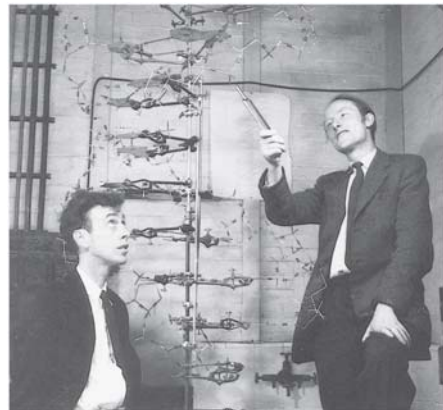


Genetics 2 Ch. 10 & 12

Intro to DNA and Protein
Synthesis (Genomics &
Proteomics) and Biotechnology

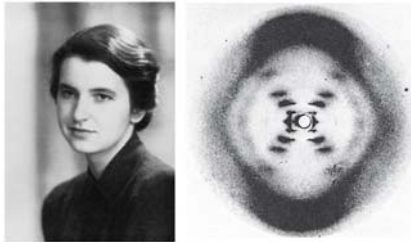
- Γ DNA- Process of discovery
- Γ Known of in the late 1800s
- Γ 1930s- specific chemical responsible for heredity
- Γ 1940s- Chromosomes made of DNA *and* proteins...
- Γ 1950s- Quest for the structure of DNA.
- Γ Watson, Crick, Wilkins and Franklin

- Γ Watson was Crick's grad student.
- Γ Franklin an X-ray crystallographer at Wilkins's lab.
- Γ Provides the critical data
- Γ Crick deduces from data
 - Γ Helix shape (spiral)
 - Γ Uniform diameter (distance from one end to the other)
- Γ The next step was putting the sugar-phosphate backbone outside and pairing the nucleotides with A-T and G-C



(a) James Watson and Francis Crick

Figure 10.3a

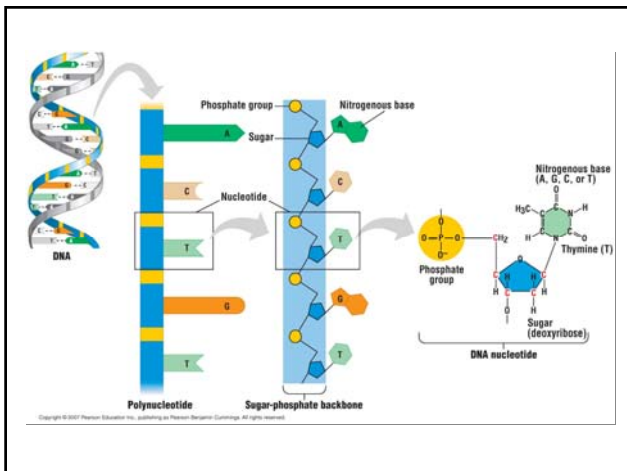


(b) Rosalind Franklin and one of her X-ray images
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Figure 10.3b

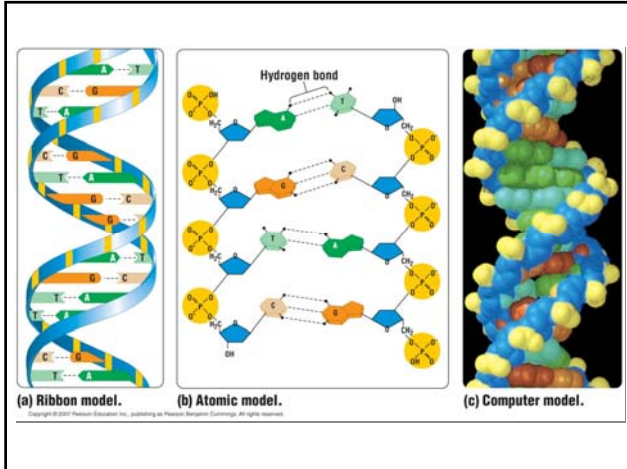
DNA and RNA

- Γ Both Nucleic acids
- Γ Both have a sugar-phosphate backbone
- Γ DNA and RNA carry information
 - Γ DNA- Genetic information
 - Γ RNA- mRNA, tRNA, rRNA,
 - Γ Found in every living organism from Bacteria to Animalia!



Watson, Crick and Wilkins's Triumphant Moment

- Γ Watson and Crick publish in 1953 in Nature (You can find this paper on-line!)
- Γ 1962 the three receive Nobel Prizes
 - Γ Sadly, Rosalind Franklin died of cancer in 1958, most likely due to X-ray radiation.
- Γ The structure "Immediately suggests a possible copying mechanism for the genetic material." WOW!!!



What's an Enzyme?

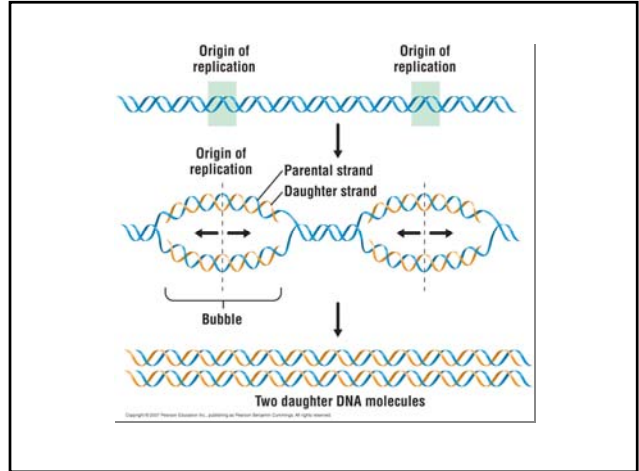
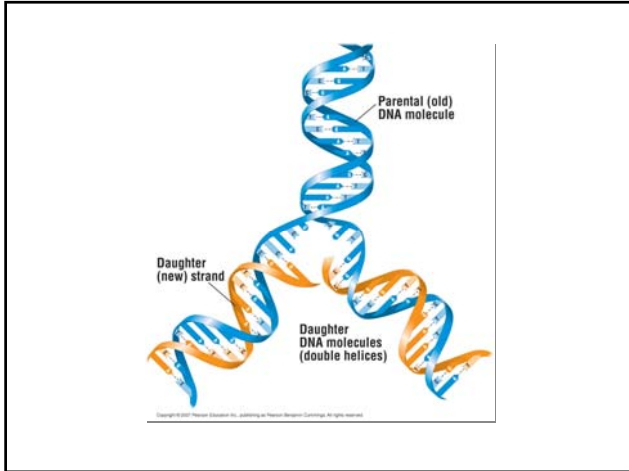
- Γ Reduces the energy *required* for a reaction
 - Γ Possibly by arranging the reactants in an energetically conducive position- Reactive site
 - Γ Allows reactions to happen which otherwise would not take place without massive energy inputs. (ATP or Heat)
- Γ Nomenclature- "-ase" suffix.
- Γ When something happens involving enzymes, it is enzymatic.

DNA Replication

- Γ DNA is replicated inside the nucleus
- Γ Requires enzymes and a proteins to happen
- Γ DNA polymerase ("Polymer"-many molecules "-ase" -enzyme).
- Γ DNA is not replicated left to right- but at origins of replication, and "bubbles"
 - Γ FAST - 50 nucleotides per second!
 - Γ ACCURATE -1 incorrect pair in a billion!

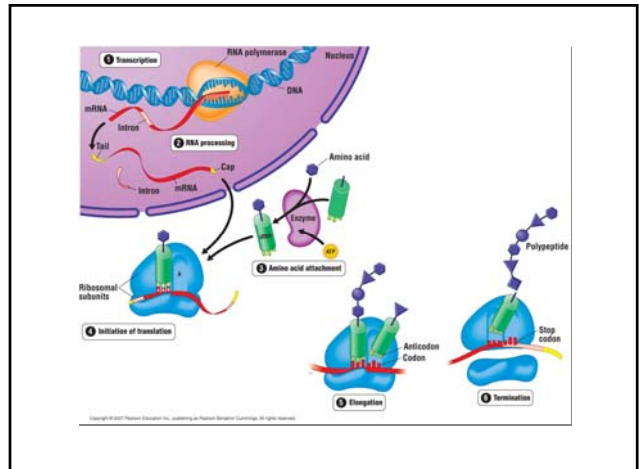
DNA as "Genes"

- Γ DNA is the mode of genetic information passing.
 - Γ From parent to offspring
 - Γ "Mother" cell to "daughter" cells (Mitosis and Meiosis)
- Γ DNA is in the Nucleus. Why?
- Γ Players in replication also take part in repair.



Flow from Genetic Information from DNA to RNA to Protein

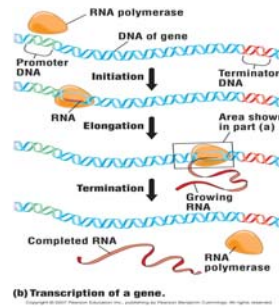
- Γ DNA- Nucleus, the genotype.
- Γ RNA- mRNA from Nucleus to Ribosomes
- Γ Proteins- Structure, enzyme, signal, physiological activity, etc. The Phenotype!
- Γ Note- DNA of twins may result in two phenotypes due to environmental conditions (exposure to chemicals, stress, etc.)



How does it happen?

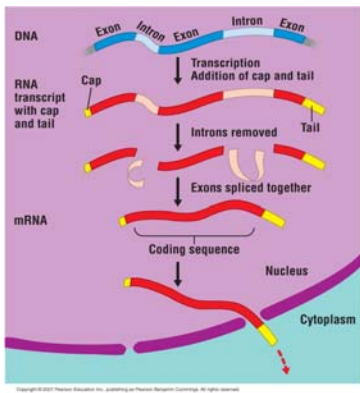
- Γ What are the steps of DNA to RNA to Protein?
- Γ Translation- DNA to messenger RNA
- Γ Transcription- RNA to protein via ribosomal action.

Transcription: RNA polymerase and mRNA



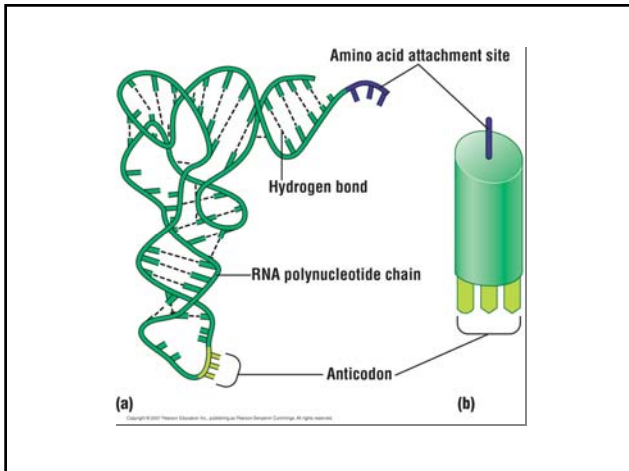
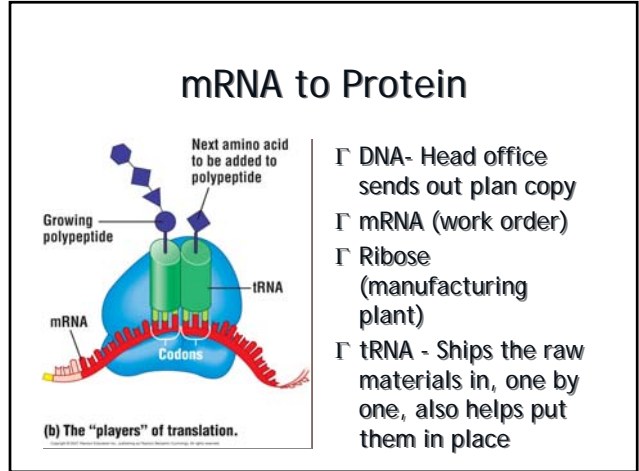
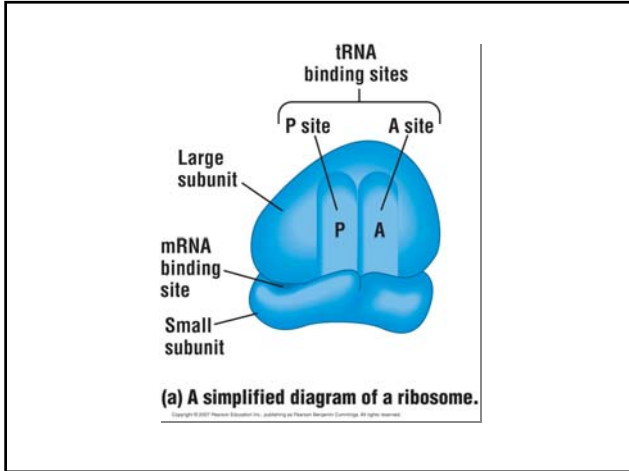
- Γ Initiation- Promoter DNA
- Γ Elongation- RNA gets longer, yep.
- Γ Termination- Stop!
- Γ Also produces tRNA and rRNA.

(b) Transcription of a gene.



Processing of eukaryotic RNA

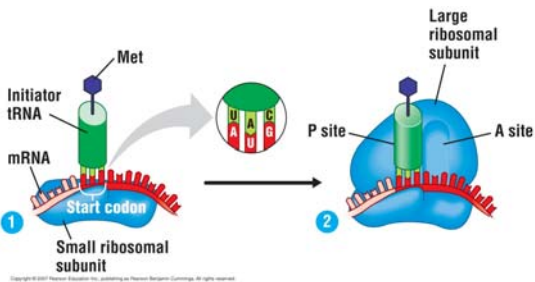
- Γ The mRNA strand from the DNA template is capped and tailed, and then the introns are removed, exons are spliced together.
- Γ One gene, one polypeptide/protein theory.



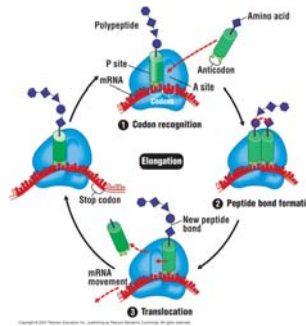
Γ Translation has three parts as well

- Γ Initiation- ribosome, mRNA and initiator tRNA are all assembled together.
- Γ Elongation - Codons on RNA are recognized by anti-codons (AUG->UAC). A.A.'s added 1 by 1.
- Γ Ribosome bonds the A.A.'s together.
- Γ Termination - stop codons (UAA, UAG, UGA) ->

Initiation



Elongation- 3 parts



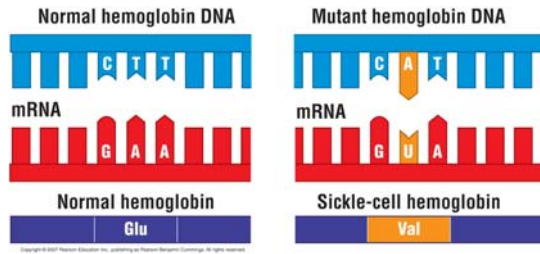
- Γ Codon recognition- tRNA pairs with mRNA codon (A site)
- Γ Peptide bond formation (by ribosome catalysis)
- Γ Translocation- tRNA moves from A site to P site after old tRNA leaves. Bye bye.

		Second base				
		U	C	A	G	
U	UUU	UCU	UAU	UGU	U C A G	
	UUC	UCC	UAC	UGC		
	UUA	UCA	UAA Stop	UGA Stop		
	UUG	UCG	UAG Stop	UGG Tryptophan (Trp)		
C	CUU	CCU	CAU	CGU	U C A G	
	CUC	CCC	CAC	CGC		
	CUA	CCA	CAA	CGA		
	CUG	CCG	CAG	CGG		
A	AUU	ACU	AAU	AGU	U C A G	
	AUC	ACC	AAC	AGC		
	AUA	ACA	AAA	AGA		
	AUG Met or start	ACG	AAG	AGG		
G	GUU	GCU	GAU	GGU	U C A G	
	GUC	GCC	GAC	GGC		
	GUA	GCA	GAA	GGA		
	GUG	GCG	GAG	GGG		

Termination

- Γ "You can just stop right there..." The polypeptide is complete.
- Γ Who says so? The stop codons (3 different ones). UAA, UAG, UGA.
- Γ The polypeptide is released by the ribosome and the mRNA is also recycled and reused.

Sickle Cell Anemia



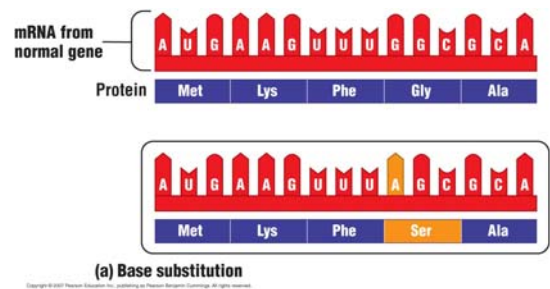
MUTATIONS

- Γ Science Fiction- usually don't create mutant martial artist turtles - a mutation most likely will cause the death of an organism, or poor health.
- Γ Changes or disables protein
- Γ Three kinds of mutations
- Γ Somatic cells (diploid) versus gametes (haploid sperm/egg)

Two categories of Mutation

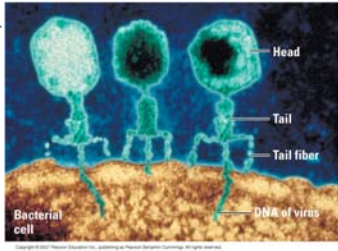
- Γ Base substitution - sickle cell anemia
 - Γ Silent mutations (redundancy of code)
 - Γ Missense mutation (changes Amino Acid)
 - Γ Nonsense mutation (makes a stop codon)
- Γ Base insertion or deletion- harmful change of reading frame. Most likely will cause loss of protein function. One *or* two deleted or inserted.
- Γ Mutagens- Carcinogens, UV, X-rays

Base Substitution



Viruses

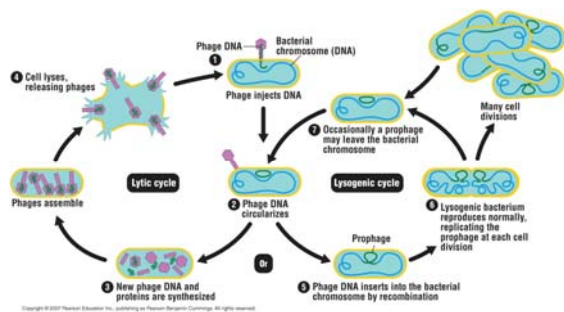
- Γ Genes in protein.
- Γ RNA and DNA viruses.
- Γ Plant and Animal viruses
- Γ Some more damaging to one species than another, some specific to a host.



Bacteriophages

- Γ “Phage” for short
- Γ “Eats” bacteria, uses their machinery to make viral proteins and reproduce the viral DNA.
- Γ Lytic and lysogenic cycles.

Lytic and Lysogenic Cycles



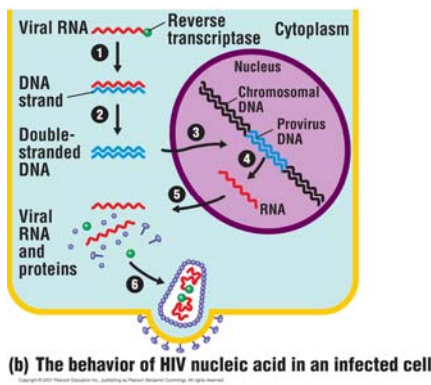
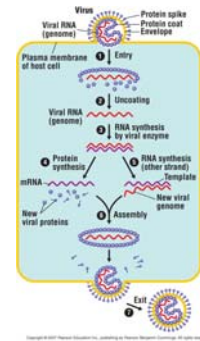
Plant Viruses



Animal Viruses

- Γ Can cause diseases or unpleasant problems like warts (body's reaction)
- Γ Most are RNA based. Influenza, common cold (rhinoviruses), measles, mumps, HIV and polio.
- Γ DNA viruses include hepatitis, chicken pox, and herpes infections.

Reproduction



Chapter 12- Biotech

- Γ The lowly bacteria has become biotechnology's manufacturer
- Γ *E. coli*- Helped researchers develop understanding of bacterial DNA and recombinant DNA technology
- Γ Biotechnology- dates back to using yeast in manufacture of bread, wine and beer.
- Γ Mammalian cell culture is a technique now widely used - growing tissue on a plate.

Various Products

- Γ Humilin- human insulin for diabetics. Developed by our neighbours, Genentech, in 1978.
- Γ HGH- 1985
- Γ EPO- erythropoietin. Produced from cultured mammalian cells.
- Γ Using yeast to make external protein of hepatitis B virus to make a vaccine.
- Γ Vaccines make your immune system "aware" of the pathogen, no longer naïve

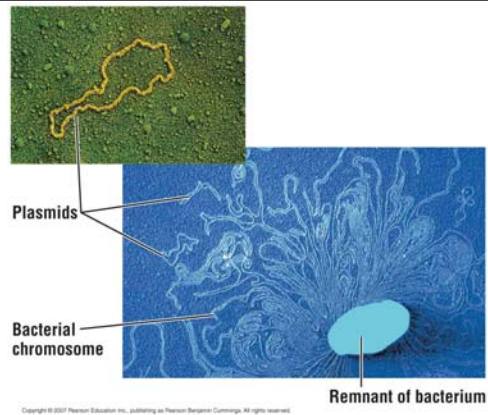
Genetically Modified Organisms (GMOs)



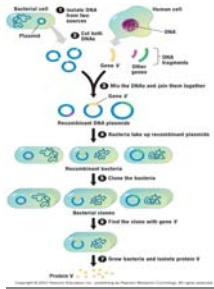
- Γ Is it a dirty word?
- Γ "Fruits determine the tree."
- Γ Rice with beta carotene.
- Γ Bananas with vaccines.
- Γ Animals with more omega-3 fatty acids in your grocery store.
- Γ Crops resistant to insects/pesticides.

BIOETHICS

- Γ Bioethics - answering ethical issues created by biotech and medical tech
- Γ Is it OK to do "good" while altering nature? (vaccines, "healthy" pork, etc.)
- Γ Every new technology and area of research relating to humans results in a political, ethical, philosophical, spiritual and even economic discussion, etc.
- Γ Must be broached using sound reason.



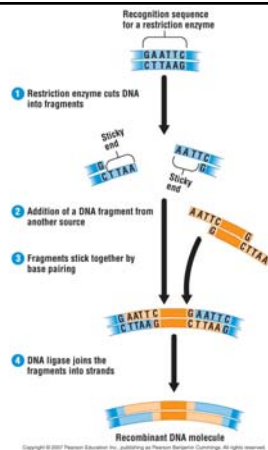
Recombinant DNA techniques



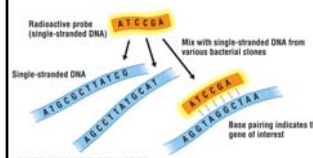
- Γ Plasmid- circular DNA readily taken up by Bacteria.
- Γ Plasmids are vectors of new genes-move DNA to a new cell.
- Γ Need LOTS of bacteria carrying the desired gene to make the desired protein.

Restriction Enzymes

- Γ Restriction Enzymes- run along DNA “reading” sequence for recognition sequence. Many enzymes recognize different sequences or types of sequ.
- Γ Cuts the DNA into restriction fragments leaving “sticky” ends! Whoa!
- Γ Gene inserted with complimentary sticky ends. DNA Ligase, another enzyme, “glues” it all together.
- Γ This technique is a “shotgun” approach. Many new genes are inserted into many plasmids.



Finding your gene



- Γ One way is to use a radioactive nucleic acid probe.
- Γ Developed by creating a genomic library of recombinant DNA
- Γ Complimentary base pairing, the gene “glows”