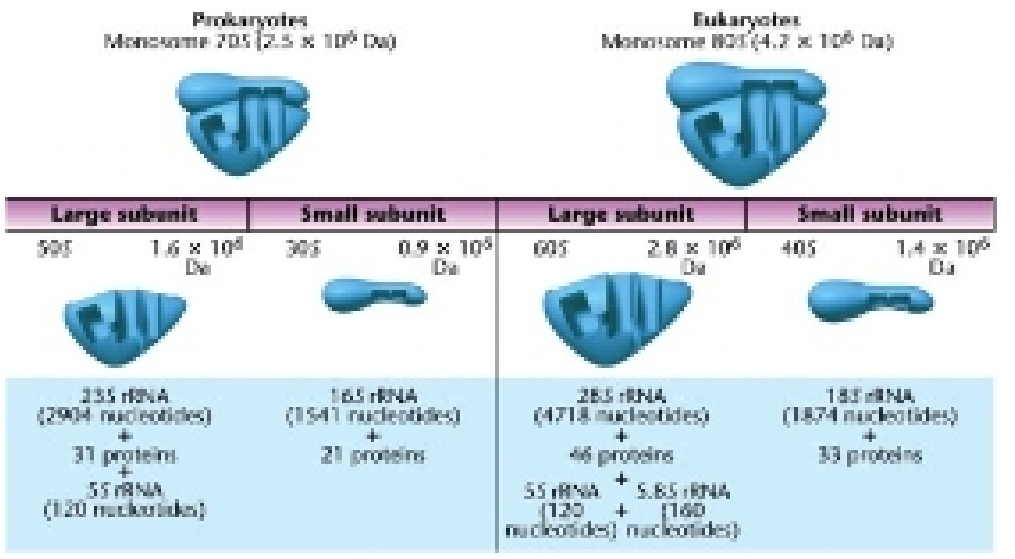
Translation and Proteins

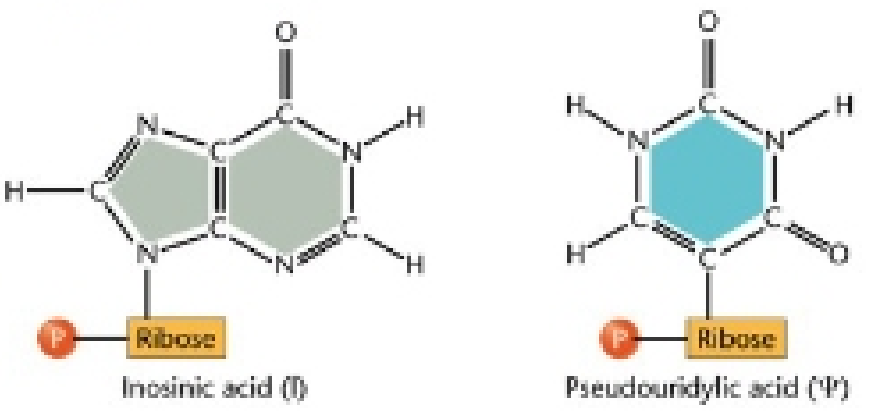
- Translation (Protein synthesis)
    - In the late 1950s Paul Zamecnik and Mahlon Hoagland noticed that the RNA in particular cytoplasmic fraction became labeled with 14C-amino acids and that the labeled RNA was subsequently able to transfer the amino acids to microsomal protein (rough ER)
    - Conclusion: the RNA later named transfer RNA of tRNA functions as an intermediate carrier of amino acids in protein synthesis
    - Zamecnik and Hoaglandlaater contributed to our understanding of how transfer process works
    - Translation depends on mRNA rRNA and tRNA
        - Each codon (triplet) specifies one amino acid
        - To connect two languages Francis Crick proposed the 'adaptor hypothesis' in 1955 wherein 'transfer RNA' (tRNA) adapts each codon triplet in mRNA to the correct amino acid
        - Anticodon in tRNA pairs with codon of mRNA
        - Site of protein manufacture is the ribosome
            - Ribosome is most intricate of cell structures about 10,000 ribosomes/bacterial cell
            - ribosomes are made of *both* RNA and protein
            - differ between prokaryotes and eukaryotes



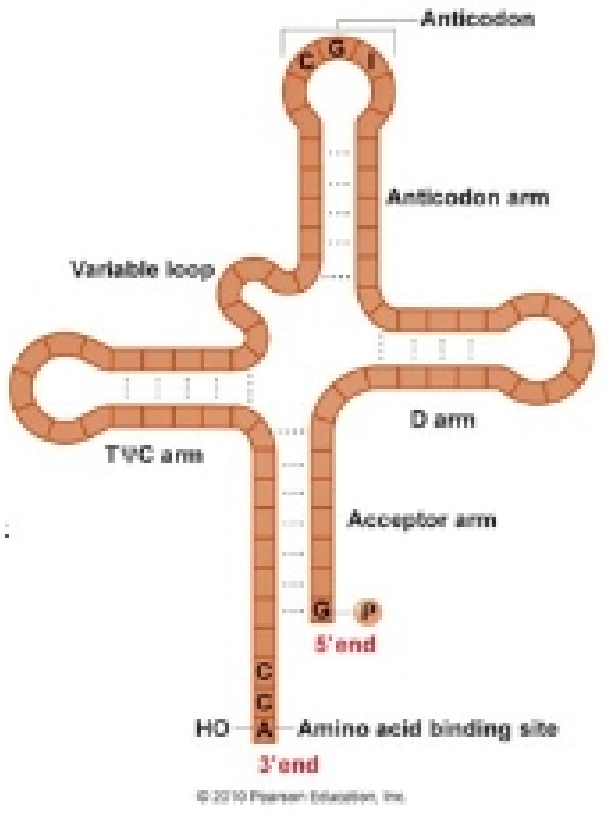
    - Summary of differences between Prokaryotic and Eukaryotic Ribosomes
        - Prokaryotes
            - 50 S subunit
                - 23 S rRNA (2904 n)
                - 31 proteins
                - 5 S rRNA (120 n)
            - 30 S subunit
                - 16S rRNA (1541 n)
                - 21 proteins
            - One transcript produces 23S, 16S, and 5S rRNA 7 copies of gene in E. coli
        - Eukaryotes

- 60 subunit
  - 28 S rRNA (4718 n)
  - 49 proteins
  - 5 S rRNA (120 n)
  - 5.8 s rRNA (160 n)
- 40 S subunit
  - 18 S rRNA (1874 n)
  - 33 proteins
- One transcript produces 28S, 18S and 5.8 s rRNA 120 copies of gene in fly

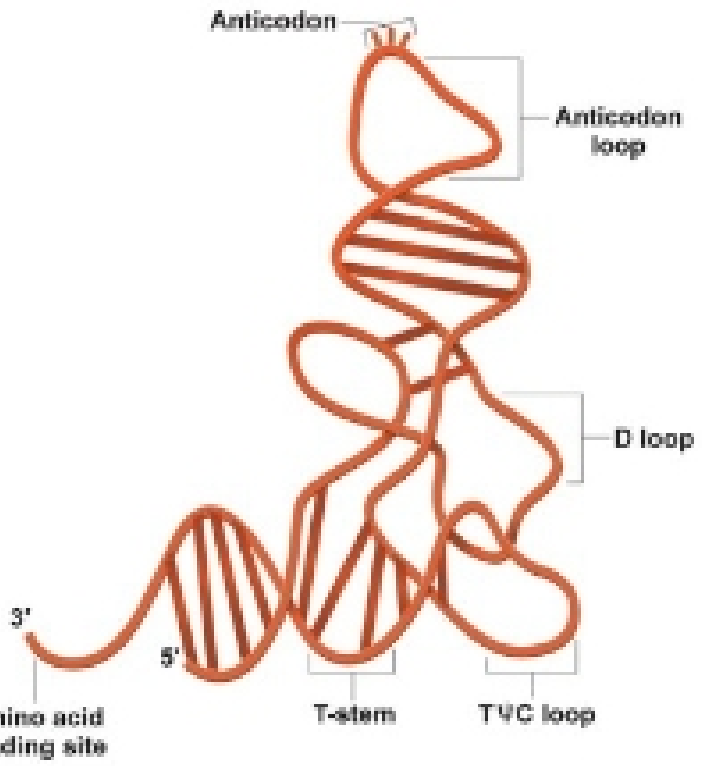
- Transfer RNA (tRNA)
  - Small (about 83 nucleotides) stable RNA molecules
  - Cleaved from larger percurser RNA
  - Contain several modified nucleotides which are modified AFTER transcription (figure below)



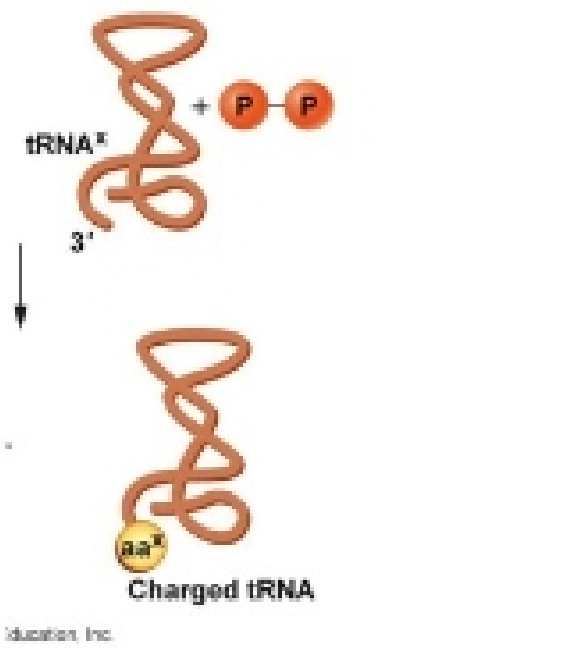
- Cloverleaf model of tRNA



  - Anticodon loop contains anticodon sequence
  - The 3' end (pCpCpA) is where amino acid is covalently bound 5' Gp at end of every tRNA
  - Shape of acceptor stem allows recognition by 'charging enzymes'
- 3-D model of tRNA



- Charging tRNA (loading the gun)



  - Aminoacyl tRNA synthetases 'charge' a tRNA so it is covalently linked to its 'cognate amino acid
  - Could be 61 tRNAs but so far only about 32 know (other codons can be reorganized by same tRNA due to 'wobble' at 3rd position)
  - Only about 20 synthetases needed in a given cell