# 2017-09-20

## DNA

- The G-C bond has three hydrogen bonds
  - This is more strong than the A-T bond, which only has two
- **Reannealing/Rehybridization** = the reformation of hydrogen bonds after heating DNA

## 5' to 3'

- We *always* write single strained DNA/RNA in 3' -> 5' notation
  - Meaning, when you write complementary strands, you need to flip it

### Use of Alternate Isotopes

- In biochemistry, alternate isotopes of elements can be used to track how and where substances are used throughout the cells
  - *e.g.*
    - ${}^{1}H$(normal), ${}^{2}H$(heavy), and ${}^{3}H$(radioactive)
    - Carbon-12, Carbon-14
- Examples
  - Distinguishing between nucliec acid and protein
    - DNA has Phospohorus, while protein does not
    - Proteins have Sulfur, while DNA does not
  - Figuring out whether DNA replication was semiconservative, conservative, etc
    - Heavy nitrogen used in initial nucleic acids
    - After replication, examine content of new double helices

### Specifics of replication

- Eukaryotic cells have linear chromosomes
- Prokaryotic cells have a circular chromosome
- **Origin of replication(ori)** = the place at which replication begins
- Since Prokaryotic cells have smaller genomes and faster replication, it can simply copy it all in one go
  - In other words, there is only one ori

- Since Eukaryotic cells have much, much larger genomes and slower replication, it must copy at many places in parallel
  - In other words, there are *many* ori's
- **Histone** = a protein structure that DNA wraps around to increase density
- **Template-driven polymerization** = using the complement strand
  - Add in dATP, dTTP, dGTP, and dCTP
    - Whichever base pairs with the existing template, **DNA polymerase** will eject a **pyrophosphate** and forms the backbone

**Additional Detail**

1. **DNA Helicase** creates a replication fork by splitting the double strand
   - Since DNA replication happens from 3' to 5'(or, equivalently, the complement is synthesized from 5' to 3'), the two single strands cannot be replicated the same way
     - **Leading strand** = the strand where DNA-polymerase can continue to synthesize the complement as the replication fork moves
     - **Lagging strand** = the strand where DNA-polymerase is working in the opposite direction of the growth of the replication fork
2. **Single-strand binding protein(SSBP)** binds to each strand to prevent reformation of hydrogen bond
3. **DNA polymerase** needs a **primer** in order to bind to the strand
   - **Primer** = a short stretch of RNA/DNA that allows DNA polymerase to bind to the strand
   - In leading strand, the replication can take place with just one primer
   - In lagging strand, the replication has to take place with many primers
     - **Ribonuclease/RNAse** goes over the strand and removes the primers
     - Then, DNA polymerase uses DNA in between the empty primers as primers and fills in the gaps
       - But, DNA polymerase cannot fill in the last base pair; **DNA Ligase** does that
4. As DNA Helicase unzips, it twists remainder of strand so that it gets harder and harder to unzip
   - **Topoisomerase** comes and "cuts" the DNA to relieve that tension, and then reattaches the DNA so that Helicase can continue its job