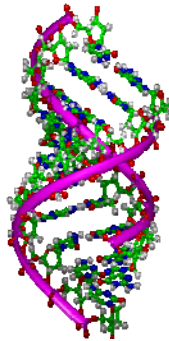
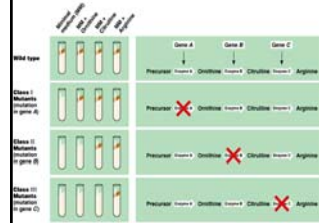


Nucleic Acids & Protein Synthesis



DNA
(Deoxyribonucleic acid)

The Connection between Genes and Proteins

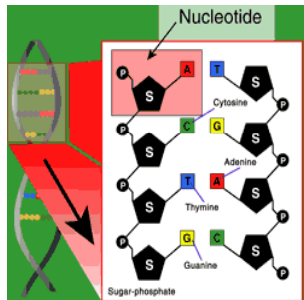


- The study of metabolic defects provided evidence that genes specify proteins
- One-gene-one-enzyme hypothesis

[HersheyChase](#)

DNA (Deoxyribonucleic acid)

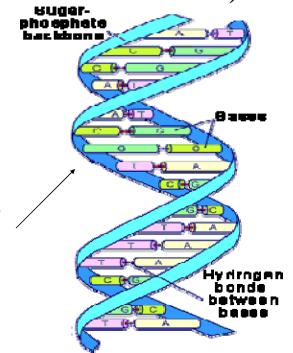
- nucleic acid polymer
- made up of smaller subunits of nucleic acid called *nucleotides*
- there are four possible nucleotides each containing one of the four bases



DNA (Deoxyribonucleic acid)

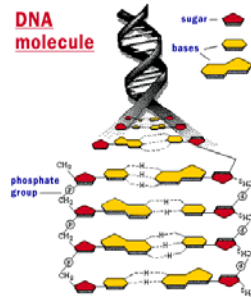
Double helix – two twisted strands of nucleotides

The order of nucleotides in the DNA strands differentiates one organism from another



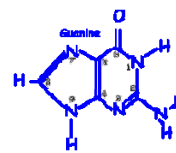
Components of DNA

- Deoxyribose sugar
- Phosphate group
- Nitrogen base
 - Organic ring structure that contains one or more atoms of nitrogen

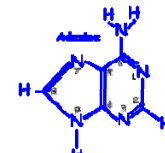


[Base Pairing](#)

The Nitrogen Bases Purines (double-ring, larger)



Guanine



Adenine

The Nitrogen Bases

Pyrimidines (single ring, smaller)



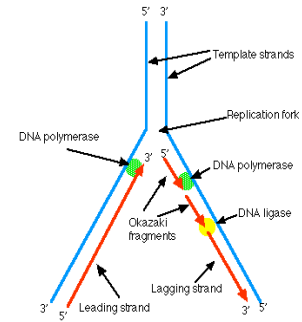
Thymine



Cytosine

DNA Replication

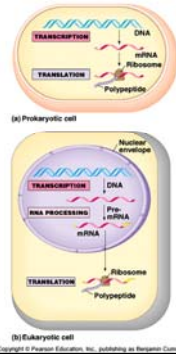
- Two strands of the double helix separate
- Bases pair with free nucleotide
- Form two molecules identical to original molecule



clip

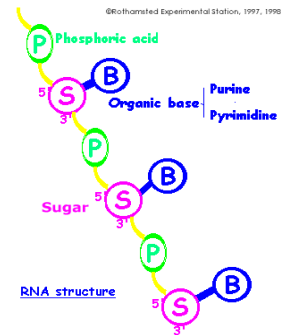
Transcription and Translation: Two Main Processes

- DNA synthesizes RNA:
 - Transcription
- RNA synthesizes Protein:
 - Translation



RNA Ribonucleic Acid

- Contains ribose sugar
- Nitrogen bases
 - Cytosine (C)
 - Guanine (G)
 - Adenine (A)
 - Uracil (U)
- Single strand only



Types of RNA

- *m*RNA – messenger RNA
 - Carries info from DNA in nucleus out into the cytoplasm and into the ribosome
- *r*RNA – ribosomal RNA
 - Produce enzymes to bond amino acids during protein synthesis
- *t*RNA – transfer RNA
 - Transfers the amino acids to the ribosomes for protein assembly
- clip

Transcription to RNA

- Making of a single copy of a DNA strand

Codon – DNA code; set of three bases coding for an amino acid (AAA, CGC, etc.)



Translation to Protein

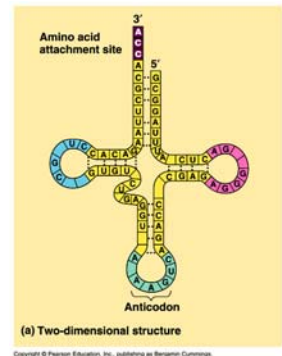
- Converting mRNA sequence to amino acid sequence that makes up a protein clip



5' [cap AUGAGAUACCAAGAACCUAACCAAGGUAGAGCUUUAGCCCCGAAAAAAAAAAAAA] 3'

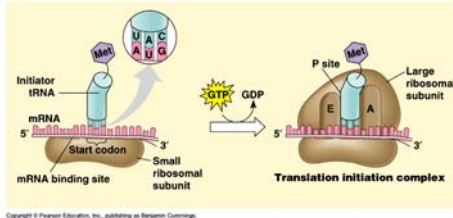
tRNA

- Interpreter between base sequence of mRNA and amino acid sequence of protein
- 45 different types
- About 80 nucleotides long
- Anticodon base pairs with codon of mRNA



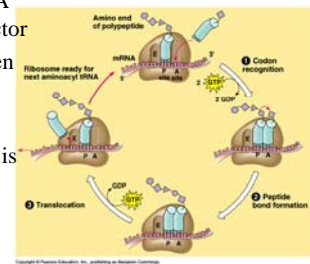
Initiation

- 5' cap attaches to small ribosome subunit
- tRNA carrying methionine attaches to mRNA codon
- Large ribosomal subunit attaches



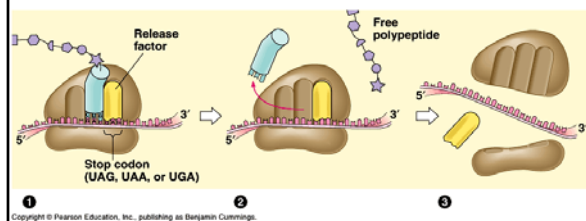
Elongation

- Codon recognition:
 - tRNA directed into the A site by an elongation factor
- Peptide bond forms between adjacent amino acids
- Translocation:
 - amino acid in the A site is moved to the P site
- mRNA moves through the ribosome 5'→3' direction



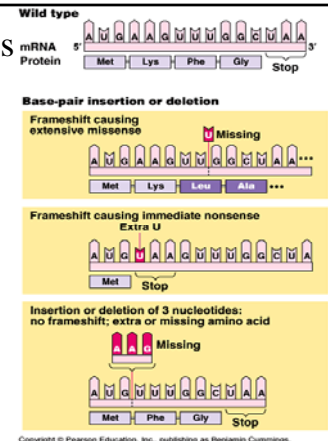
Termination

- Termination sequence is encountered
- Release factor binds to sequence
- Release factor separates polypeptide and tRNA



Point Mutations

- Insertions or deletions:
 - add or subtract base pair(s)
- May cause frameshift
- Mutations



Mutations in DNA

- Frameshift mutation – a single base is added or deleted from DNA

Original Strand

AUG AAG UUU GGC GCA

Met Lys Phe Gly Ala

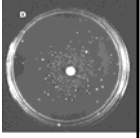
New Strand

AUG AAG UUG GCG CA..

Met Lys Leu Ala

Mutagens

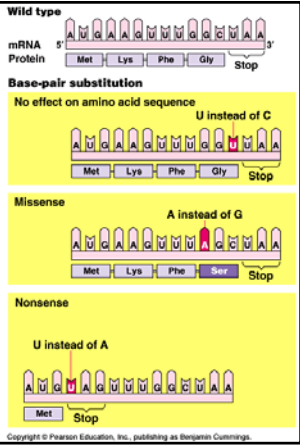
- Physical or chemical agents that cause mutations
- Radiation
- Base analogues
 - Chemicals that mimic normal DNA bases
- Ames Test
 - A test for determining if a chemical is a mutagen
 - Certain chemicals become carcinogenic in the body



<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/A/AmesTest.html>

Point Mutations: *substitutions*

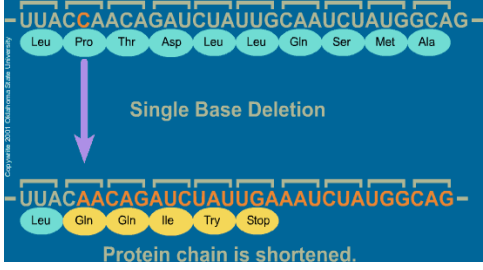
- Replacement of one base pair with another
- Types:
 - silent
 - conservative
 - missense
 - nonsense
- One wrong letter (8 1/2 min)



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Mutations in DNA

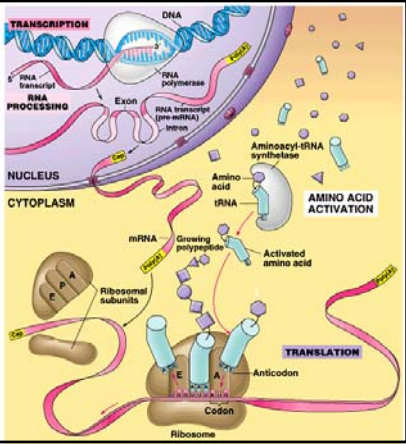
- Point Mutation – a change in a single base pair in DNA



Protein chain is shortened.

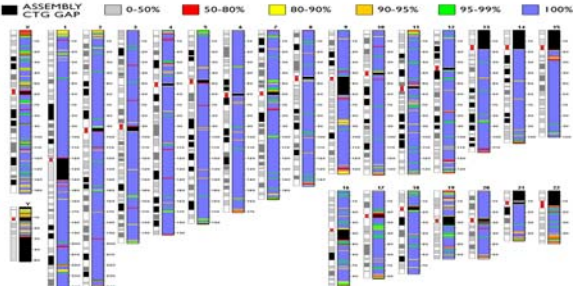
Protein Synthesis

- Each gene in DNA can be transcribed repeatedly into many RNA molecules
- Each mRNA can be translated into many polypeptides
- Let's Review



The Human Genome Project

- Working to determine the sequences of nucleotide bases for the human species.

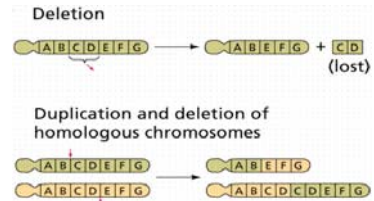


Mutations in Chromosomes

- Changes happen to the chromosome itself
- Affect the distribution of genes to gametes during meiosis

Types of Mutations

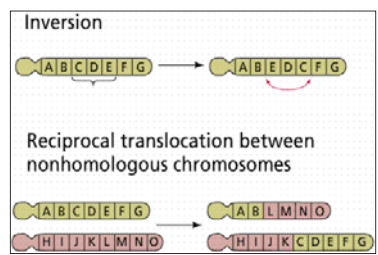
- Deletion – part of a chromosome is left out
- Insertion – a chromatid breaks off and attaches to sister chromatid
 - Results in duplication of genes on the same chromosome



Types of Mutations

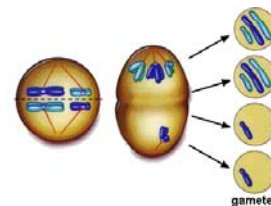
- Inversion – part a chromosome breaks off and is reinserted backwards
- Translocation – part of one chromosome breaks off and added to a different chromosome

- clip



Nondisjunction

- The failure of homologous chromosomes to separate properly during meiosis



Trisomy

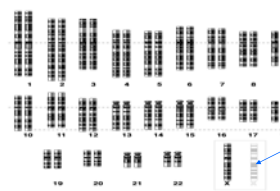
- A gamete with an extra chromosome is fertilized by a normal gamete
- Zygote has an extra chromosome
- Ex. Down syndrome (Trisomy 21)



Extra chromosome

Monosomy

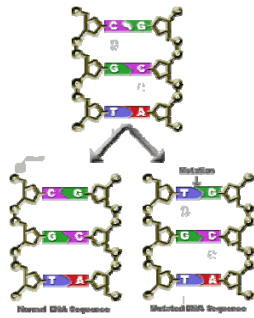
- A gamete with a missing chromosome is fertilized by a normal gamete
- Zygote lacks a chromosome
- Ex. human females with only a single X-chromosome



Missing chromosome

Causes of mutation

- Spontaneous mutation – mutations that occur at random
- Environmental
 - Exposure to X-rays, UV light, radioactive substances and other chemicals



Meiosis & Mitosis ??

- If mutation occurs in gametes
 - Leads to birth defects
- If mutation occurs in body cells
 - Cancer

