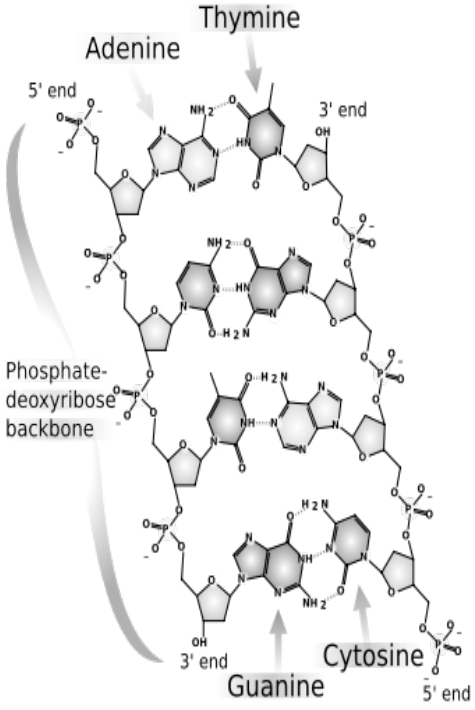
DNA

Structure
&
Replication

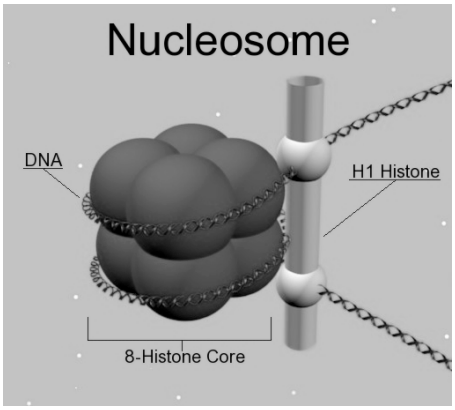
A. Structure

1. General
   - Double helix:
     - Two anti-parallel strands (one is 5' to 3' carbon, the other 3' to 5' carbon)
   - Nucleotides:
     - Nitrogenous base
       - Purines (adenine and guanine) hydrogen bond with pyrimidines (thymine and cytosine)
       - A-T, G-C
     - Phosphate group & sugar
       - Phosphate covalently attached to the C_5 of the deoxyribose
   - 3' - 5' linkage:phosphate of next nucleotide attaches to the C_3



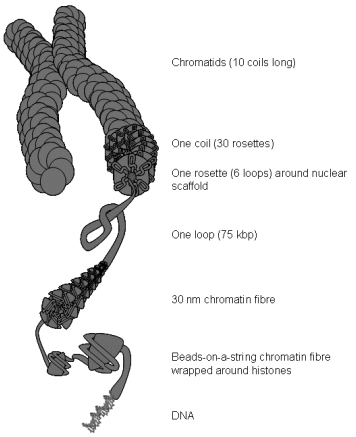
A. Structure, continued

2. Nucleosome structure
   - In eukaryotes, DNA is associated with proteins to form nucleosomes.
   - 8 histones wrapped twice with DNA, held together by another histone.



A. Structure, continued

3. Nucleosome function
   - Helps to supercoil chromosomes for mitosis and meiosis
   - Regulate transcription
     - Mark genes to promote gene expression by transcription & translation
     - Cause silencing of a gene by preventing transcription

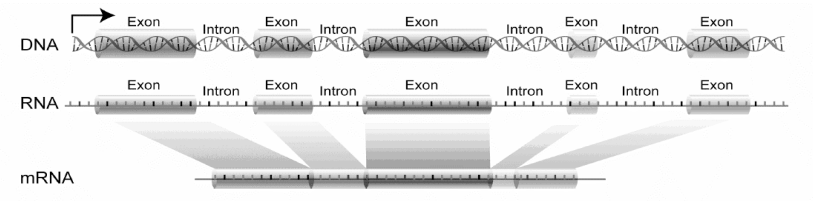


A. Structure, continued

4. Repetitive Sequences
   - Much of Eukaryotic DNA is repetitive - and is NOT translated.
   - Sometimes called satellite DNA (5-300 bases, may repeat as many as 10,000 times)
   - Function not known.
   - Constitute 5-45% of typical eukaryote DNA
   - Single copy, or unique genes 1.5% of human genome. These carry our genetic information.

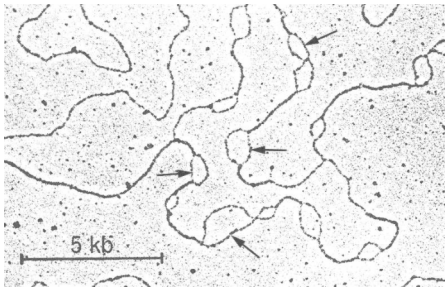
A. Structure, continued

5. Introns & Exons
   - Introns - sequences of bases that are transcribed, but not translated.
   - Exons - sequences of bases that are transcribed AND translated.
   - After transcription of the whole gene, the introns are cut out. (called "post-transcriptional modification")
   - Prokaryotes do not have introns in their genes.



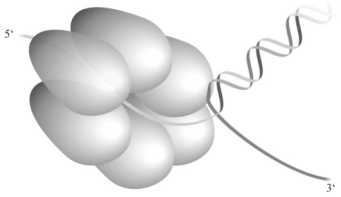
B. Replication

1. Replication is initiated at many points on the eukaryotic chromosome.
   - Called replication "bubbles"



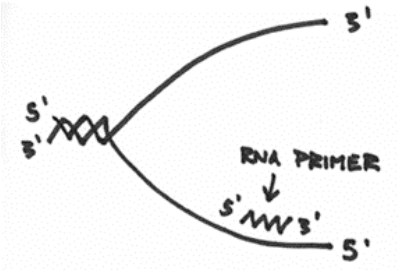
B. Replication, continued

2. Helicases (enzymes)
   - Unwind the double helix
   - Breaks the hydrogen bonds between the nitrogenous bases
   - Splits it into two separate template strands
   - One strand is 3' to 5' while the other is 5' to 3'.



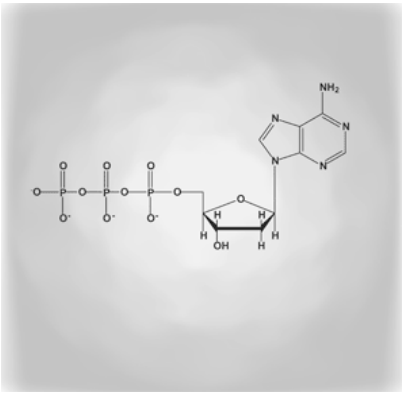
B. Replication, continued

3. RNA Primer
   - A few RNA nucleotides bind to the old DNA strand
   - Hydrogen bonds between bases
   - The enzyme RNA Primase will bind these nucleotides together (covalent bonds).
   - This primer must be there to start the replication.



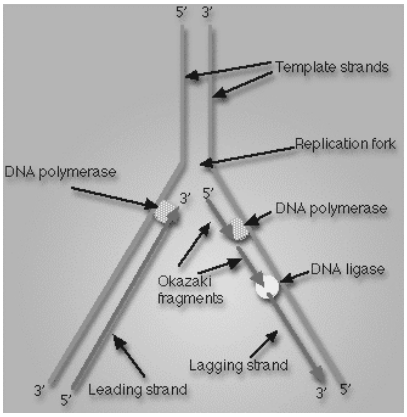
B. Replication, continued

4. The cell has many free nucleotides
   - "deoxyribonucleoside triphosphates" (dATP, dCTP, dGTP, dTTP)
   - each has 3 phosphate groups
   - 2 phosphate groups are removed during replication to release energy (as in ATP)
   - The rest binds to the DNA as a nucleotide building block.



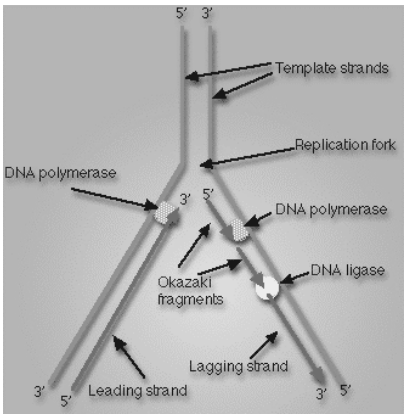
B. Replication, continued

5. DNA Polymerase III
   - The free nucleotides bond to template in 5' to 3' direction
   - New strand is complementary to template
   - Enzyme makes covalent bonds between nucleotides
   - DNA Polymerase III only works in one direction
     - Leading strand made in the same direction as the replication fork
     - The lagging strand takes a little more work.



B. Replication, continued

6. Lagging strand built
   - RNA primase adds RNA Primer
   - Deoxyrobonucleoside triphosphates hydrogen bond with the complementary bases in the template
   - DNA Polymerase adds nucleotides in the 5' to 3' direction to form short pieces called Okazaki fragments.



B. Replication, continued

7. Finishing up
   - DNA Polymerase I removes RNA Primer and replaces it with DNA
   - DNA Ligase forms bonds between Okazaki fragments to create ONE strand.