DNA Synthesis = DNA Replication

making a copy of the DNA molecule
every cell needs a copy of genetic material
this occurs prior to cell division

***note**: every cell needs an entire copy of the DNA molecule, for you 46 chromosomes in 23 pairs, however, cells only use a portion of that DNA

a muscle cell makes different proteins than a skin cell, which uses different DNA than a nerve cell, etc.

there are **3 major steps to DNA synthesis**

1-binding of enzymes to DNA

2-unwinding & unzipping DNA

3-synthesis of new complementary strand

DNA synthesis or replication

1- first step, **enzymes bind to DNA**

enzymes bind to specific areas of DNA called **replication origins**

in eukaryotes, there are many binding sites started at one time, DNA molecules are so large that it would take too long to start at the beginning & go to the end

in prokaryotes, there is one single circular DNA molecule so there is only one replication origin, replication begins at one point and goes in both directions until the circular chromsome is copied

2-second step, an **enzyme (helicase) unwinds DNA** strand

DNA is actually wound in a double helix b/c of an attraction of charges, so the enzyme breaks these

another **enzyme unzips the DNA** btw the base pairs by breaking the H bonds that hold the pairs together

3-Finally, we are ready to **synthesize the new DNA strand**

the **enzyme DNA polymerase** reads the DNA base and brings in the matching or complementary nucleotide, then it reads next base & brings in next nucleotide, etc

this continues until the next replication origin is reached

-the two strands of DNA are made slightly differently, one strand of DNA is made continuously reading the bases in sequential order, this is called the **leading strand**

-the other strand in made is short segments, this is called the **lagging strand**

the difference is b/c DNA is antiparallel

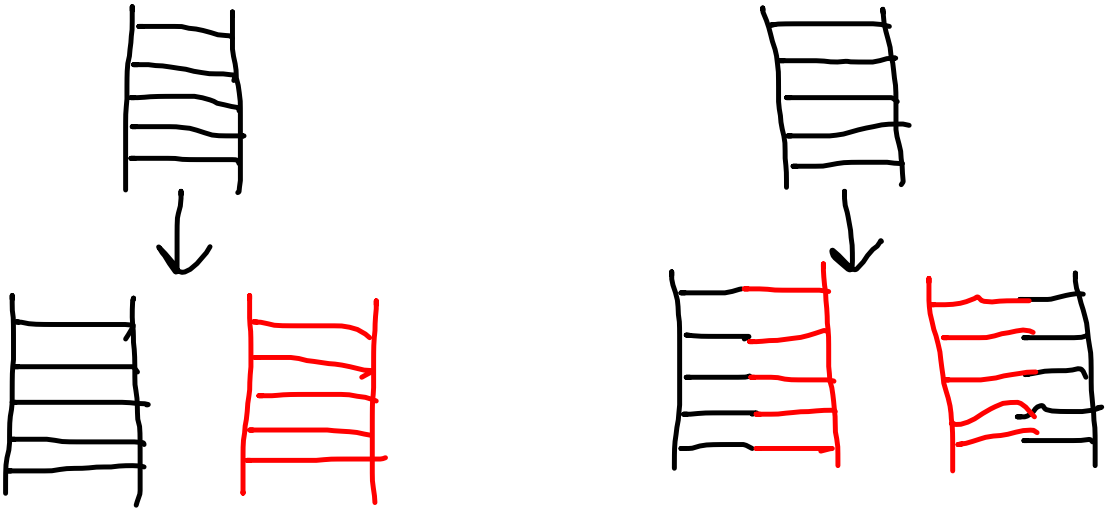
another enzyme comes in later & fills in the gaps

DNA replication is a **semiconservative** process

b/c each new strand is 1/2 old DNA, 1/2 new DNA

a conservative process would be one whole new strand of DNA and one whole old strand at the end which is actually harder to accomplish

by unzipping the DNA we have a template to make a new DNA strand



DNA Repair

each chromosome can contain millions of base pairs

in DNA replication, we bring in complementary copy of each base thus there is a great chance of making a mistake

a **mutation** is a spontaneous change in the DNA sequence, if a mutation occurs here, it is a simple copying mistake

there are **3 effects of mutations**

1-they can be **silent**, meaning there is no harm

the majority of mutations fall in this category

2-they can be **harmful or lethal**

3-they can be **beneficial**

this is what drives evolution

when DNA is being copied, 1 in every 10,000 bases brought in by DNA polymerase is wrong, but when the whole strand is finished, there is only 1 mutation per 10 million base pairs

this is b/c **DNA proofreads** itself

every time a new nucleotide is added, DNA polymerase checks it, if wrong, it removes the nucleotide and brings in correct one

once DNA is made and is functioning in the cell, it is constantly checked for changes, cells have the ability to repair damage

mutagens: any substance in environment that can damage DNA

DNA can be repaired by process called **excision repair**

an enzyme checks the DNA, recognizes mismatch, binds to DNA, breaks phosphate-sugar bonds & removes the damaged section

then DNA polymerase puts in correct nucleotide sequence, enz reforms phosphate-sugar bonds