Reminders:

1. This week's lab group will need to check on their plates next Monday at 2:30 PM. I will bring your notebooks to lab tomorrow. Other group will get yours next week.

2. Biology exam is next Monday. All lectures are posted. Review slides follow this lecture.

3. Next Tuesday morning is free! Chemistry take home exam is due. Second bioinformatics group need to turn in their phylogenetic trees and GenomeScan pdf.

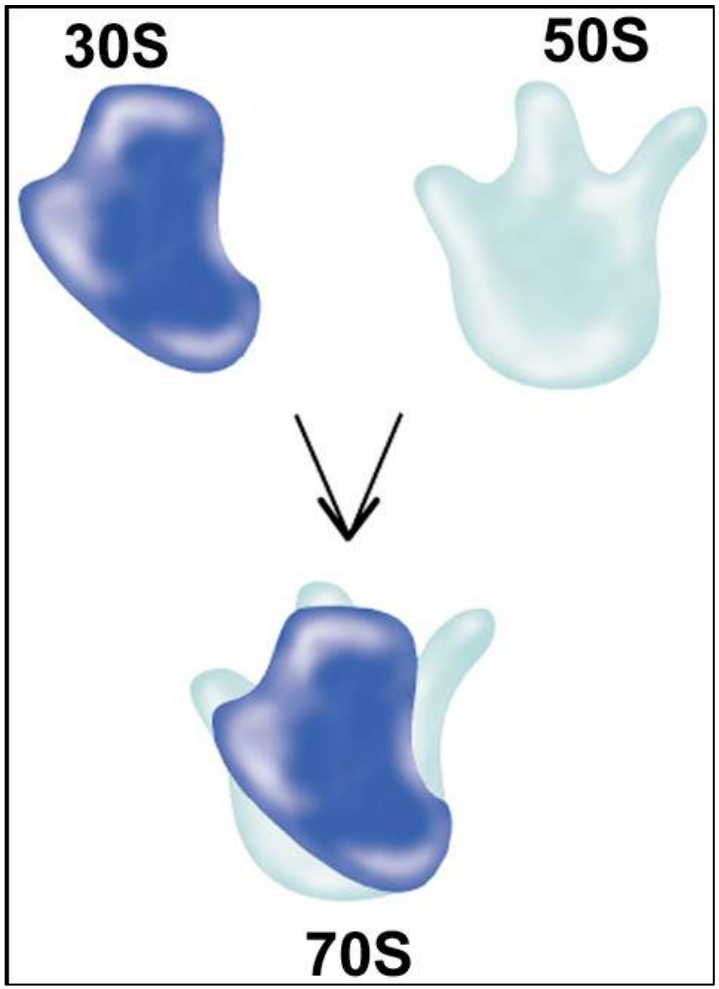
4. Next Wednesday and Thursday are presentations; Thursday is also a potluck. Please bring something to share.

Translation

- How do various RNAs made during transcription participate in protein synthesis?
- How is information encoded in an mRNA deciphered?
- what factors are required for protein synthesis
- mechanism of proteins synthesis
- post-translation modification of proteins

Structure 70S Prokaryotic Ribosome: Site of Protein Synthesis

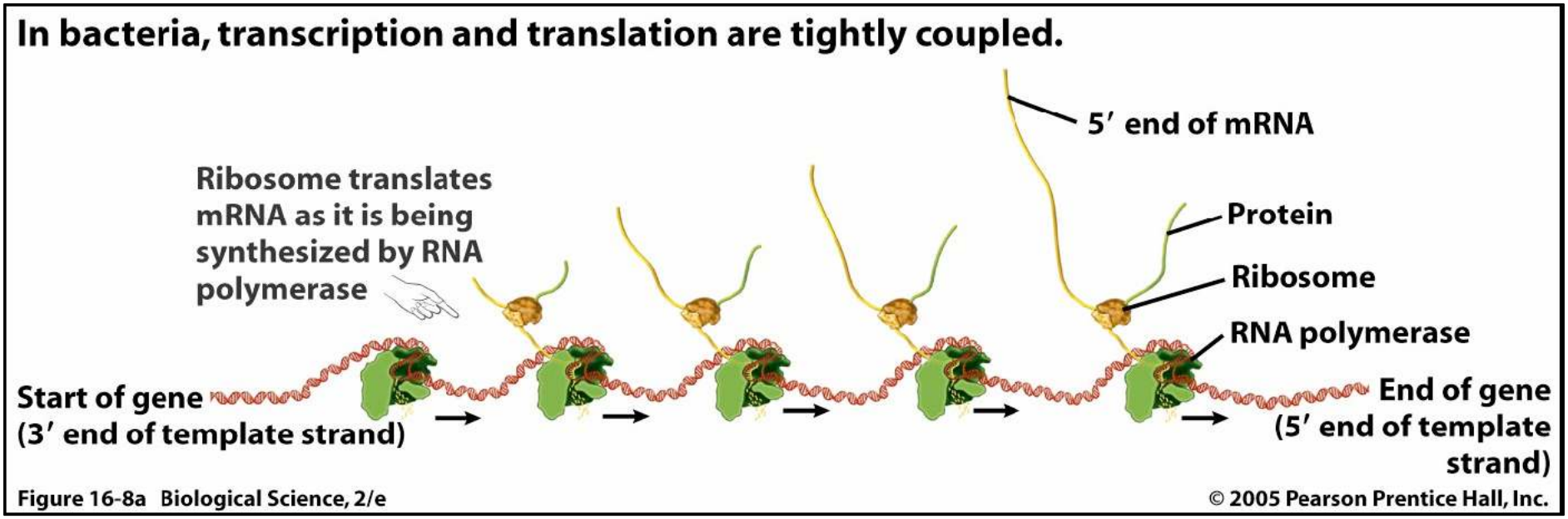
16S rRNA, ~21 different proteins



23S and 5S rRNA ~35 different proteins

The Endosymbiotic Theory

70S ribosomes in mitochondria and chloroplasts



- Gene can be transcribed by more than one RNA pol
- Can begin translation before mRNA has been completely synthesized.
- More than one ribosome can bind to a single mRNA.

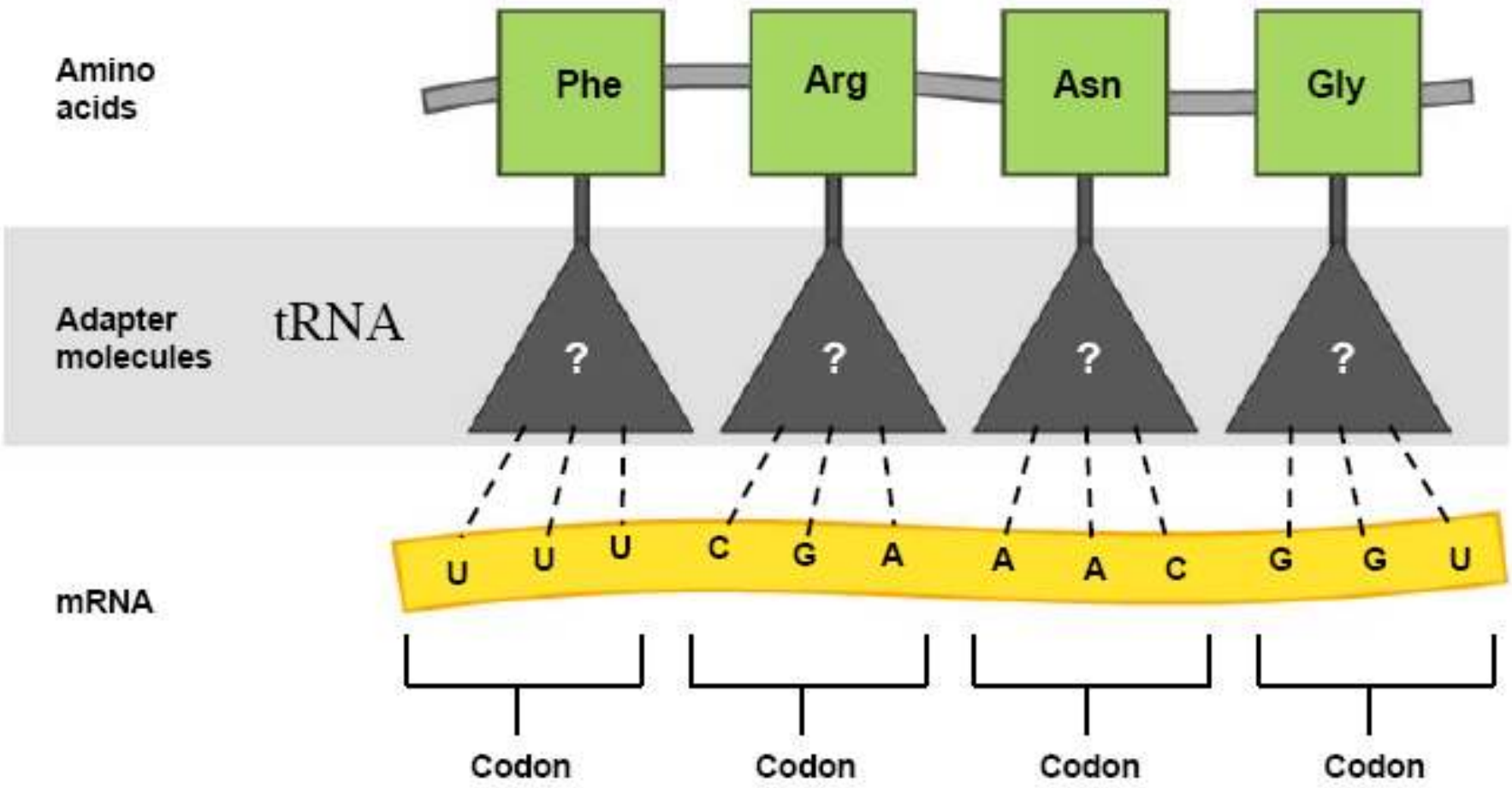
Role of mRNA in Translation

- **Sequence of mRNA will dictate the sequence of amino acids in a protein**

- **Many different species of mRNA that will differ in their sequence; multiple copies of a single species of mRNA can be present**

- **In eukaryotes, mRNAs are monocistronic; prokaryotes mRNAs can be monocistronic or**

Polycistronic:
more than one translation start site per mRNA, so more than one message

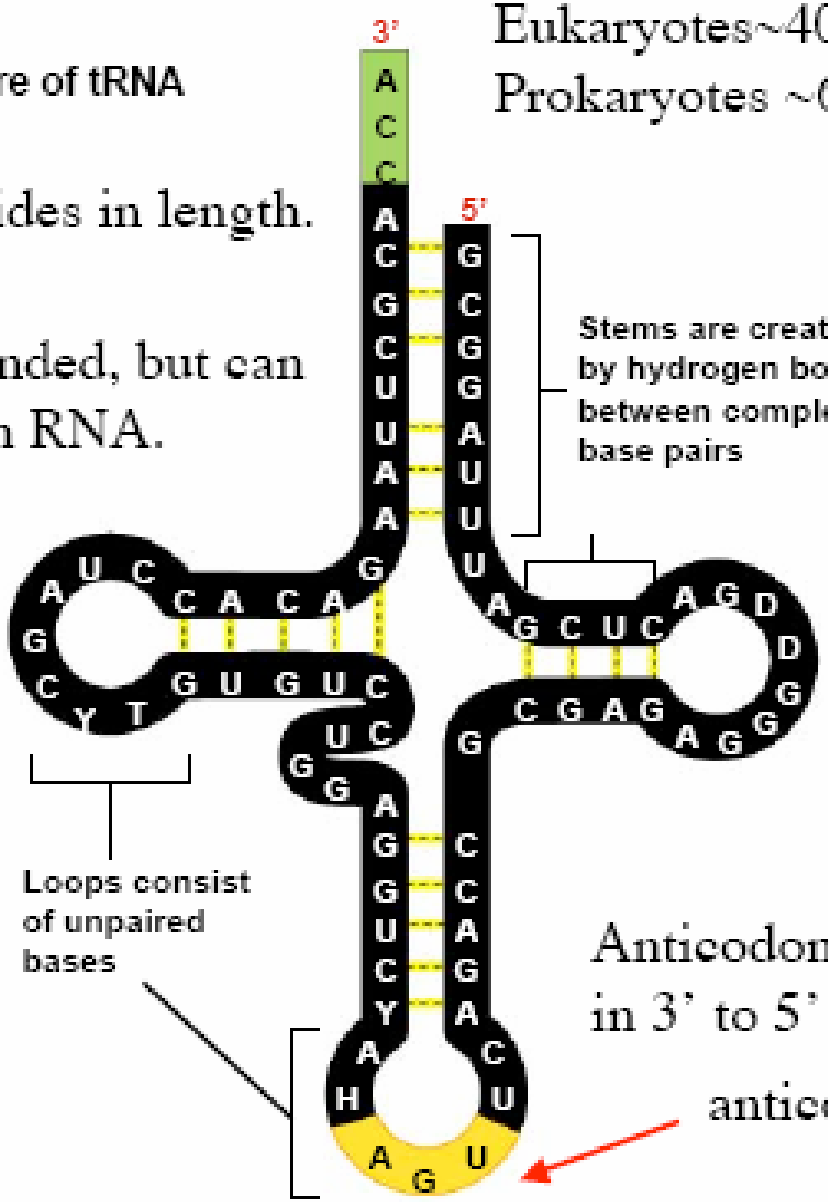

Amino acids
Phe
Arg
Asn
Gly
Adapter molecules
tRNA
?
?
?
?
mRNA
U U U C G A A A C G G U
Codon
Codon
Codon
Codon

Secondary structure of tRNA

Eukaryotes~40 different tRNAs
Prokaryotes ~60 tRNAs

73-93 nucleotides in length.

All single stranded, but can have bp within RNA.



Role of tRNA

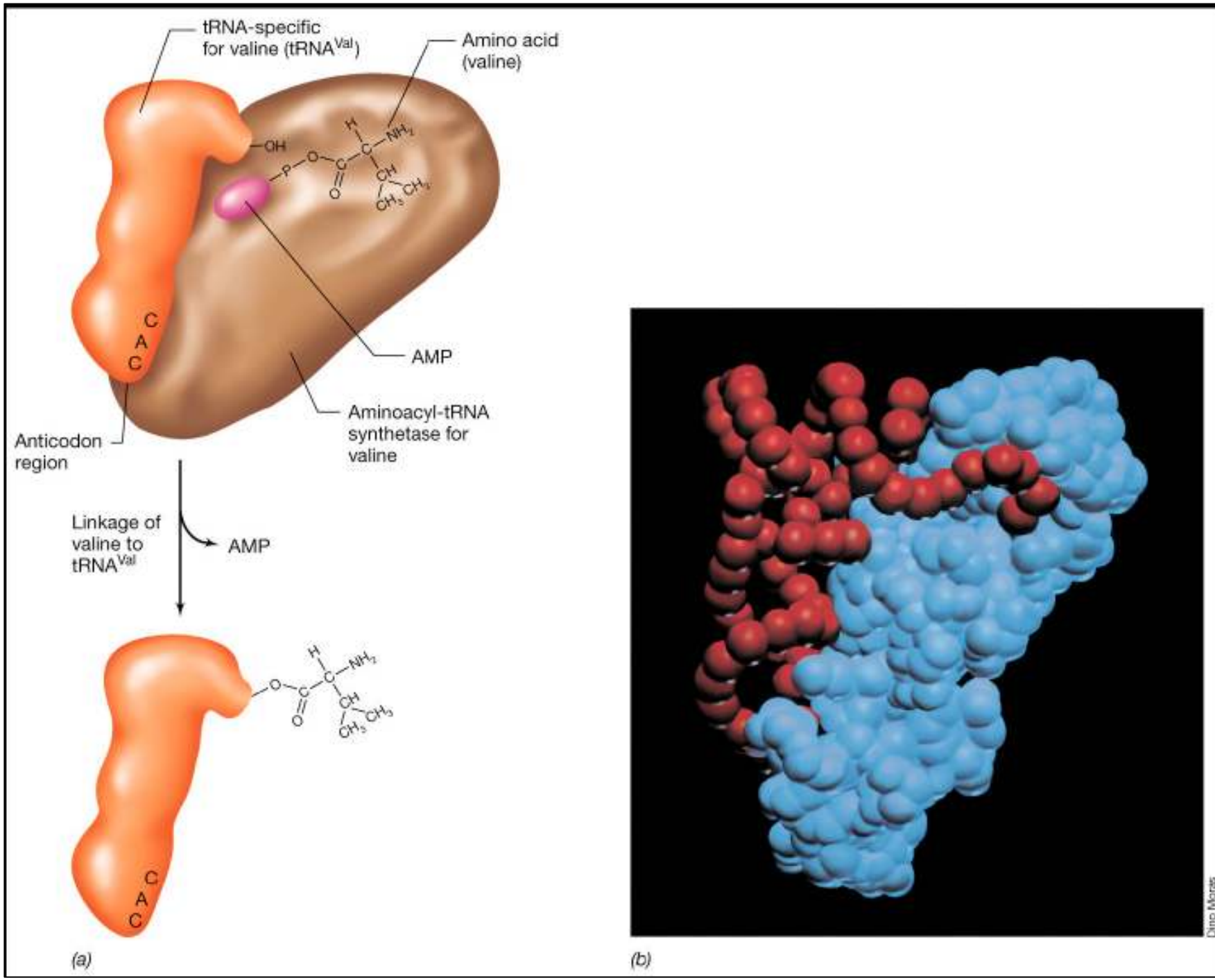
- **Each tRNA will covalently bind to a specific amino acid. Process called charging**

- **charged tRNA's will bring amino acids to site of protein synthesis, ribosome.**

Charging of a tRNA

(1) Activation of amino acid:
ATP + amino acid ---> aminoacyl(aa)-AMP + P-P ---> 2Pi
two high-energy phosphate bonds are required for activation.

(2) Linking activated amino acid to a tRNA:
aa-AMP + tRNA -------> aa-tRNA + AMP
Aminoacyl synthetases

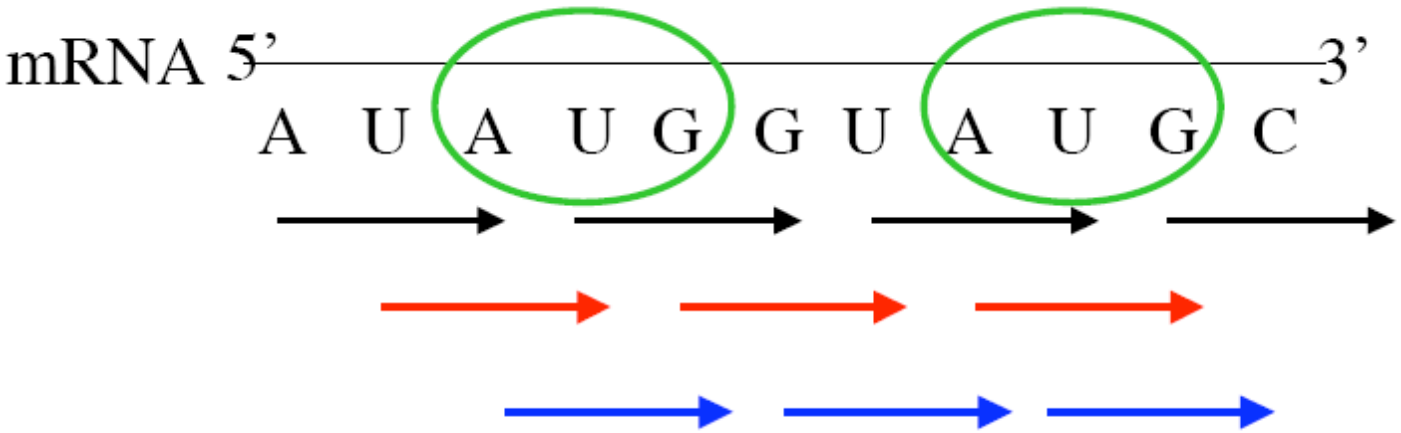

tRNA-specific for valine (tRNA^{Val})
Amino acid (valine)
OH
H
NH$_2$
P
O
C
CH
CH$_3$
CH$_3$
C
A
C
AMP
Aminoacyl-tRNA synthetase for valine
Anticodon region
Linkage of valine to tRNA^{Val}
AMP
(a)
(b)
Dino Moras

Where does translation start?

How Determine Correct Reading Frame?

***Eukarya/Archaea*- Methionine**

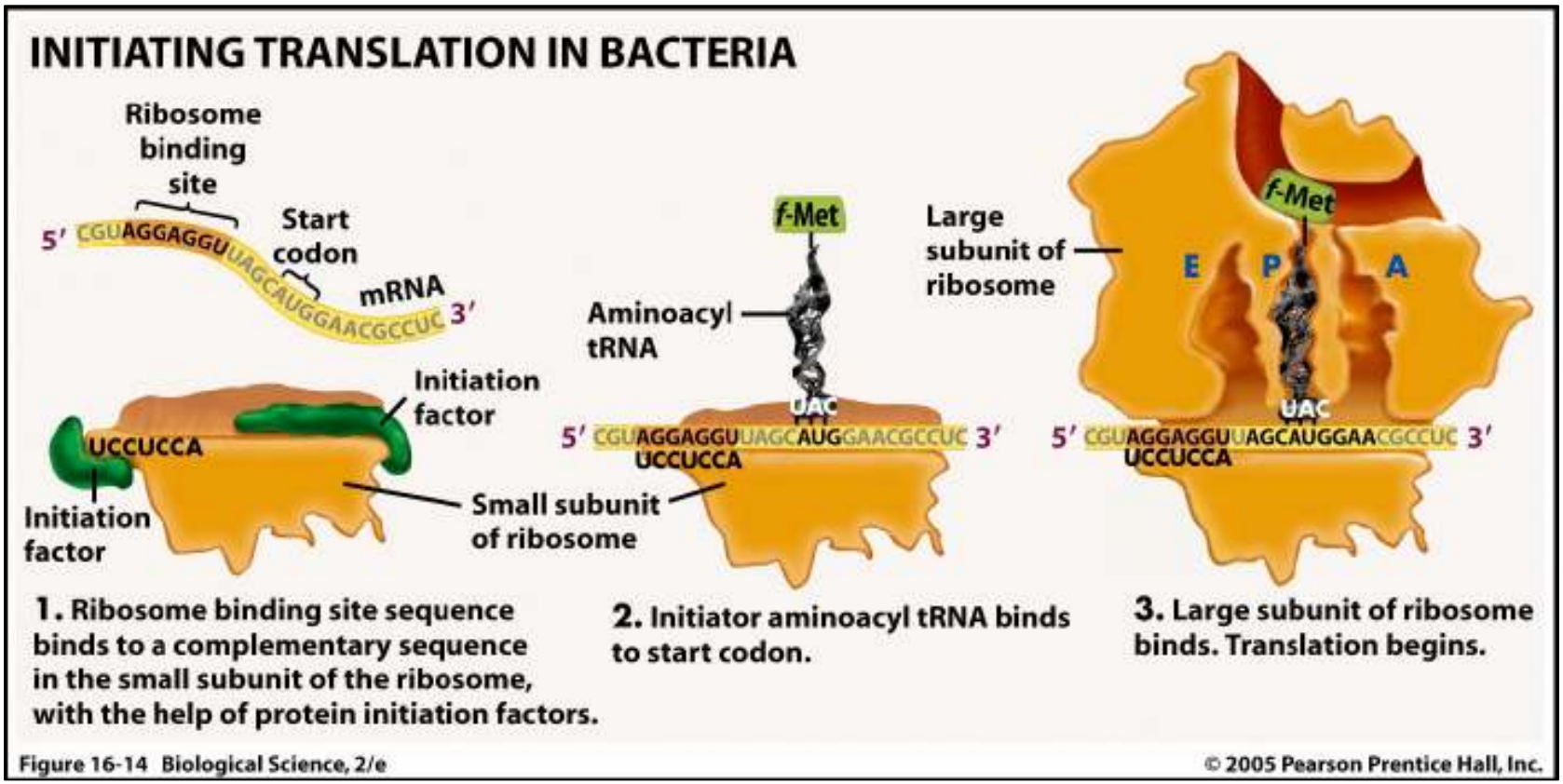
***Bacteria*- N-formylmethionine**



Which AUG?

INITIATION

Peptidyl site
Acyl site
Exit site



ELONGATION

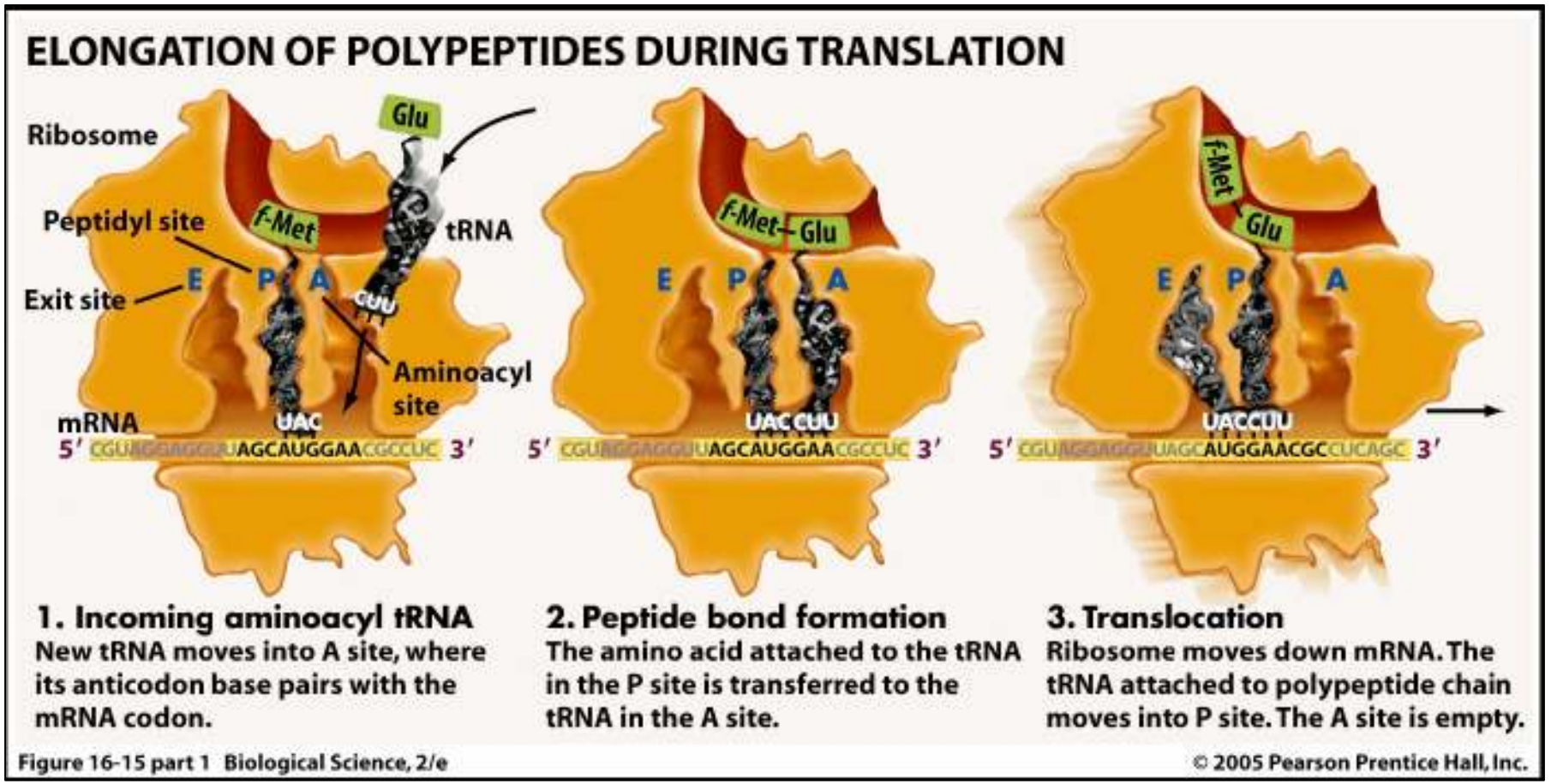


Figure 16-15 part 1 Biological Science, 2/e

ELONGATION

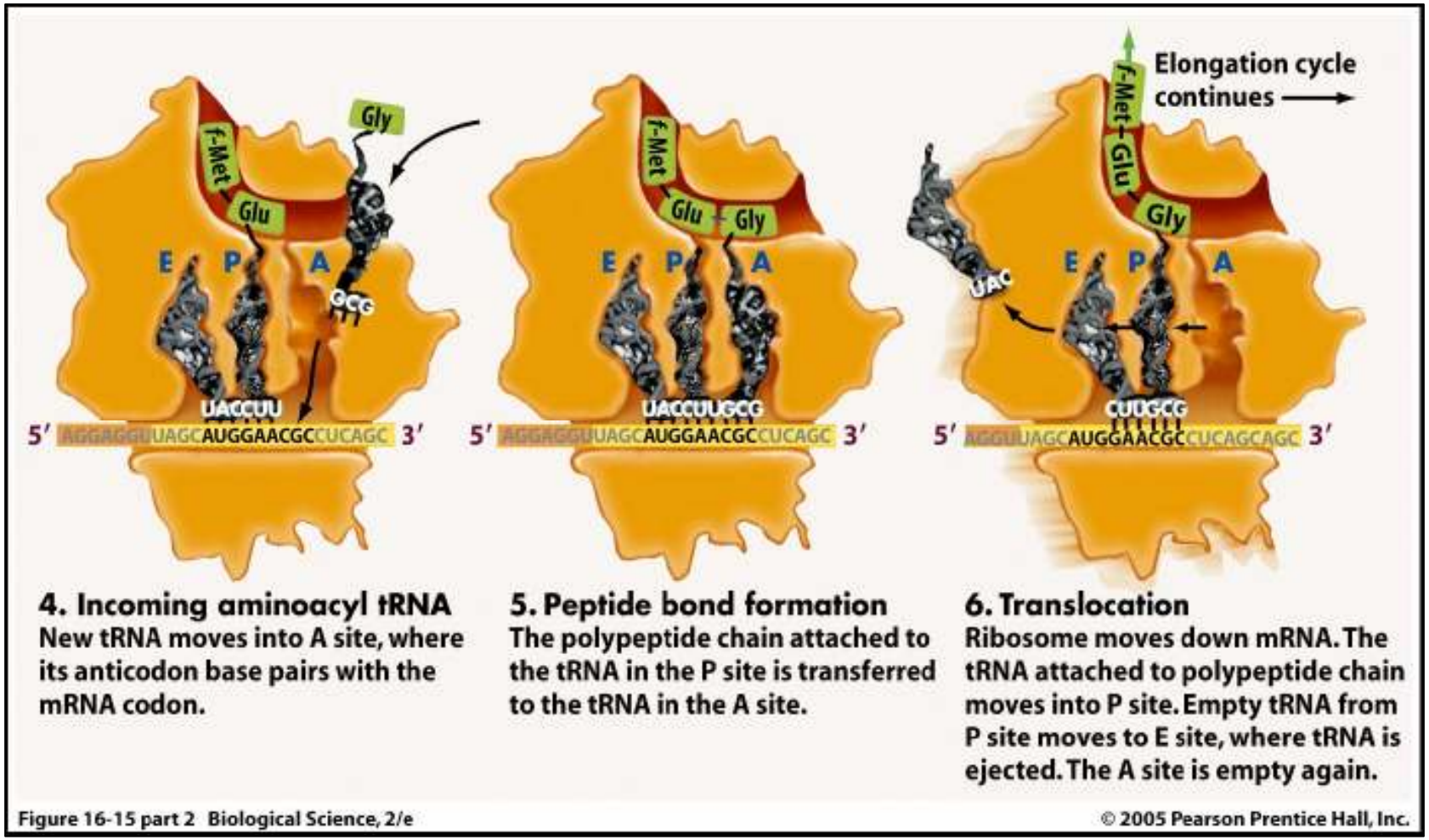


Figure 16-15 part 2 Biological Science, 2/e

Termination of Translation

- **Translation terminates when ribosome reaches a stop codon.**

- **Release factor reads stop codon (UAA, UAG, UGA), enters empty A-site, and cleaves polypeptide from terminal tRNA.**

TERMINATION

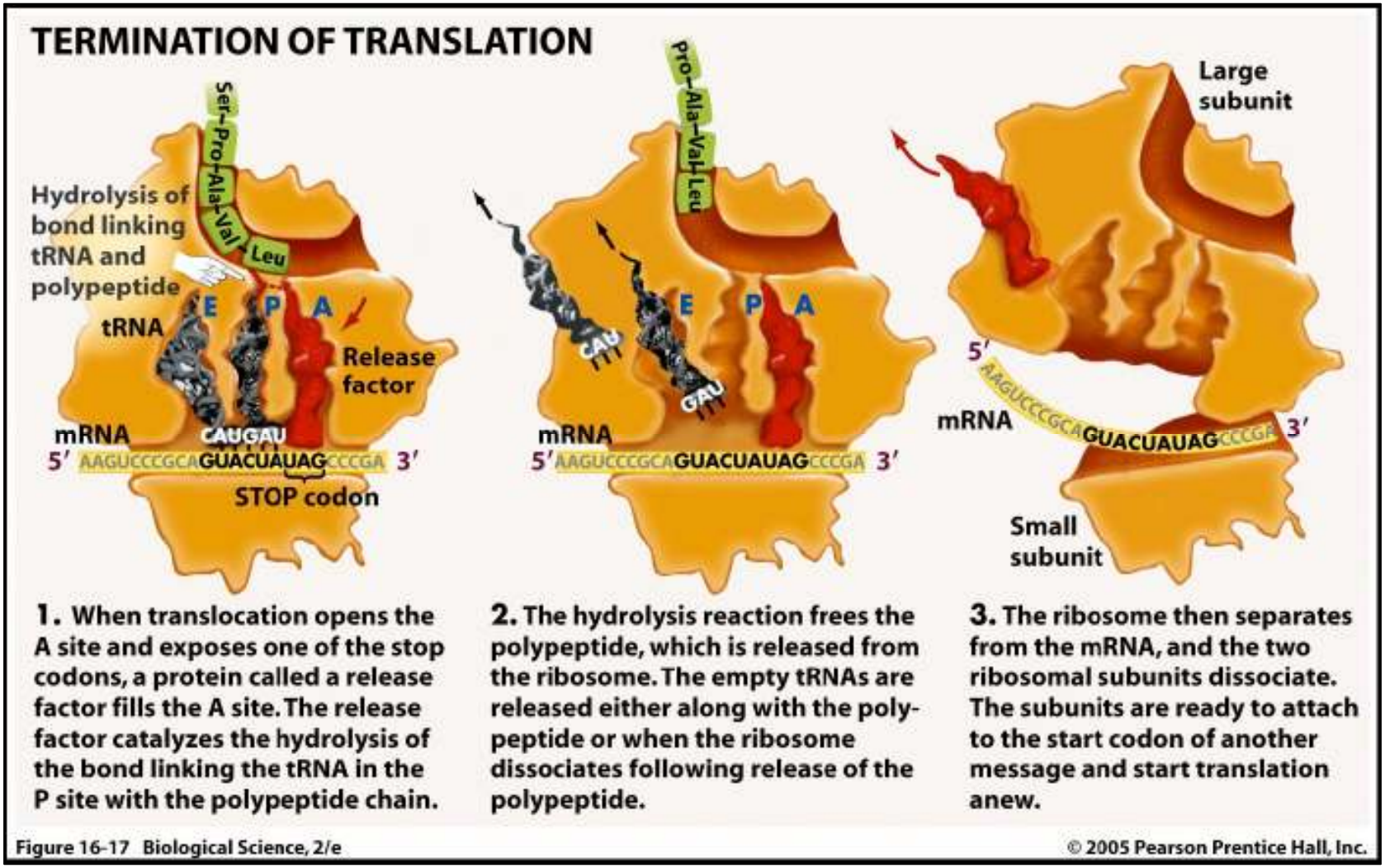


Figure 16-17 Biological Science, 2/e

What happens after translation?

- Role of Chaperones in protein folding

- Covalently modify protein (sugars and lipids added; some are phosphorylated)

- Proteins are localized and/or secreted

Translation

Sketch out the steps of:

Initiation

Elongation

Termination

List factors involved.

What are the differences between prokaryotes and eukaryotes?

Final Exam Material

Lipids – structure & function; membrane permeability and membrane composition; diffusion and osmosis

Membrane proteins – structure & function; channels, transporters, and pumps; electrochemical gradients

Metabolism – ATP: anabolic & catabolic reactions; structure and function of ATP; energy associated with hydrolysis of ATP; **Overview:** energy fixation and flow from photosynthesis to respiration; **Glycolysis:** purpose & overview; number of steps and regulation; molecules in and out; location; substrate level phosphorylation; **Linking step:** purpose & overview; number of steps and regulation; molecules in and out; location; **KREB cycle:** purpose & overview; number of steps and regulation; molecules in and out; location; **Electron transport chain:** purpose & overview; redox reactions, electronegativity & energy flow; flow of electrons and protons through complexes; proton motive force & oxidative phosphorylation; regulation; molecules in and out; location; **Fermentation:** purpose; electron donors and acceptors; examples.

Central Dogma – Nucleic acids: structure & function of nucleotides and nucleic acids; basic features of bases (eg. workshop problem); polymerization; structure & function of DNA and RNA; **Genetic code:** purpose; deciphering it for translation; know AUG and all three stop codons.

Final Exam Material

Central Dogma – continued

One gene, one enzyme – metabolic pathways: conceptual understanding of genetic screen for loss-of-function mutants and related data analysis

Transcription: location; process of initiation (promoter structures, proteins involved, steps), elongation (direction RNA is synthesized and DNA is read, steps, complementary base pairing, energy from ribonucleotide triphosphates, what is transcribed), and termination (hairpin loop structures) in prokaryotes (coupled with translation) and eukaryotes (requires processing); types of RNA and associated RNA polymerases.

RNA processing: location; intron splicing and snRNPs function; addition of 5'cap and poly A tail (all required for transport to the cytoplasm)

Translation: process of initiation (aminoacyl synthetases, charging of tRNAs, binding of mRNA by small subunit etc…); elongation (steps in E, P, and A sites, ribosome movement, peptide bond formation), and termination (release factor and steps); know the differences of translation in prokaryotes and eukaryotes (initiation, coupled transcription and translation)