

DNA: CH 13

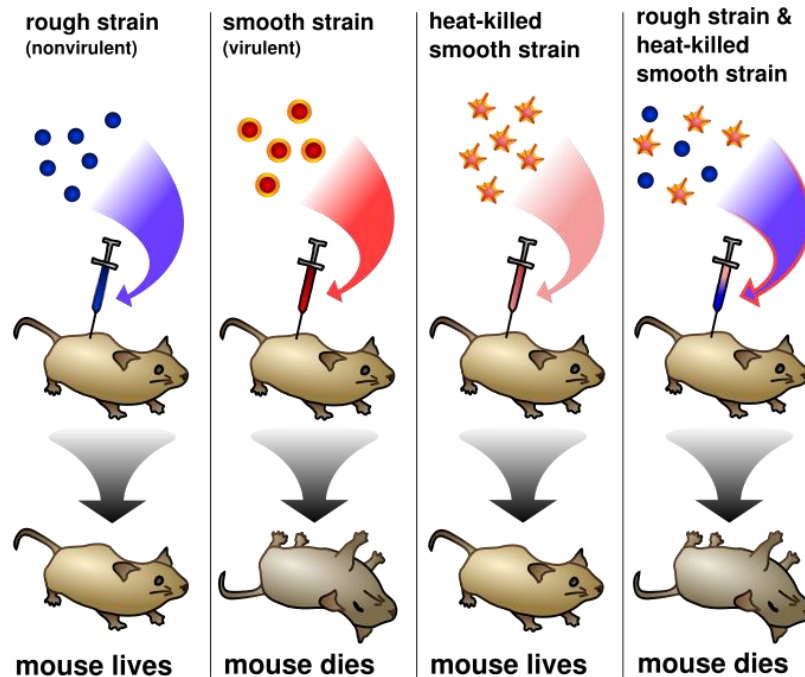
Macromolecule Review



- Nucleic acid
 - Monomer = nucleotide
 - Polymer = DNA, RNA
 - Function = genetic information
- Protein
 - Monomer = amino acid
 - Polymer = polypeptide
 - Function = structure and chemical reactions

Discovering DNA's Function

- 1928: Frederick Griffith studied bacteria



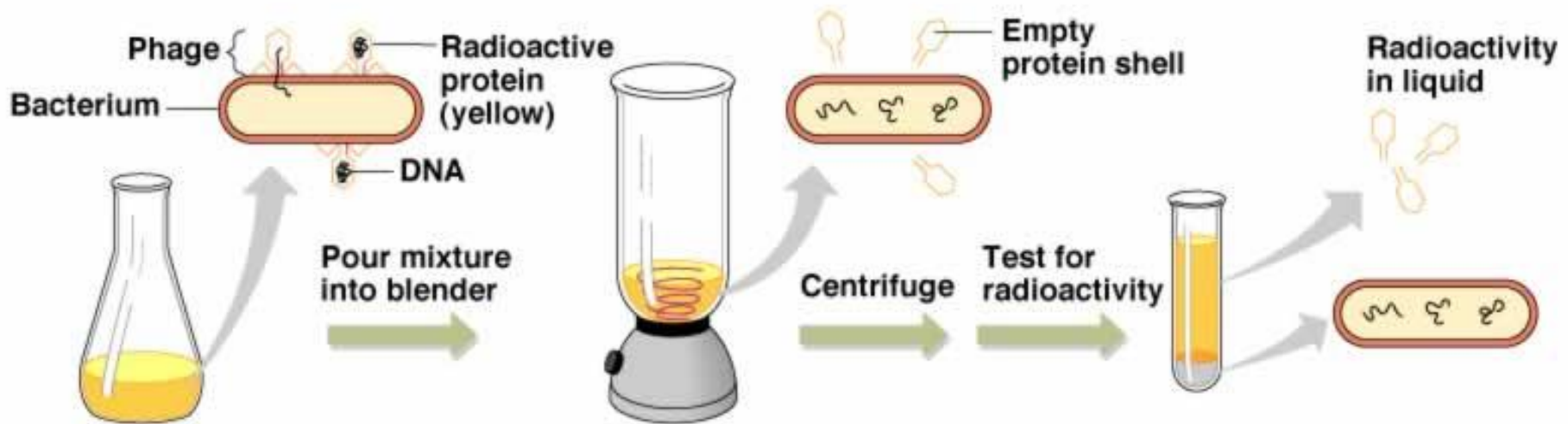
Conclusion: Genetic material can be transferred between cells

Griffith's Experiment

- Used harmless and harmful strains of bacteria that were injected into mice
- He recorded if they lived or died
- His final setup was a mixture of harmless bacteria and heat killed bacteria.
 - The mice died because of passing genetic material from the harmful bacteria to the healthy bacteria.
 - This changed the traits of the harmless bacteria.

Discovering DNA's Function

- 1940: Oswald Avery tried to determine WHAT was the material transferred in Griffith's experiment: DNA, proteins, or RNA
- 1952: Alfred Hershey and Martha Chase modified Avery's experiment
 - Conclusion: Found out that DNA was the material being transferred

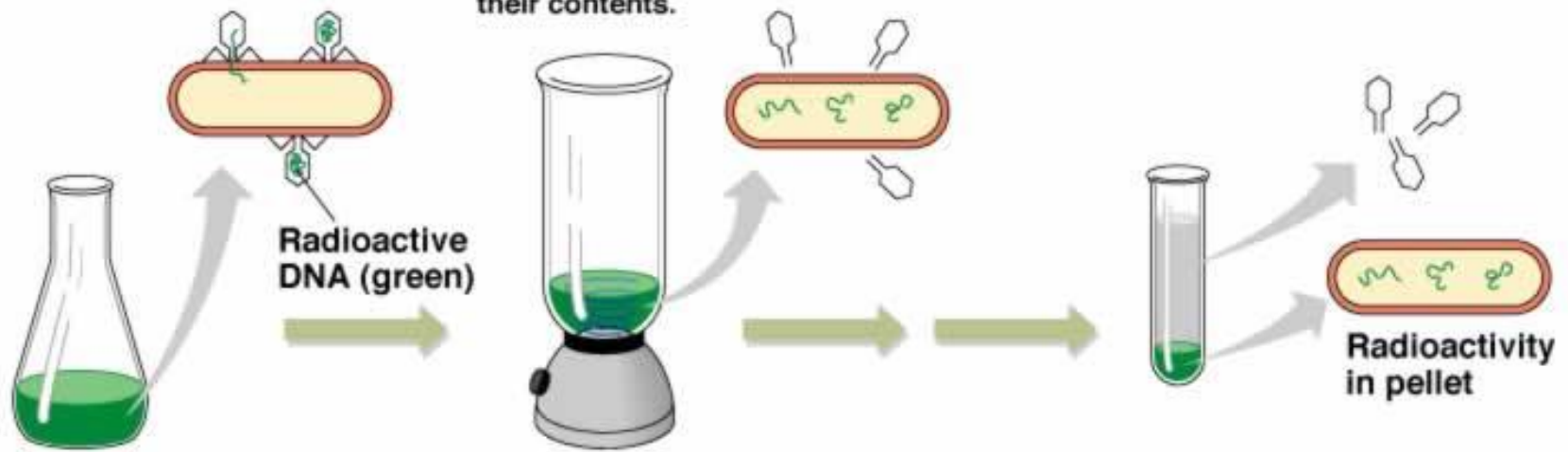


1 Mix radioactively labeled phages with bacteria. The phages infect the bacterial cells.

2 Agitate in a blender to separate phages outside the bacteria from the bacterial cells and their contents.

3 Centrifuge the mixture.

4 Measure the radioactivity in the pellet and the liquid.



Hershey/Chase Experiment

- Used bacteriophage (virus) to infect bacteria cells
- Radioactively labeled the protein in one setup and then the DNA in another setup
- After the virus infected the bacteria, the glowing radioactively labeled DNA went into the cell and the protein stayed outside the cell

Discovering DNA's Structure

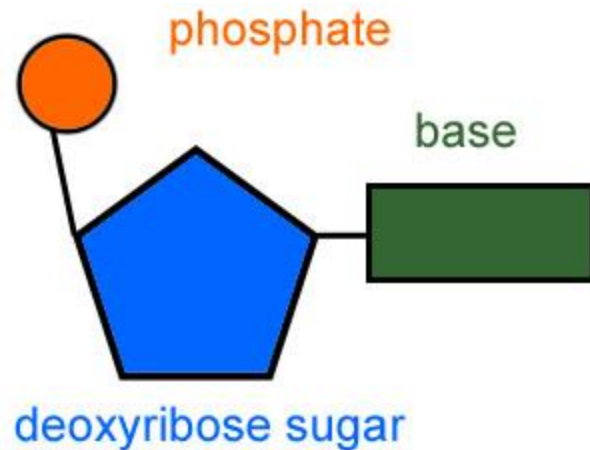
- 1949: Erwin Chargaff found that the amount of A's always equaled the amount of T's, and same with G's and C's
- 1952: Rosalind Franklin and Maurice Wilkins took the first picture (x-ray) of DNA and determined that the structure must be a coiled double helix
- 1953: James Watson and Francis Crick built a model of DNA using data from previous studies

Structure and Function of DNA

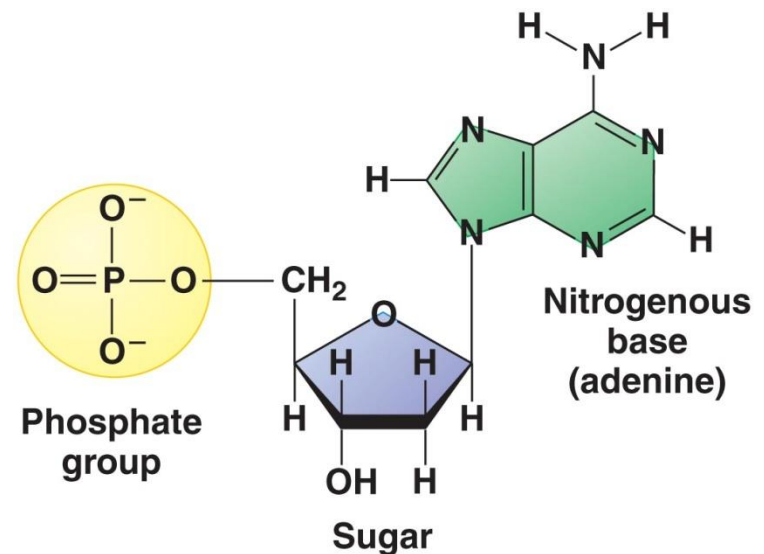
- DNA = deoxyribonucleic acid
- Function = stores genetic information for the cell
- Gene = segment of DNA that codes for a trait
- Shape of DNA = double helix (twisted ladder)

DNA Nucleotide

- Sugar – deoxyribose
- Phosphate
- Nitrogen base – A, T, G, or C



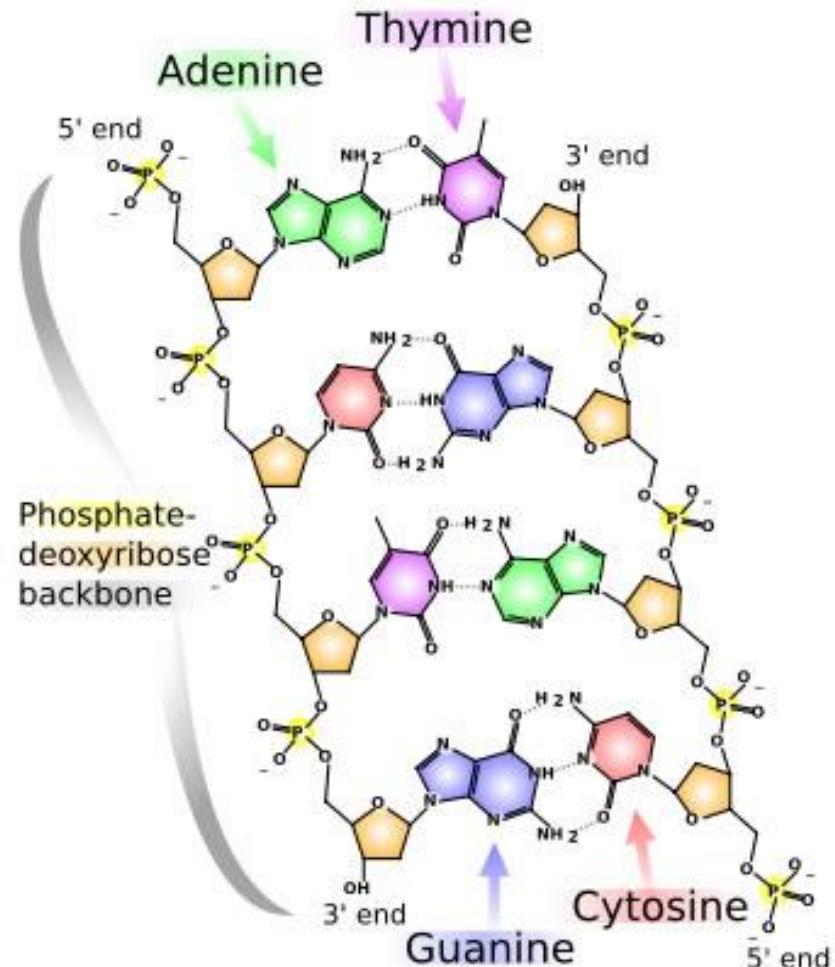
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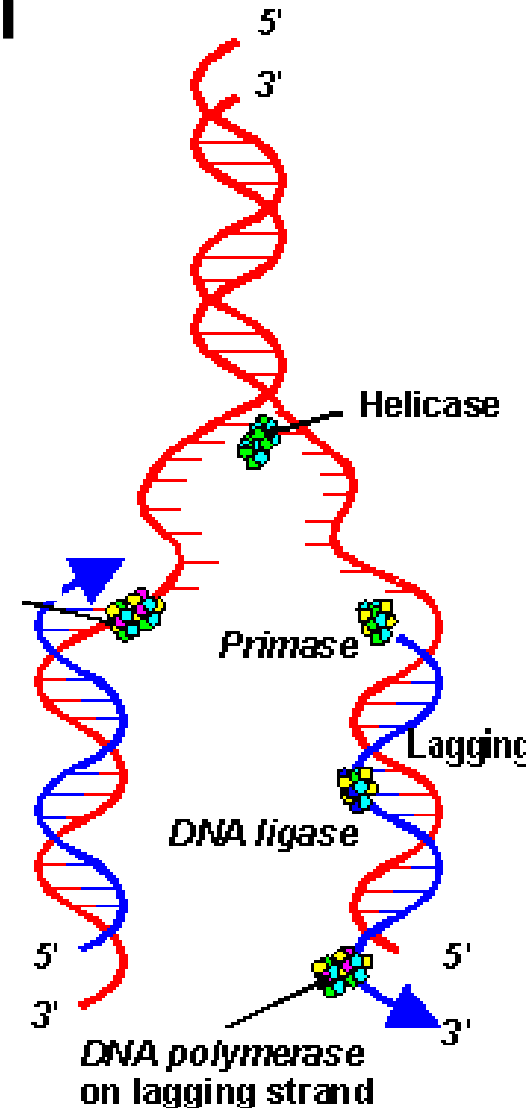
Structure of DNA

- Base pair rules – complementary bases form hydrogen bonds with each other which forms the double helix
- DNA base pair rules:
 - A matches with T
 - G matches with C



DNA Replication

1. When = Occurs before cell division
2. Summary of steps
 - The enzyme Helicase unwinds DNA strands and separates the two sides
 - The enzyme DNA Polymerase adds DNA nucleotides one at a time to each of the separated strands
 - End product = 2 identical pieces of DNA each containing a new and old strand



RNA Structure

- RNA = ribonucleic acid
- Sugar = ribose
- Phosphate
- Nitrogen base – A, U, C, or G
- One side or strand

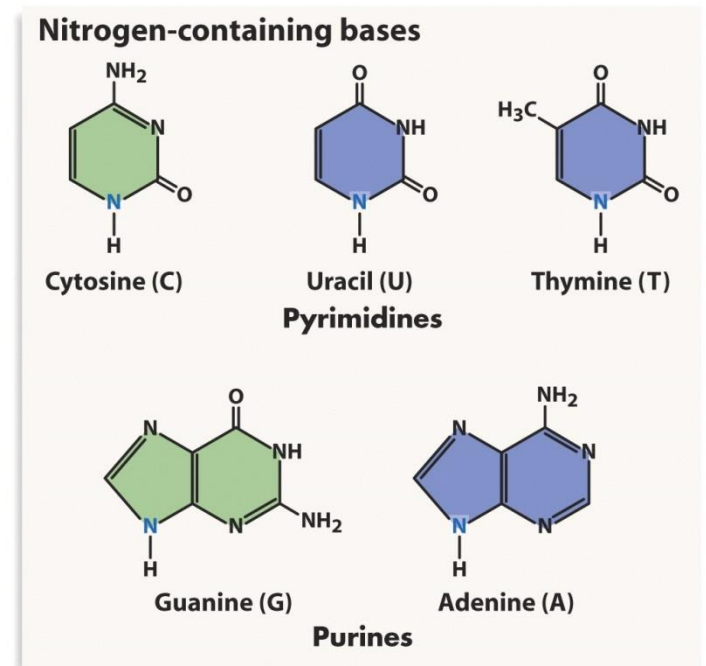
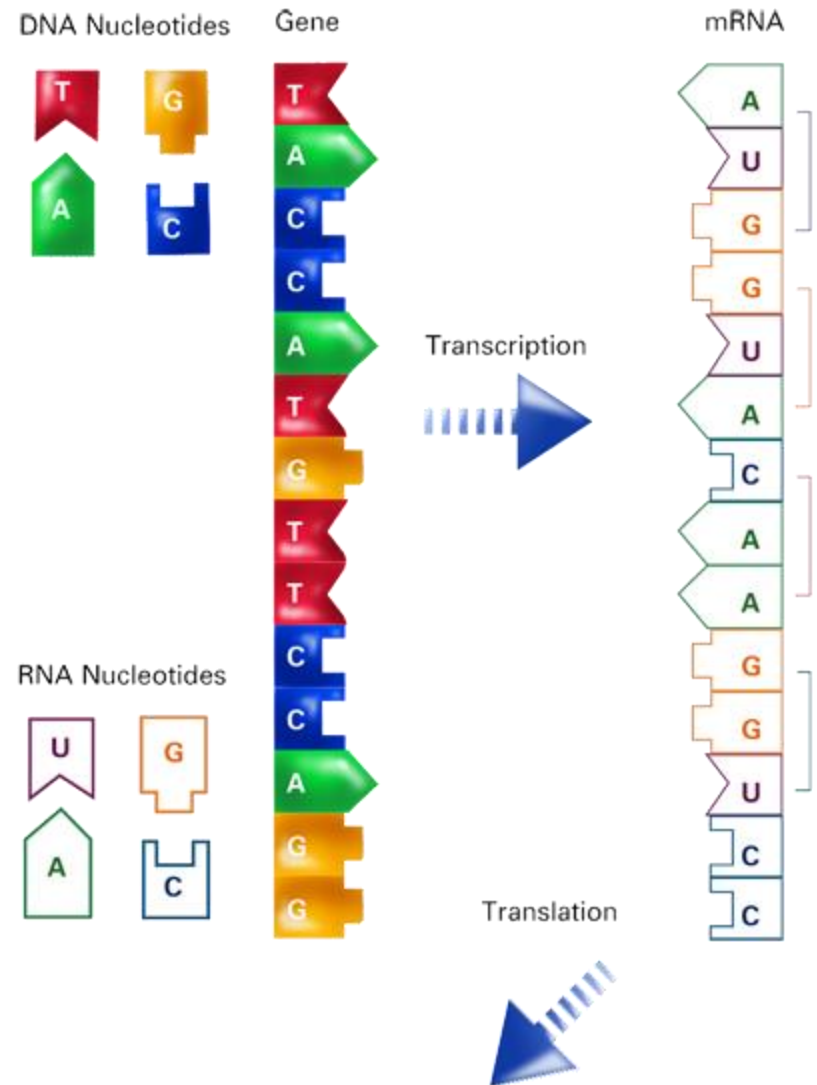


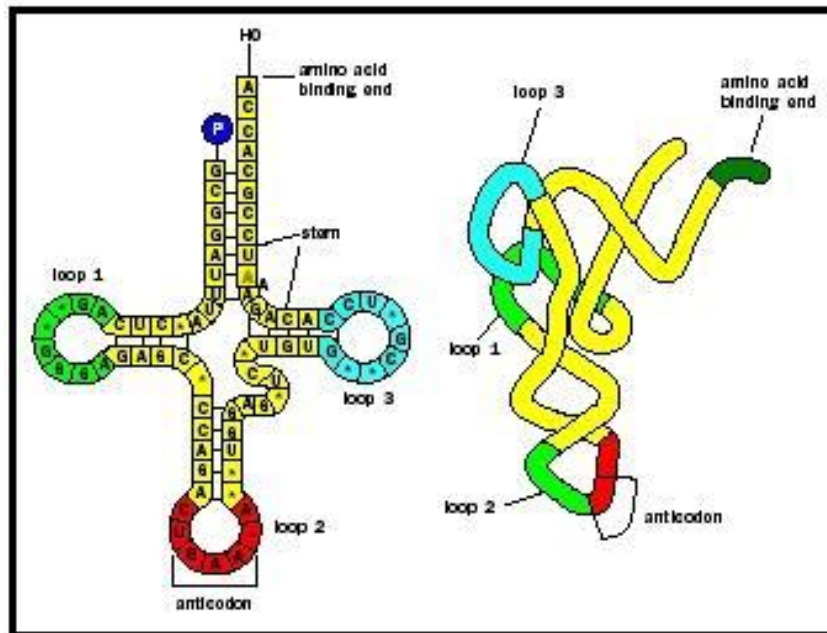
Figure 4-1c Biological Science, 2/e

RNA and Gene Expression

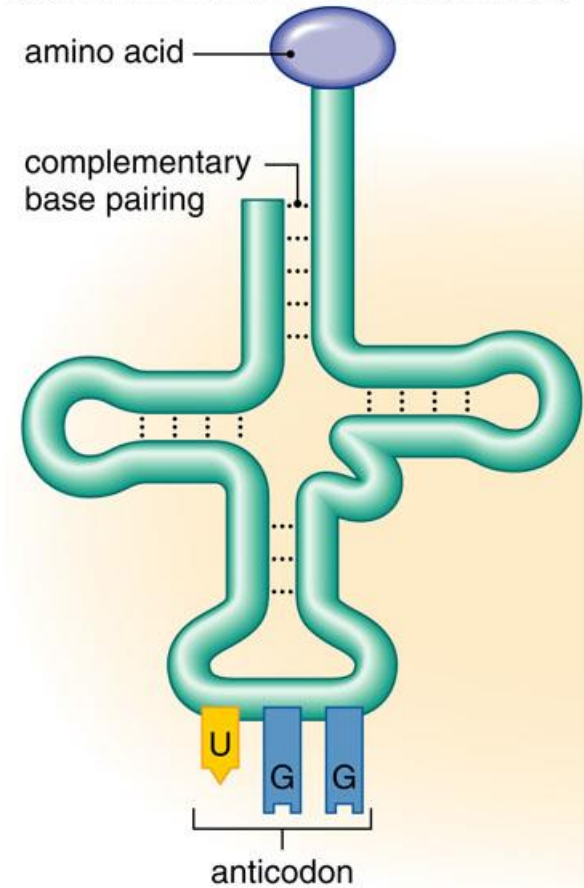
- Function = move genetic information
- mRNA: Messenger RNA = moves genetic information from the nucleus to the ribosome



- tRNA: Transfer RNA = transfers amino acids from the cytoplasm to the growing protein

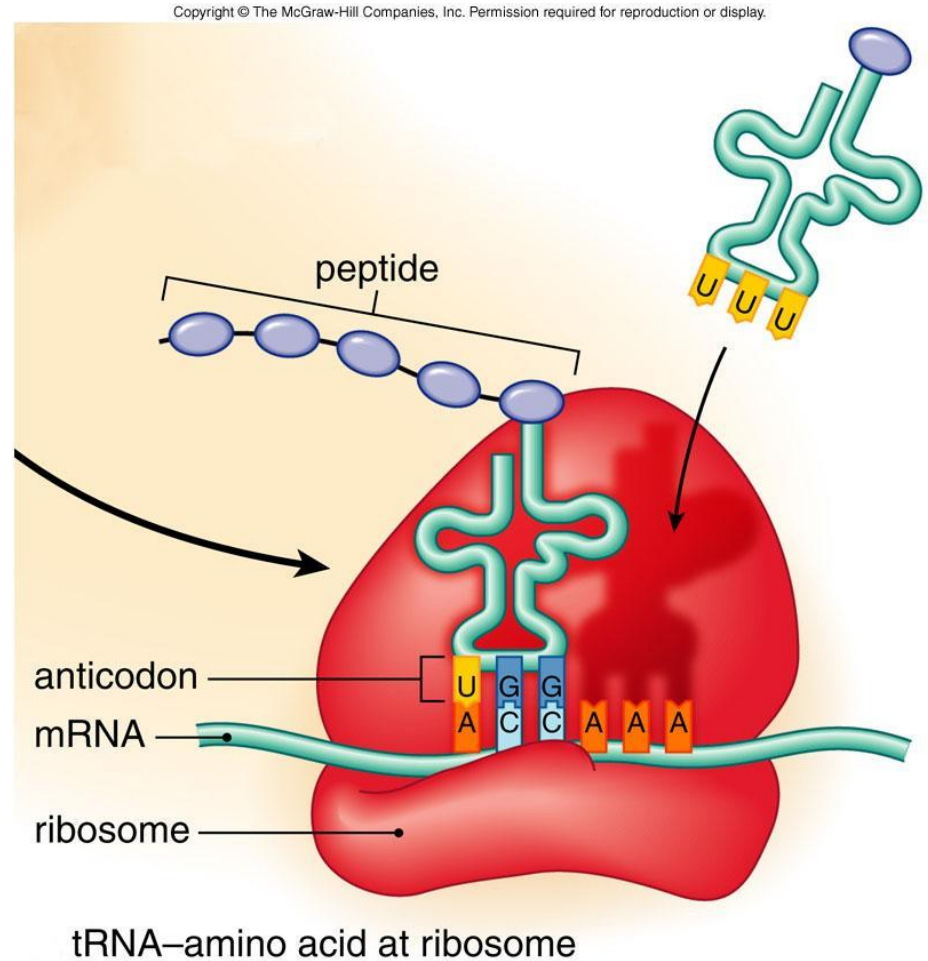
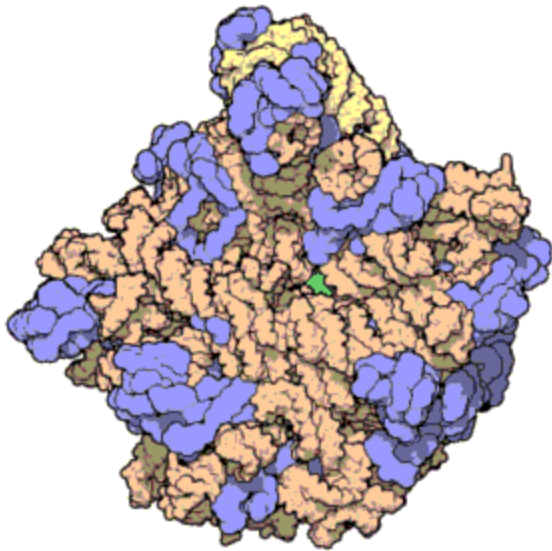


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a. tRNA–amino acid

- rRNA: Ribosomal RNA = makes up part of the ribosome



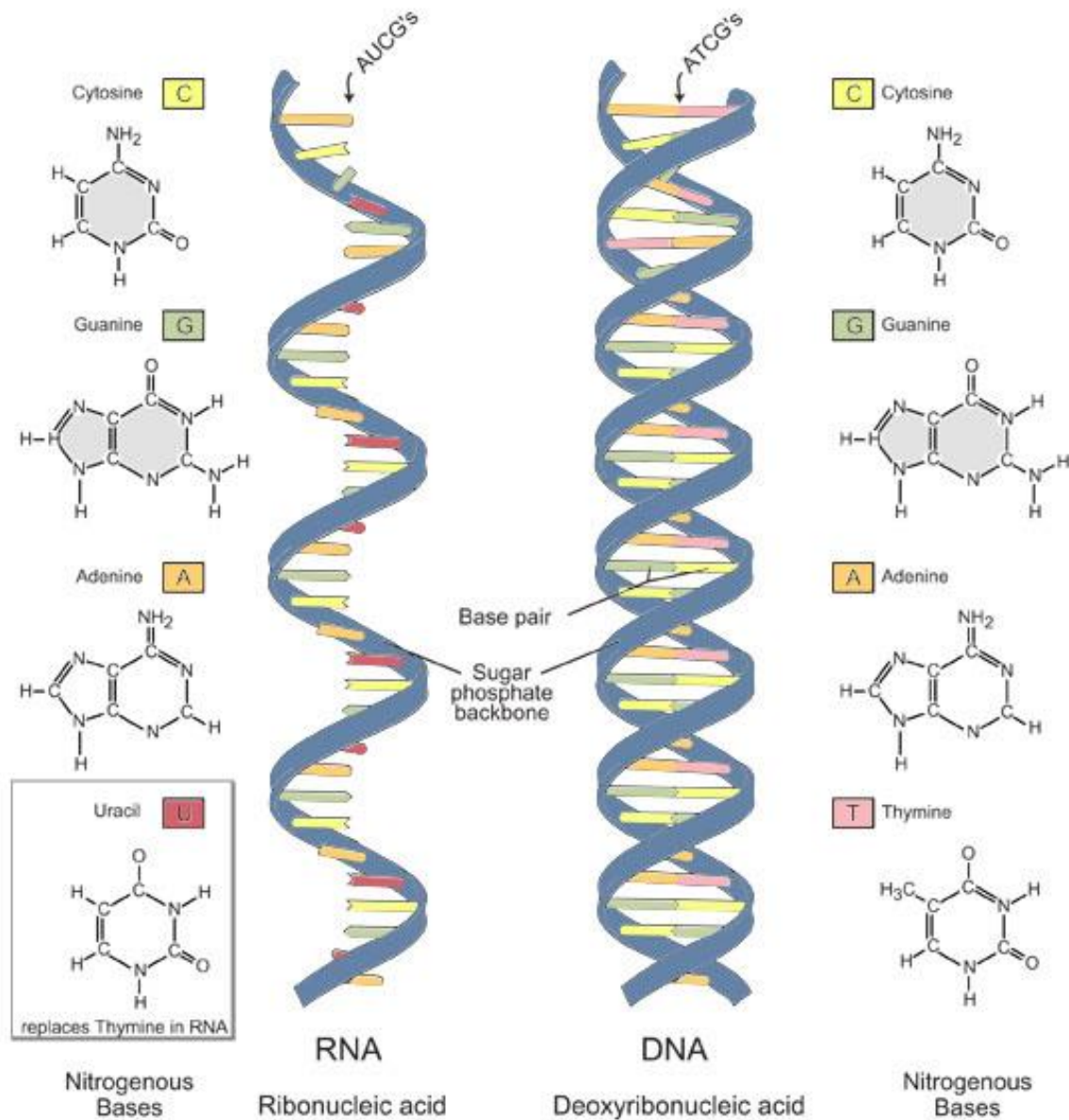


Image adapted from: National Human Genome Research Institute. Talking Glossary of Genetic Terms. Available at: www.genome.gov/Pages/Hyperion/DIR/VIP/Glossary/Illustration/rna.shtml.

Protein Synthesis

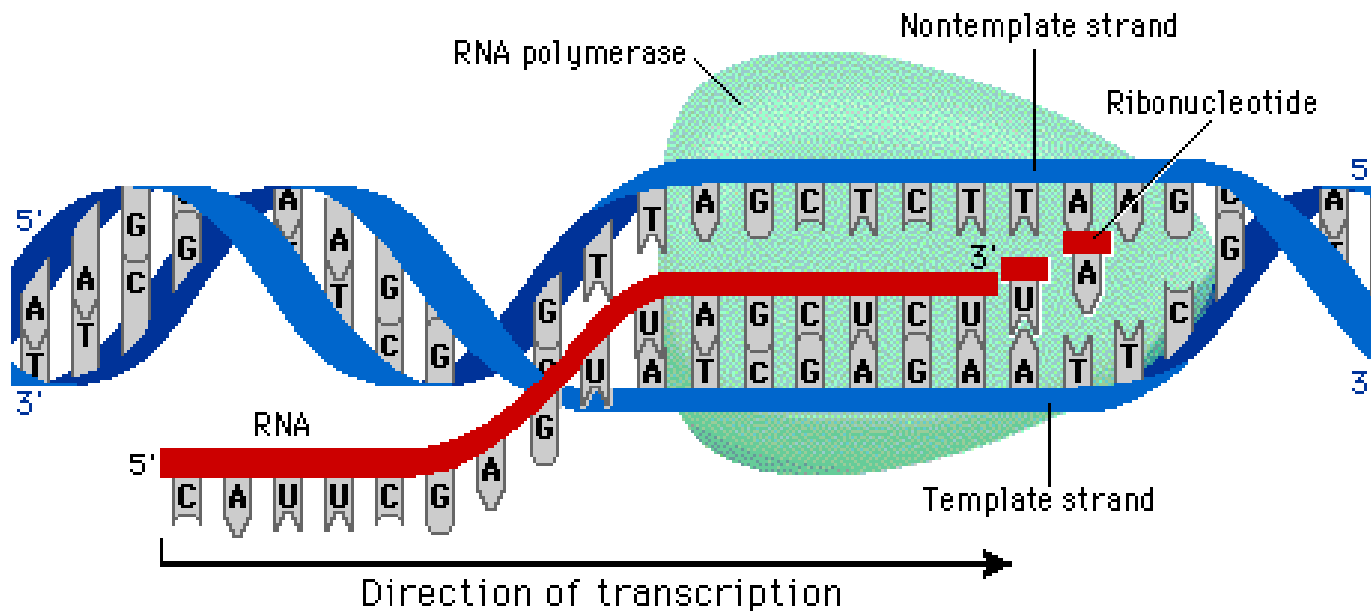
- Transcription = the process of forming an RNA molecule from a DNA molecule in the nucleus
- Translation = the process that takes place in the ribosome and uses mRNA and tRNA to make an amino acid sequence (protein)

Protein Synthesis

- DNA → RNA → Protein

Transcription

- Location: nucleus
- Molecules: DNA, mRNA

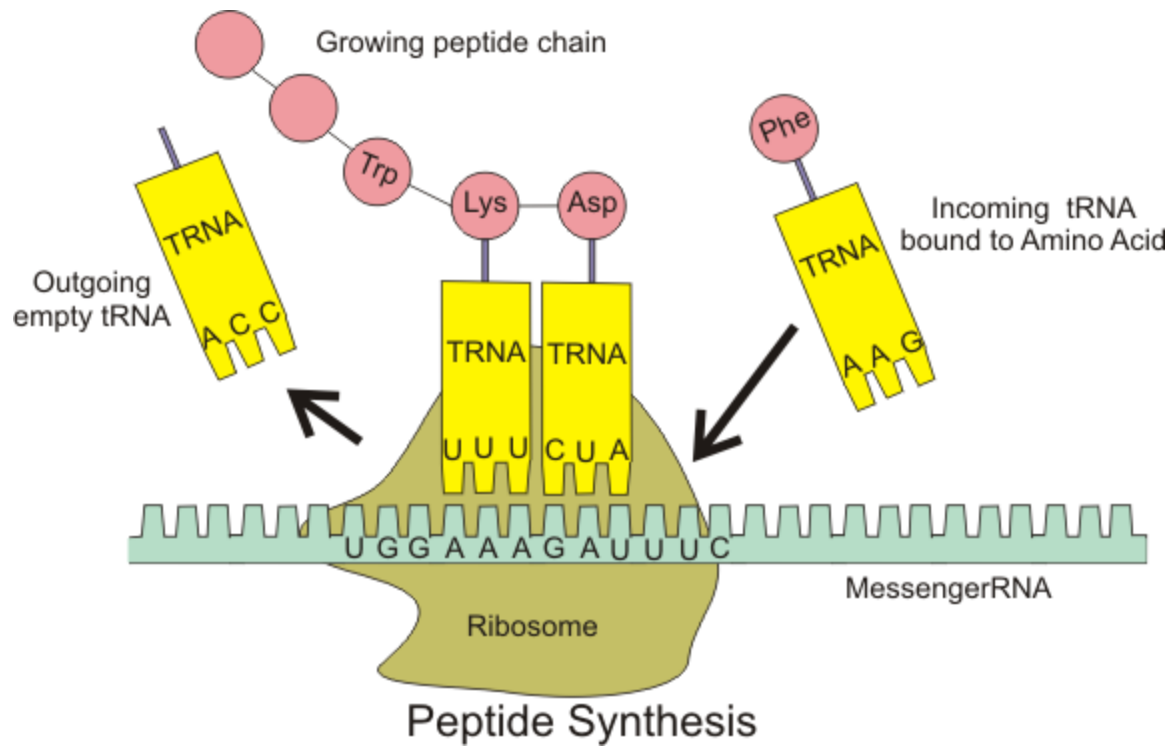


Transcription

1. DNA unzips by breaking the hydrogen bonds
2. One RNA nucleotide at a time gets added to the DNA
3. Continues to build the mRNA until the stop code is reached
4. mRNA leaves the nucleus and DNA binds back together

Translation

- Location: ribosome
- Molecules: mRNA, tRNA with amino acids, rRNA - ribosome



Translation

1. mRNA attaches to the ribosome
2. First tRNA with an amino acid binds to the mRNA **codon** = every 3 bases (or letters) on mRNA
3. Second tRNA attaches its **anticodon** = 3 letters on the tRNA, to the second mRNA codon
4. First amino acid pops off and attaches to the second and the tRNA leaves

Translation

5. Third tRNA attaches to the next mRNA codon and the first 2 amino acids pop off and attach to the third tRNA

6. Process continues until an amino acid chain is built. Protein is formed and mRNA breaks down.