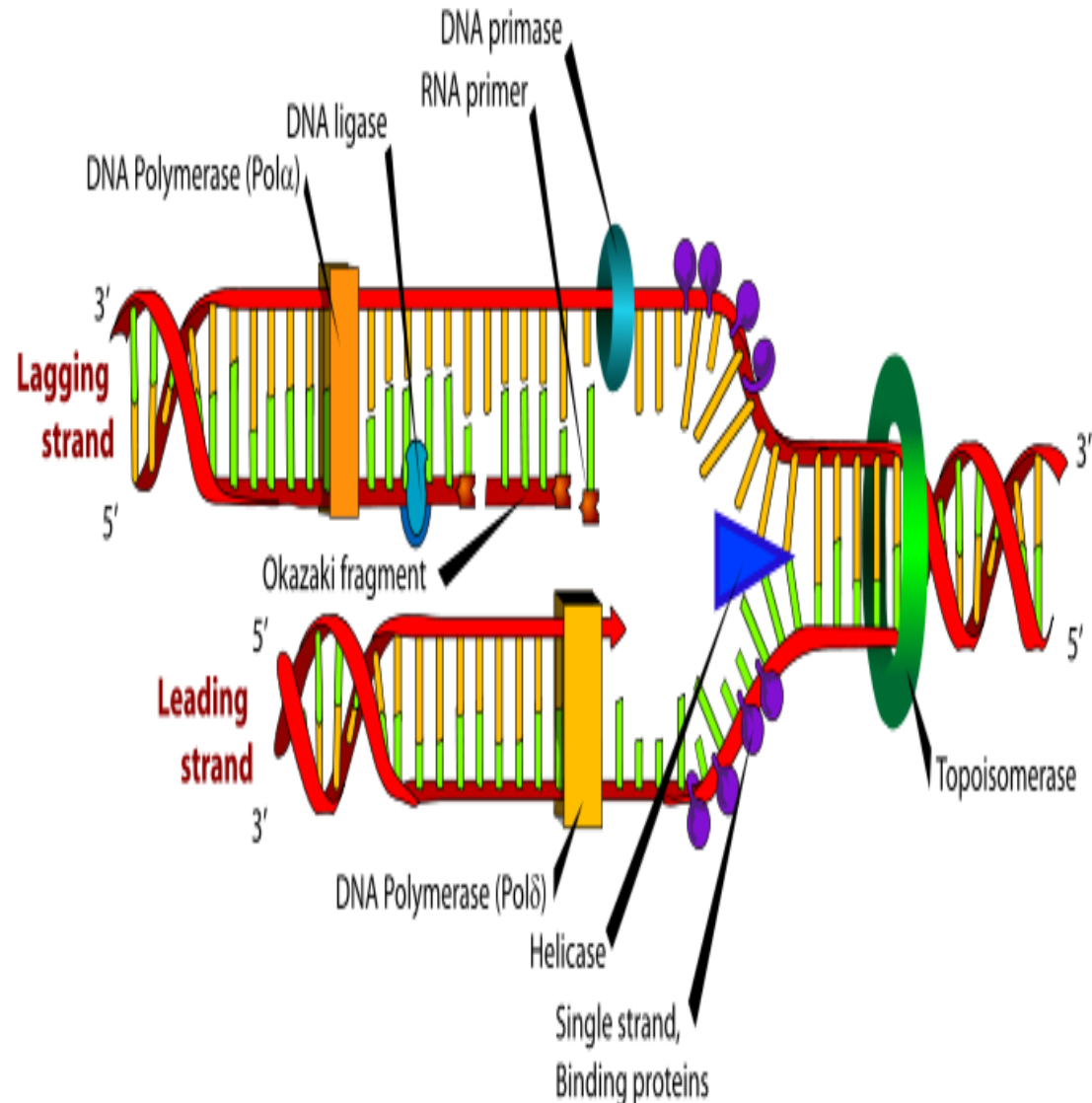
DNA Replication: Leading & Lagging Strand

Leading Strand

Synthesis proceeds smoothly as the replication fork unzips.

Lagging Strand

Synthesis away from the replication fork (Okazaki fragments); joined by DNA ligase.



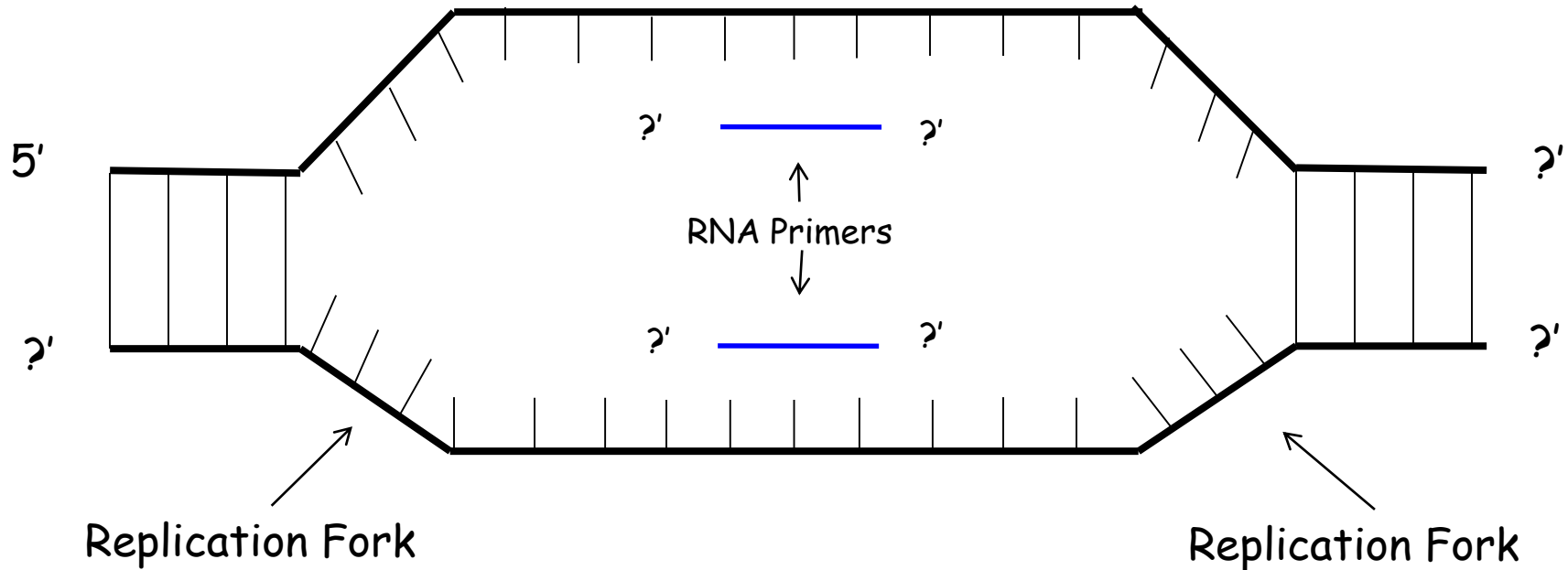
REVIEW

[DNA Replication Animations](#)

from McGraw-Hill

This link will take you to a page with 4 links on it. Please view the first, "How Nucleotides are Added in DNA Replication" and the fourth "DNA Replication Fork".

Let's Practice How Leading & Lagging Daughter Strands Are Built Within the Replication Bubble

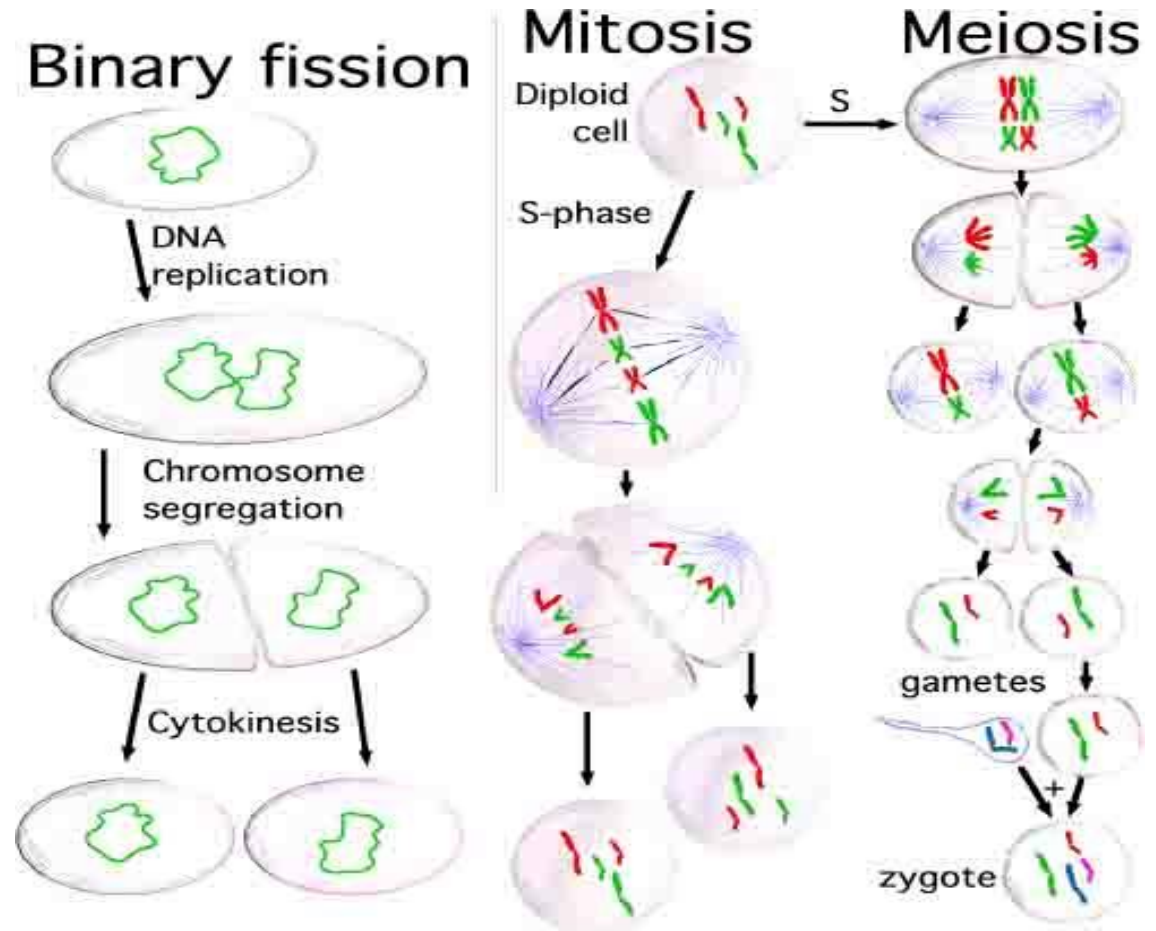


Now let's look at how replication of the leading and lagging strands occurs at each of the two replication forks within the replication bubble:

1. Label each end of the parent strands as either 5' or 3'.
2. Start a RNA primer for each daughter strand and label its 5' and 3' ends.
3. Show how new strands are built (continuously or discontinuously).

Reminder... Why is the DNA copied?

Replication occurs prior to cell division, because the new, daughter cell will also need a complete copy of cellular DNA.

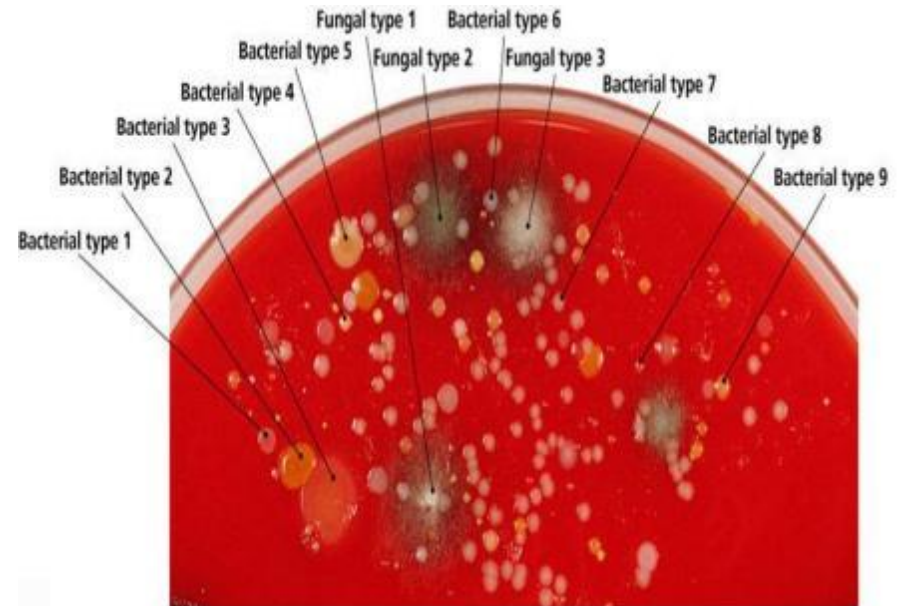
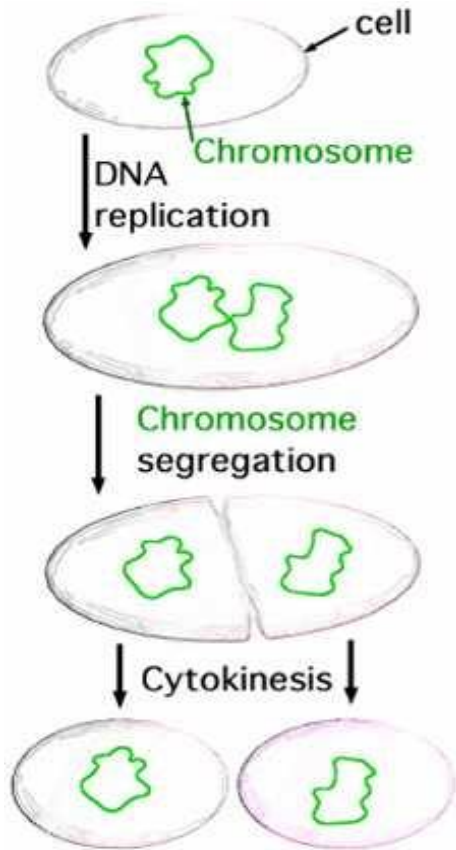


Genetic Diversity in Prokaryotes

If binary fission creates clones...

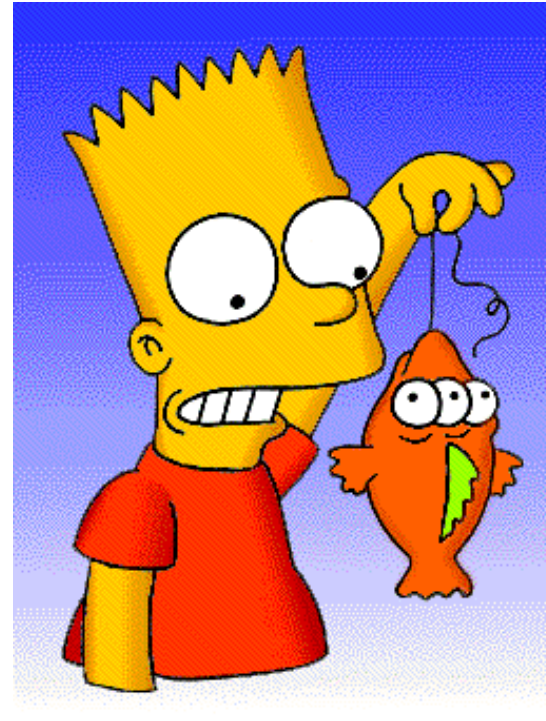
...then:

- Why isn't there just one type of bacteria?
- How do bacteria change (for example develop resistance to antibiotics)?



Replication Mistakes: Mutations of Genes

- Change in the nucleotide base sequence of a genome; rare.
- Almost always bad news, but...
- Rarely leads to a protein having a novel property that improves ability of organism and its descendants to survive and reproduce.

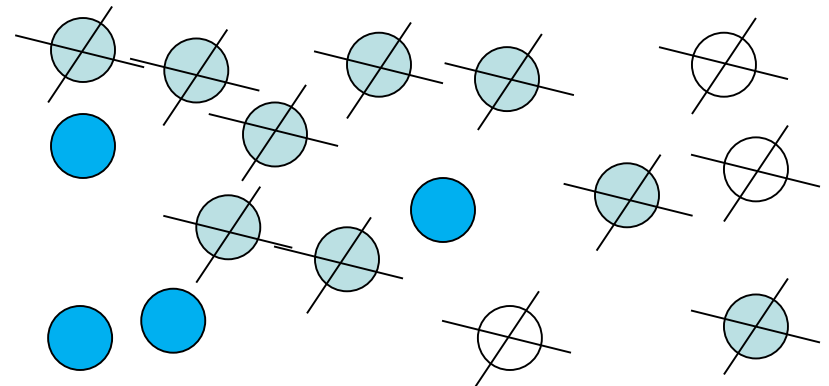


Mutation and Bacterial Change



- Antibiotic resistance = When a microorganism is able to survive exposure to an antibiotic.
- Genetic mutation in bacteria can produce resistance to antimicrobial drugs (example: beta-lactamase).
- If those genes are on a plasmid, they can be transferred between bacteria by conjugation and other forms of horizontal gene transfer.
- If a bacterium carries several resistance genes, it is called multidrug resistant (MDR) or, informally, a superbug or super bacterium.
- Any use of antibiotics can increase selective pressure in a population of bacteria to allow the resistant bacteria to thrive and the susceptible bacteria to die off.

REVIEW!
Antibiotic Resistance
Animation
from Sumanas



Confused?

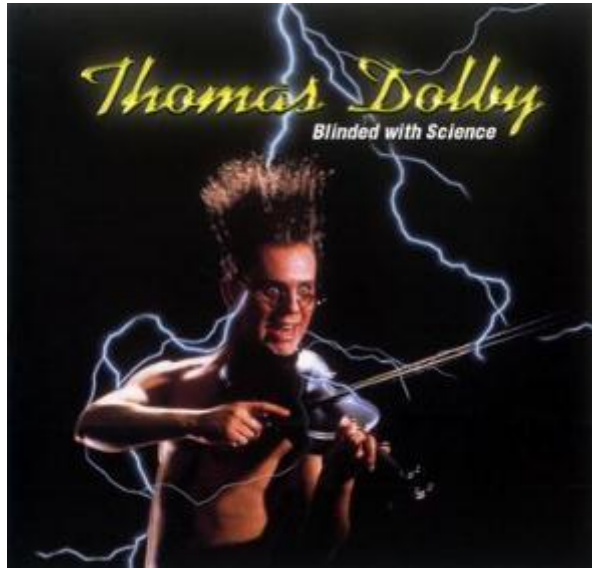
Here are links to fun resources that further explain genetic replication:

- [Molecular Genetics: Replication](#) Main Page on the Virtual Cell Biology Classroom of [Science Prof Online](#).
- ["That Spells DNA"](#) song by Jonathan Coulton.
- [DNA Structure](#) Cell Biology Animation from John Kyrk.
- [Build a DNA Molecule](#) from University of Utah.
- [DNA Replication](#) animation and review questions.
- ["Bio Rad GTCA Song"](#) musical advertisement for SsoFast™.
- [DNA Replication Process](#) animated video by FreeScienceLectures.com.
- [DNA Replication](#) step-through animation by John Kyrk.
- ["She Blinded Me With Science"](#) music video Thomas Dolby.

(You must be in PPT slideshow view to click on links.)

Smart Links





Are you feeling blinded by science?

Do yourself a favor. Use the...

Virtual Cell Biology Classroom (VCBC)!

The VCBC is full of resources to help you succeed,
including:



- practice test questions
- review questions
- study guides and learning objectives
- PowerPoints on other topics

You can access the [Virtual Cell Biology Classroom](#) by going to the Science Prof Online website www.ScienceProfOnline.com