




Dr. Kathleen Hill
Assistant Professor
Department of Biology
The University of Western Ontario
khill22@uwo.ca

Office Hours: Monday 1 to 5pm
 Room 333 Western Science Centre

Research Website:
<http://www.uwo.ca/biology/Faculty/hill/index.htm>


**Genomes
 DNA
 Genes to Proteins**



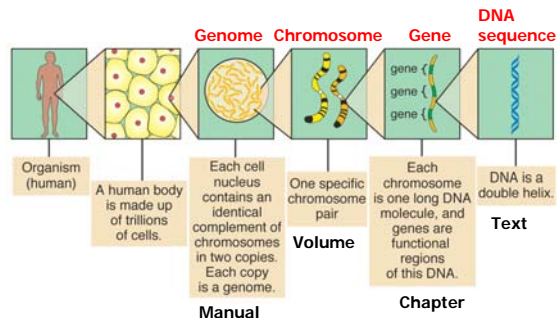
Kathleen Hill
January 18 Lecture/Workshop
January 25th Lab Tour WSC 333

The human genome is a multi-volume instruction manual

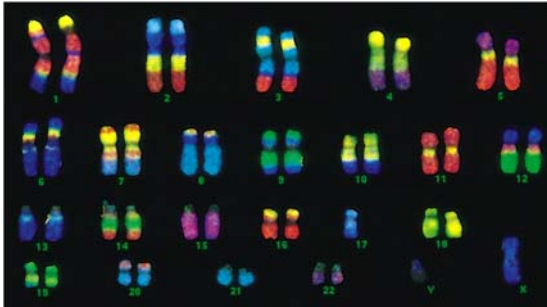
- The **GENOME** is a multi-volume instruction manual
- Each **CHROMOSOME** is a volume of text
- **Genes** are a chapter of text in the volume
- The text is written in a chemical language that has a four letter alphabet **A,C,G,T NUCLEOTIDES**



Our instruction manual can be read in our DNA



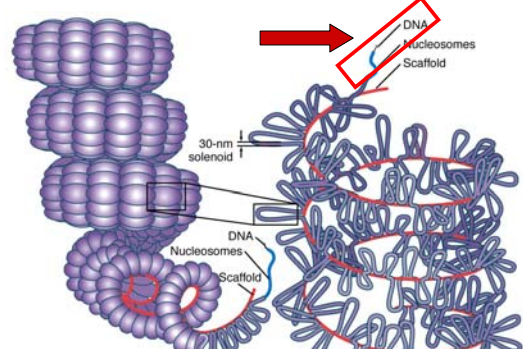
Human Genome

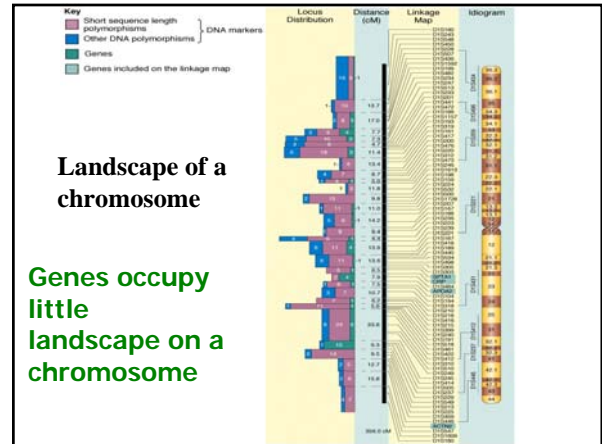
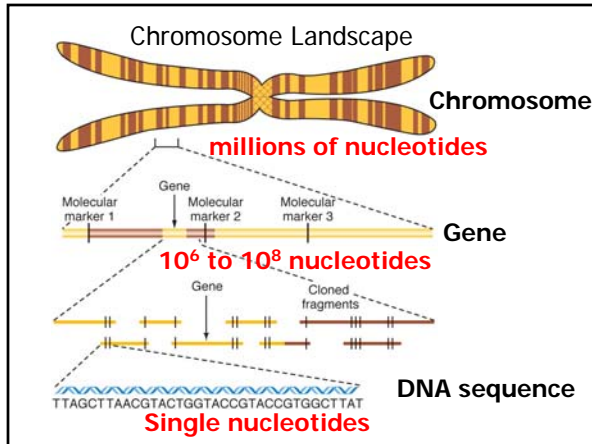
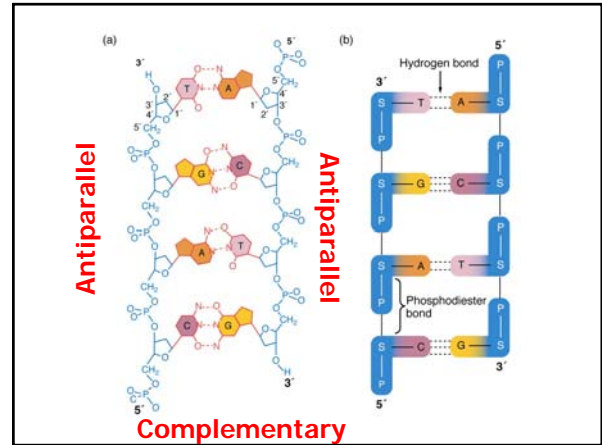
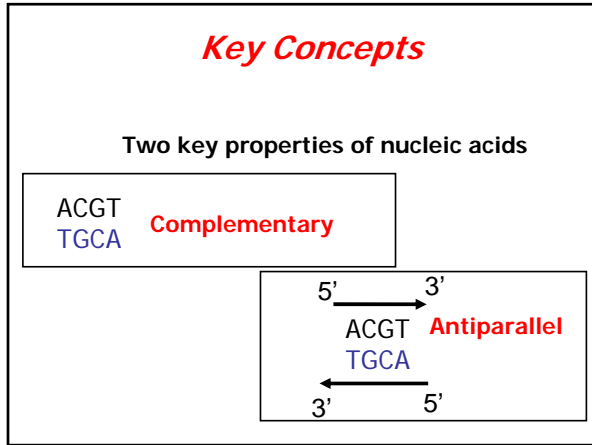
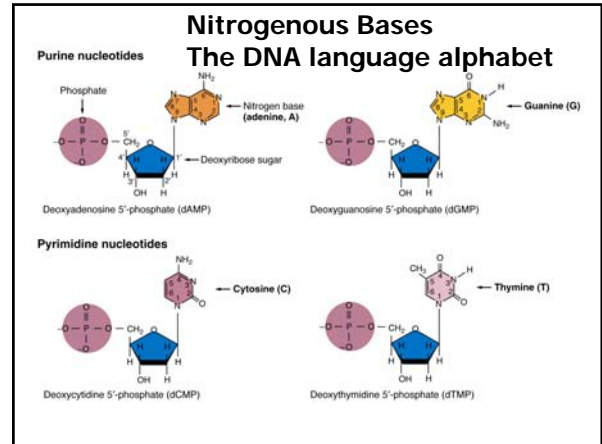
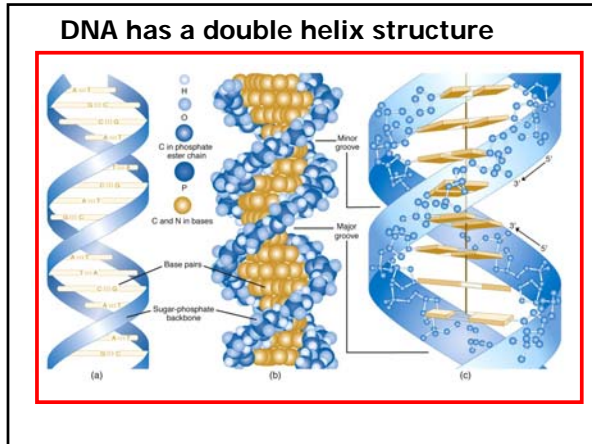


46 chromosomes
22 pairs of autosomes
1 pair of sex chromosomes

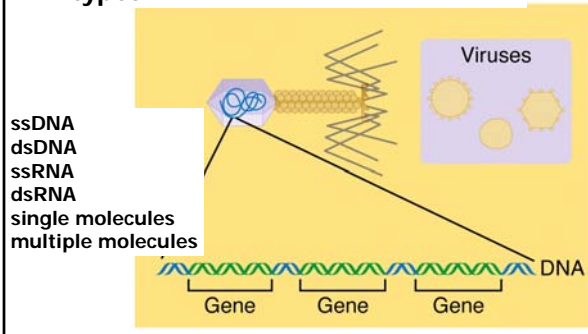
Male Karyotype

Human nuclear DNA is highly packaged in chromosomes

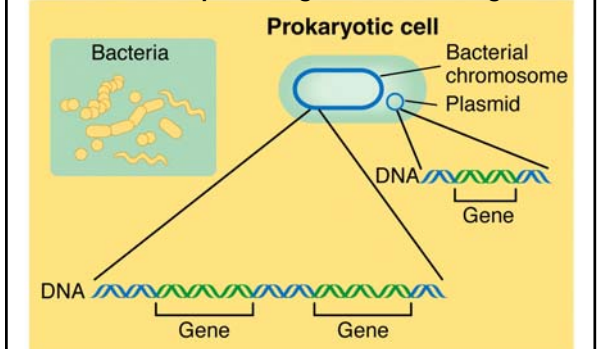




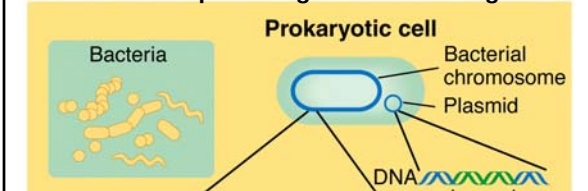
Viruses are "nonliving" and have the greatest diversity in genome types



Bacterial Genomes
Single molecules, circular dsDNA
Smaller circular plasmid genomes - extragenomic

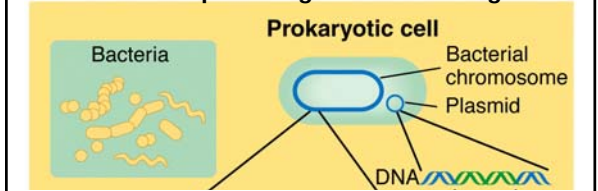


Bacterial Genomes
Single molecules, circular dsDNA
Smaller circular plasmid genomes - extragenomic



Genetic information can be exchanged between bacteria via plasmids and between the plasmid and the bacterial chromosome

Bacterial Genomes
Single molecules, circular dsDNA
Smaller circular plasmid genomes - extragenomic



Viruses can infect bacteria and add genetic information to the bacterial host chromosome

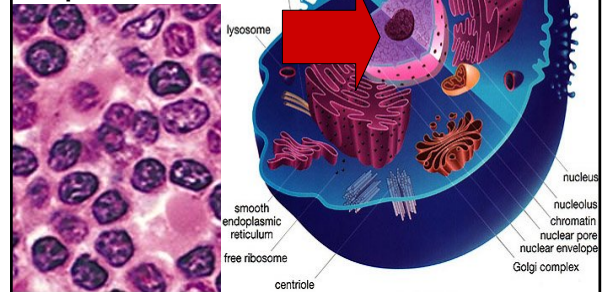
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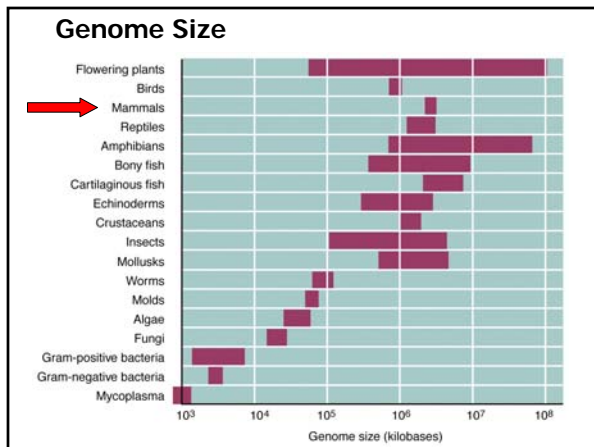
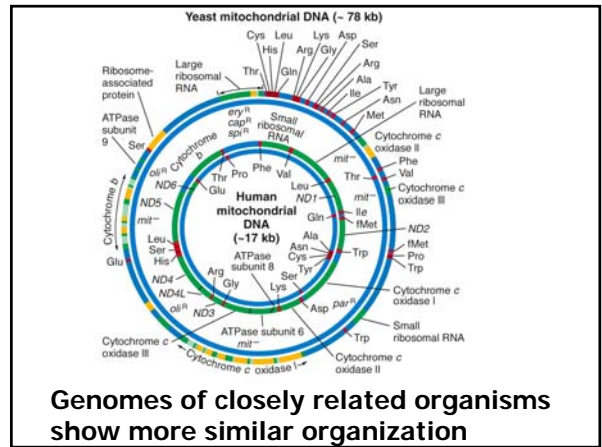
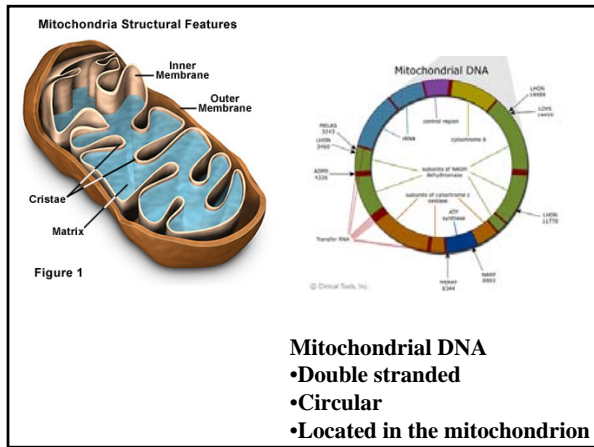
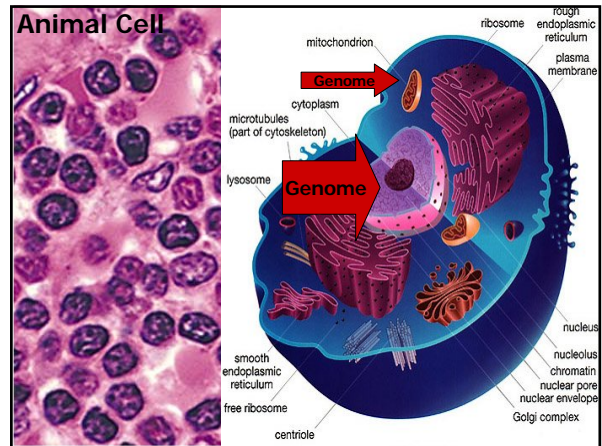
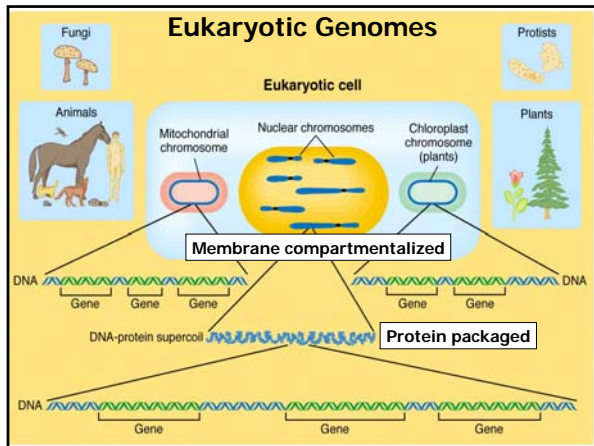


Genome is not enclosed in a separate compartment in the prokaryotic cell

Genomic DNA is not protein packaged

Eukaryotic Cell:
Genome is contained in separate cell compartment



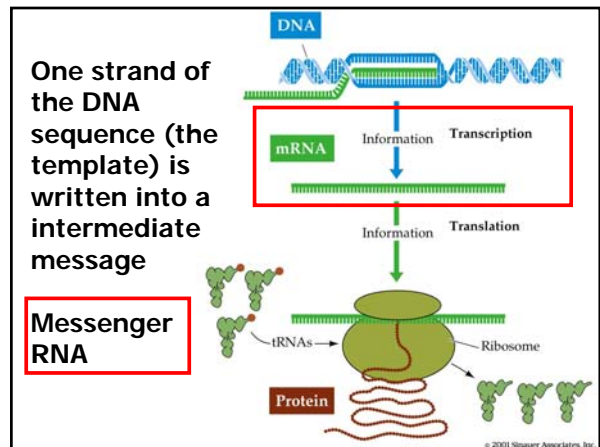
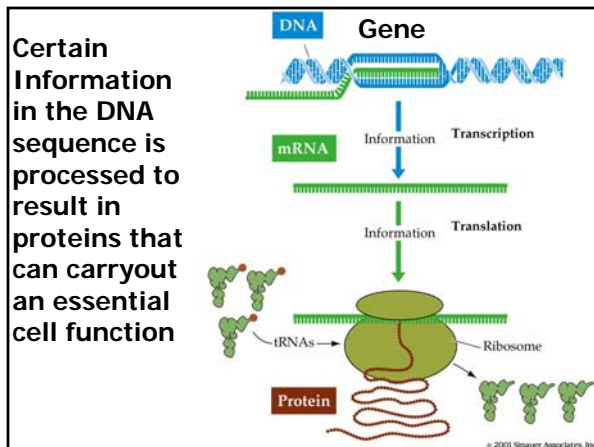
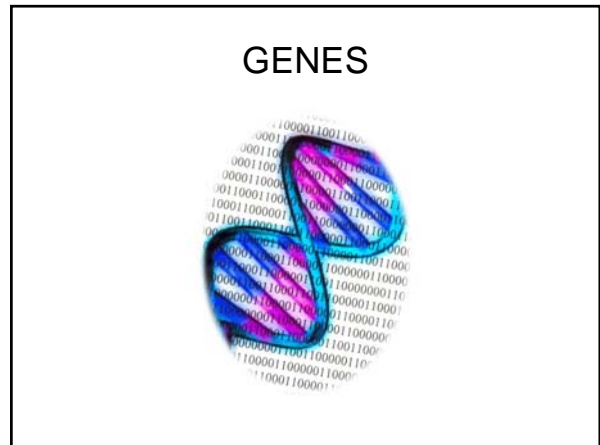
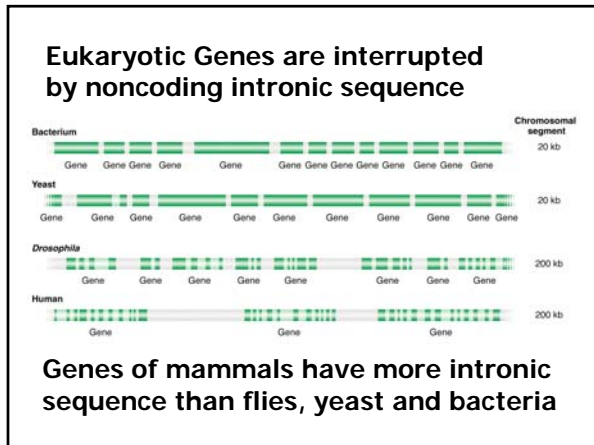
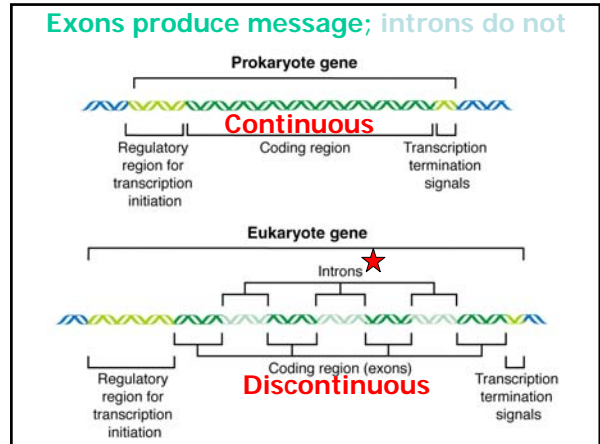
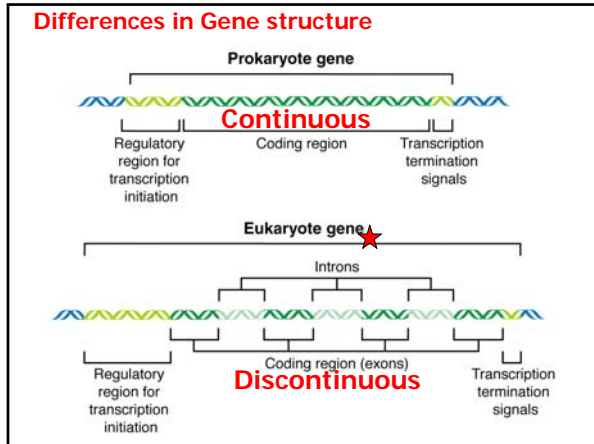


Genome Size and Number of Genes

| Genome | Group | Size (kb) ^a | Number of Genes |
|------------------------------------------|---------------------------------|------------------------|-----------------|
| <i>Eukaryotic nucleus</i> | | | |
| <i>Saccharomyces cerevisiae</i> | Yeast | 13,500 (L) | 6,000 |
| <i>Caenorhabditis elegans</i> | Nematode | 100,000 (L) | 13,500 |
| <i>Arabidopsis thaliana</i> | Plant | 120,000 (L) | 25,000 |
| <i>Homo sapiens</i> | Human | 3,000,000 (L) | 30,000–100,000 |
| <i>Prokaryote</i> | | | |
| <i>Escherichia coli</i> | Bacterium | 4,700 (C) | 4,000 |
| <i>Haemophilus influenzae</i> | Bacterium | 1,830 (C) | 1,703 |
| <i>Methanococcus jannaschii</i> | Bacterium | 1,660 (C) | 1,738 |
| <i>Viruses</i> | | | |
| T4 | Bacterial virus | 172 (L,C) | 300 |
| HCMV (herpes group) | Human virus | 229 (L) | 200 |
| <i>Eukaryotic organelles</i> | | | |
| <i>S. cerevisiae</i> mitochondria | Yeast | 78 (C) | 34 |
| <i>H. sapiens</i> mitochondria | Human | 17 (C) | 37 |
| <i>Marchantia polymorpha</i> chloroplast | Liverwort | 121 (C) | 136 |
| <i>Plasmids</i> | | | |
| F plasmid | In <i>E. coli</i> | 100 (C) | 29 |
| Kalilo | In the fungus <i>Neurospora</i> | 9 (L) | 2 |

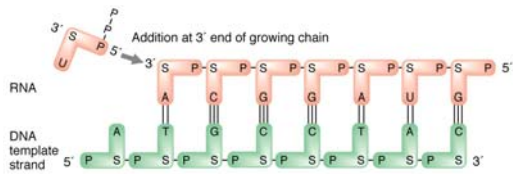
^aC = circular DNA molecule; L = linear DNA molecule; L,C = linear in free virus, circular in cell.

Human Genome: 3.4 billion nucleotides



One strand of the DNA sequence (the template) is written into a intermediate message

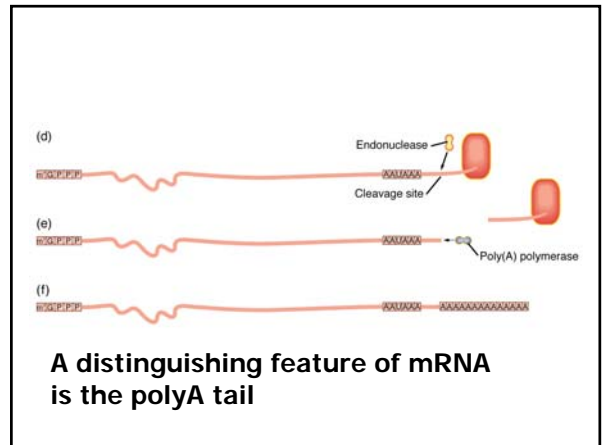
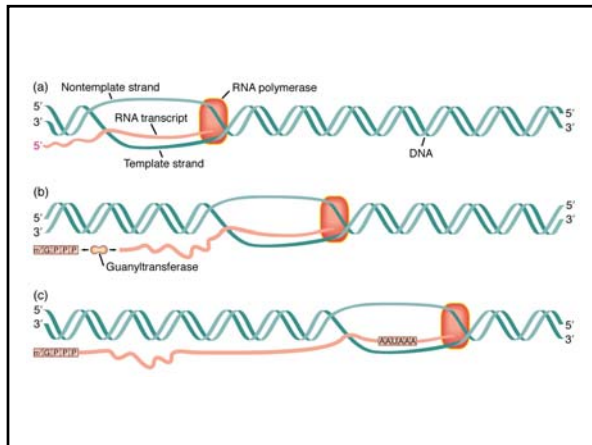
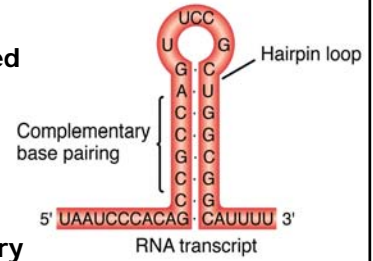
Messenger RNA (mRNA)



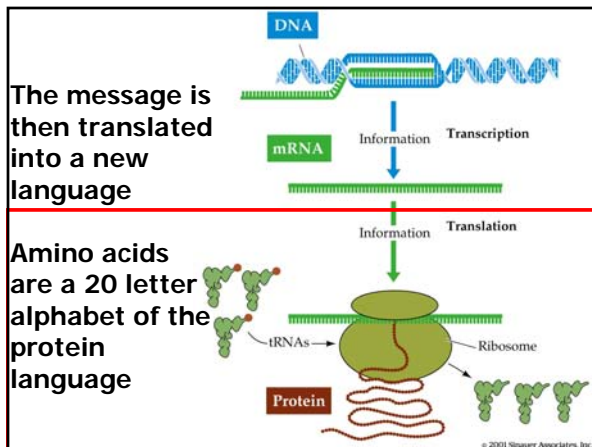
mRNA
• Single stranded

• Complex secondary structure

• Complementary sequence shows hydrogen bonding



A distinguishing feature of mRNA is the polyA tail



One code used to translate from nucleic acid to protein sequence

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

Each codon will be translated to an amino acid

