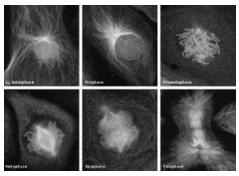
Places Mutations get passed on:
Cell Reproduction:

- 2 types of cell reproduction:



1. Mitosis = growth, repair, asexual reproduction
   - Photocopy machine
   - Growth/Repair
   - Passed on in the same body

2. Meiosis = sexual reproduction
   - ½ of your genetics
   - Gametes (egg and sperm)
   - Passed on to offspring

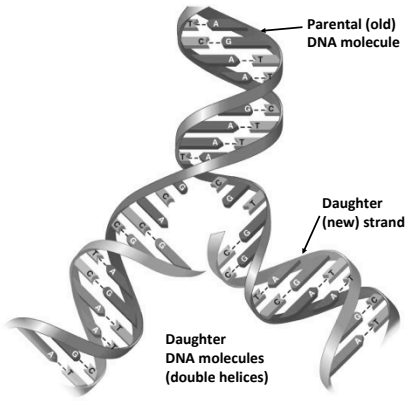


Figure 10.6

– **DNA polymerases**:
- Are enzymes
- Make the covalent bonds between the nucleotides of a new DNA strand
- Are involved in repairing damaged DNA

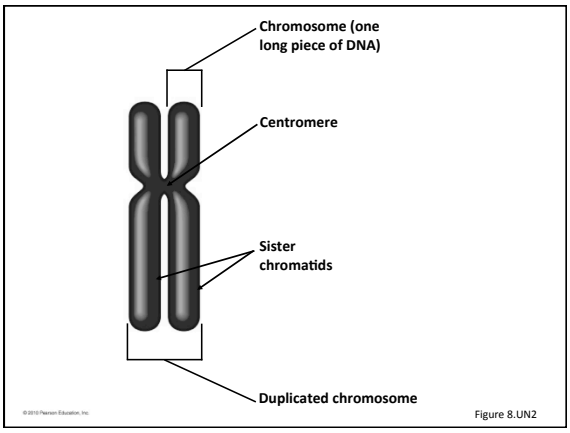


Figure 8.UN2

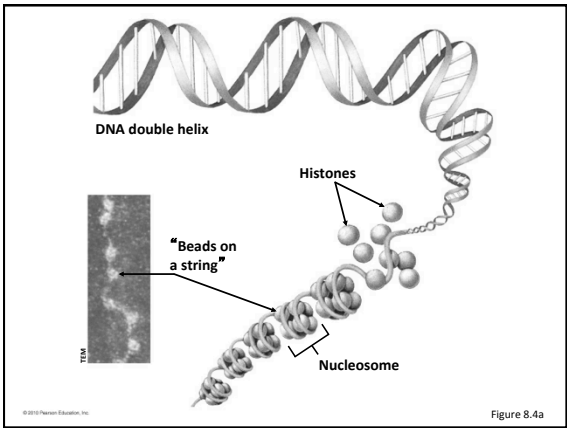


Figure 8.4a

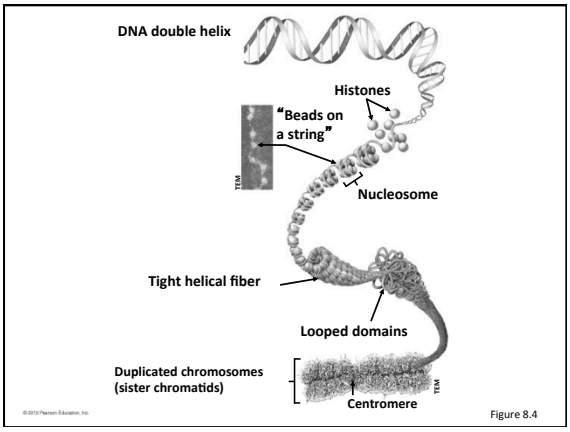


Figure 8.4

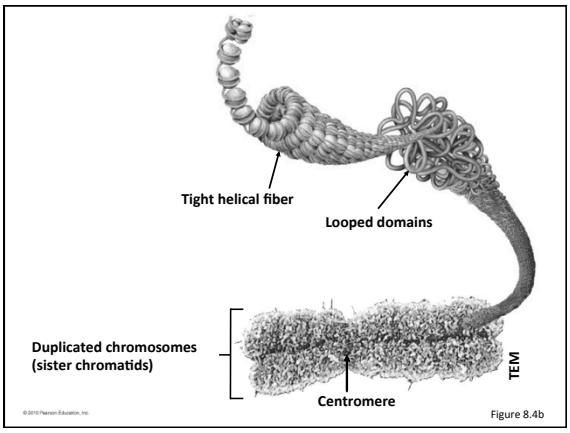


Figure 8.4b

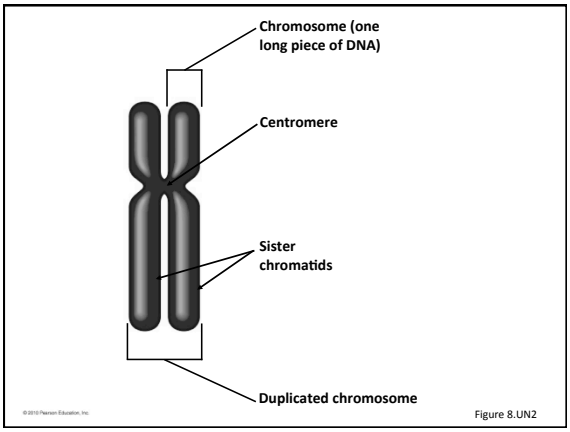


Figure 8.UN2

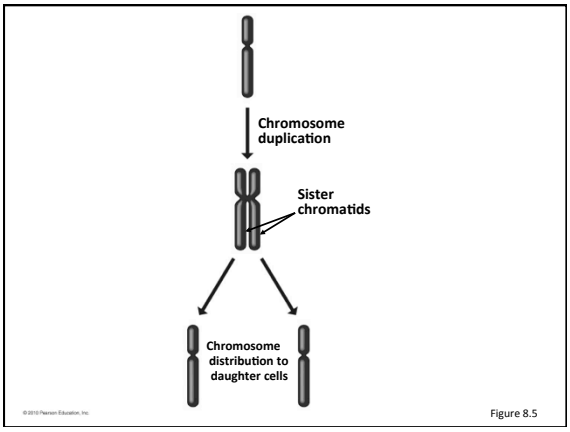
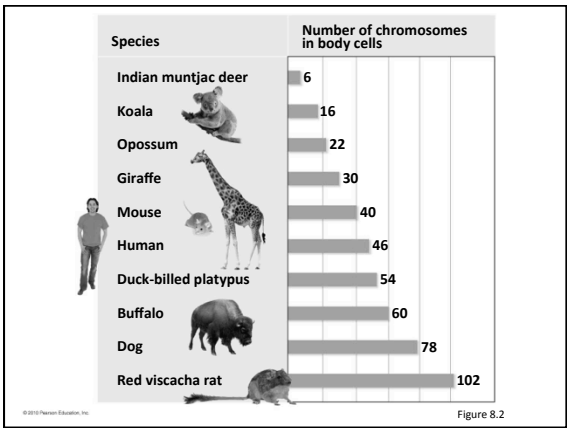
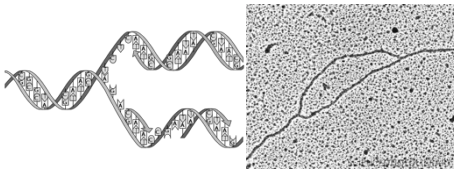


Figure 8.5



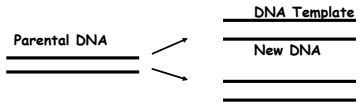
DNA Replication WHAT

1. **What**:
   - Making a copy of the DNA



DNA Replication - WHAT

- **Model: Semiconservative Model of Replication**
  - **Idea presented by Watson & Crick**
  - **The two strands of the parental molecule separate, and each acts as a template for a new complementary strand**
  - **New DNA consists of 1 PARENTAL (original) and 1 NEW strand of DNA**

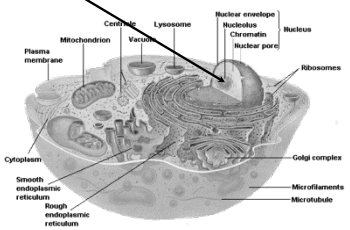


DNA Replication
WHY

2. Why:
- Because we need to make more DNA for new cells
  - Grow
  - Repair
- DNA has to be copied before a cell divides
- New cells will need identical DNA strands

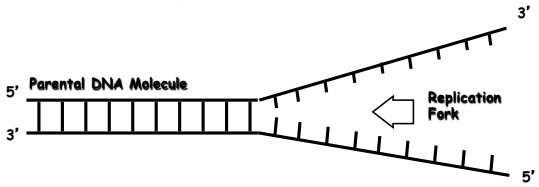
DNA Replication
WHERE

3. Where:
- **Nucleus of eukaryotes**
- **Because that is where the DNA is**



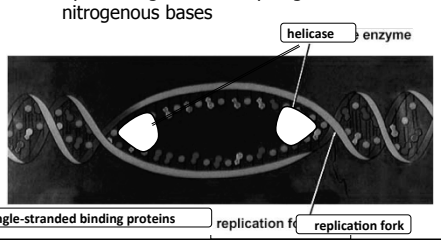
DNA Replication
HOW

4. How:
- **Begins at Origins of Replication**
- **Two strands open forming Replication Forks (Y-shaped region)**
  - **Helicase the enzyme unzips the DNA**
- **New strands grow at the forks**



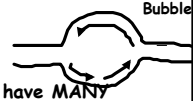
How: Replication: 1st step

- Unwind DNA
  - helicase enzyme
    - unwinds part of DNA helix
    - by breaking the weak hydrogen bonds between the nitrogenous bases

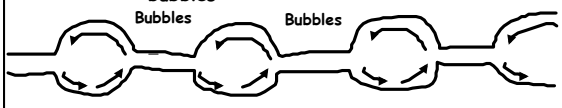


DNA Replication HOW

- **As the 2 DNA strands open at the origin, Replication Bubbles form**
  - **Prokaryotes (bacteria) have a single bubble**



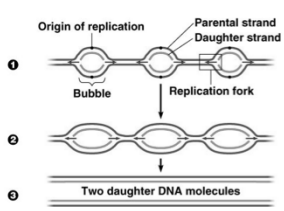
  - **Eukaryotic chromosomes have MANY bubbles**



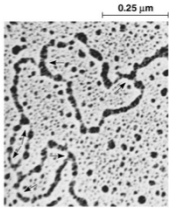
Q: What Happens when the bubbles connect?

DNA Replication - Process

- Large team of enzymes coordinates replication



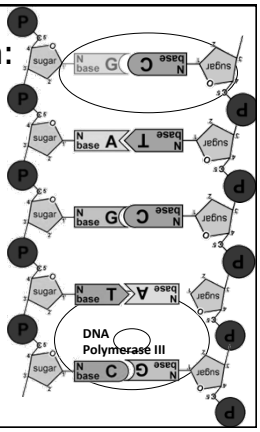
(a) In eukaryotes, DNA replication begins at many sites along the giant DNA molecule of each chromosome.



(b) In this micrograph, three replication bubbles are visible along the DNA of cultured Chinese hamster cells. The arrows indicate the direction of DNA replication at the two ends of each bubble (TEM).

HOW: Replication: 2nd step

- **Build daughter DNA strand**
  - **DNA polymerase:** adds new complementary bases



3rd step: Proofreading New DNA

- **DNA polymerase initially makes about 1 in 10,000 base pairing errors**
- **Enzymes proofread and correct these mistakes**
- **The new error rate for DNA that has been proofread is 1 in 1 billion base pairing errors**

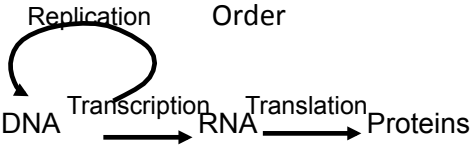
What do you notice about enzyme names?

Two Types of Cell Reproduction:

- Mitosis – for growth and repair in multicellular organisms, or asexual reproduction in single celled organisms
- Meiosis – for making sperm, eggs, or spores for sexual reproduction
- Both require DNA to be duplicated first.

Transcription and Translation

Replication Order



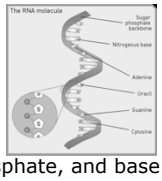
1. DNA
2. DNA → RNA (change the T's to U's)
3. Codons (start at Met – AUG)
4. Ribosome reads Codons into Amino Acids
5. Amino Acids strung together with peptide bonds
6. Protein

Protein Structure

- Made up of amino acids
- Polypeptide- string of amino acids
- 20 amino acids are arranged in different orders to make a variety of proteins
- Assembled on a ribosome

RNA vs. DNA

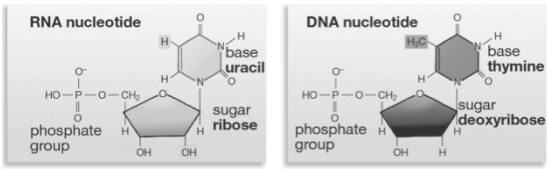
DNA	RNA
• Double stranded	• Single stranded
• Deoxyribose sugar	• Ribose sugar
• Bases: C,G A,T	• Bases: C,G,A,U



Both contain a sugar, phosphate, and base.

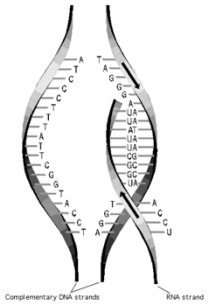
RNA

(a) Comparison of RNA and DNA nucleotides



RNA is a nucleic acid polymer that uses a slightly different sugar than DNA and the base uracil (U) in place of thymine (T).

Transcription



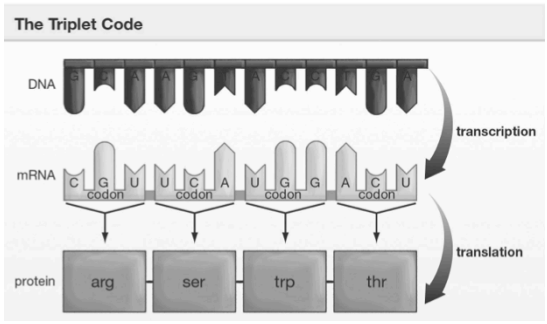
- RNA forms base pairs with DNA
  - C-G
  - A-U
- Primary transcript- length of RNA that results from the process of transcription

TRANSCRIPTION

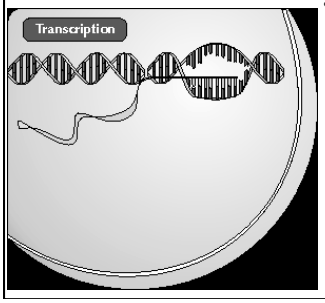
Make the complementary strand

ACGATACCCTGACGAGCGTTAGCTATCG

The Genetic Language Uses 4 Letters Written Into 3-Letter Words



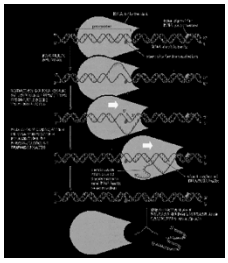
Major players in transcription



- mRNA- (the m is for messenger): type of RNA that encodes information for the synthesis of proteins and carries it to a ribosome from the nucleus

Major players in transcription

- RNA polymerase- complex of enzymes with 2 functions:
  - Unwind DNA sequence
  - Produce primary transcript by stringing together the chain of RNA nucleotides



Transcription is done…what now?

Now we have mature mRNA transcribed from the cell's DNA. It is leaving the nucleus through a **nuclear pore**. Once in the cytoplasm, it finds a ribosome so that translation can begin.

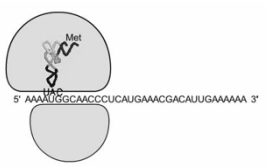
We know how mRNA is made, but how do we "read" the code?

Translation

- Second stage of protein production
- mRNA is on a ribosome

Translation

- Second stage of protein production
- mRNA is on a ribosome
- tRNA brings amino acids to the ribosome

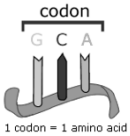


tRNA Function

- Amino acids must be in the correct order for the protein to function correctly
- tRNA lines up amino acids using mRNA code

Reading the DNA code

- Every 3 DNA bases pairs with 3 mRNA bases
- Every group of 3 mRNA bases encodes a single amino acid
- Codon- coding triplet of mRNA bases



ACGATACCCTGACGAGCGTTAGCTATCG
UGCUAUGGGACUG
{ Start }

First position	Second position U		Second position C		Second position A		Second position G		Third position
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U
	UUC	Phe	UCC	Ser	UAC	Tyr	UGC	Cys	C
	UUA	Leu	UCA	Ser	UAA	*Stop*	UGA	*Stop*	A
	UUG	Leu	UCG	Ser	UAG	*Stop*	UGG	Trp	G
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U
	CUC	Leu	CCC	Pro	CAC	His	CGC	Arg	C
	CUA	Leu	CCA	Pro	CAA	Gln	CGA	Arg	A
	CUG	Leu	CCG	Pro	CAG	Gln	CGG	Arg	G
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U
	AUC	Ile	ACC	Thr	AAC	Asn	AGC	Ser	C
	AUA	Ile	ACA	Thr	AAA	Lys	AGA	Arg	A
	AUG	Met	ACG	Thr	AAG	Lys	AGG	Arg	G
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U
	GUC	Val	GCC	Ala	GAC	Asp	GGC	Gly	C
	GUA	Val	GCA	Ala	GAA	Glu	GGA	Gly	A
	GUG	Val	GCG	Ala	GAG	Glu	GGG	Gly	G

Which codons code for which amino acids?

- Genetic code- inventory of linkages between nucleotide triplets and the amino acids they code for
- A gene is a segment of RNA that brings about transcription of a segment of RNA

Transcription vs. Translation Review

Transcription

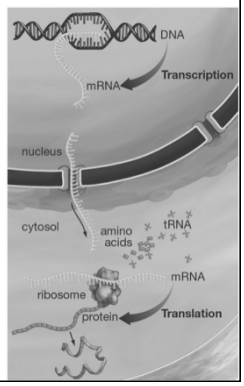
- Process by which genetic information encoded in DNA is copied onto messenger RNA
- Occurs in the nucleus
- DNA ⟶ mRNA

Translation

- Process by which information encoded in mRNA is used to assemble a protein at a ribosome
- Occurs on a Ribosome
- mRNA ⟶ protein

The "Central Dogma" of Molecular Genetics

Transcription Translation
DNA → RNA → Protein → Trait
RNA processing



Basic Genetic Mechanisms are Universal

The storage of genetic information in DNA, the use of an RNA intermediate that is read in three letter words, and the mechanism of protein synthesis are essentially the same in all organisms.

Among other things, this means cancer can be studied productively in flies or yeast.

It also means that human genes can be expressed in a plant or mouse genes in a yeast.