BIO 311C
Spring 2010

For the Final Exam, you will not be responsible for the Chapter 12 textbook reading assignment (May 3 reading assignment).

You will responsible for all other assignments listed in the course schedule.

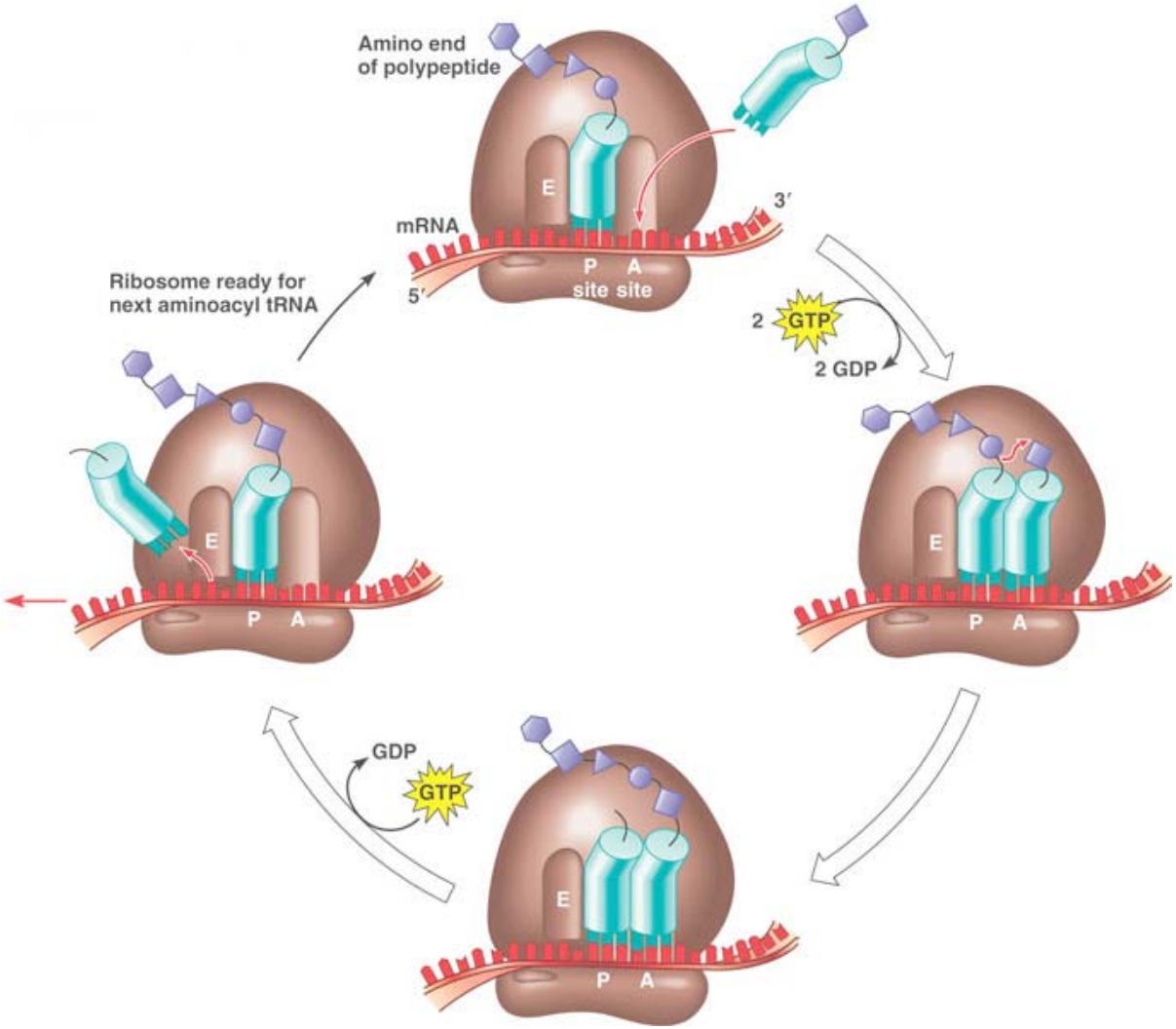
Approximately 45% of the questions on the final exam will relate to material covered since the 3rd exam. The remaining questions will be over material covered in previous exams.

Some of the questions over material covered since the third exam will ask more detailed information than questions over material covered earlier in the semester.

The Final Exam will be approximately 50% longer than the previous exams. It will be similar in format to previous BIO 311c-Brand exams this year, and similar in length to BIO 311c-Brand Final exams from previous years.

Lecture 37 – Friday 30 April

The steps in translation that require external energy are:
- forcing a charged tRNA into the correct site on the ribosome (requires 2 high-energy bonds)
- moving the ribosome one codon length along the mRNA (requires one high-energy bond)



*

Five "high-energy" (acid anhydride) bonds must be broken for every amino acid that is activated and incorporated into a polypeptide chain. Thus, 500 high-energy bonds must be expended just to synthesize a single polypeptide chain that contains 100 amino acids.

Question: How many glucose molecules would have to be oxidized during respiration to provide enough high-energy bonds to synthesize one of these protein molecules during translation?

*

Many kinds of polypeptide chains do not spontaneously become functional proteins after they are synthesized.

Three kind of events that may be required for a recently-synthesized polypeptide chain to become a functional protein are:

a. Post-translational processing

b. Translocation into or through a membrane

c. Assembly into a multimolecular complex or into an intracellular structure

Examples of post-translational processing:

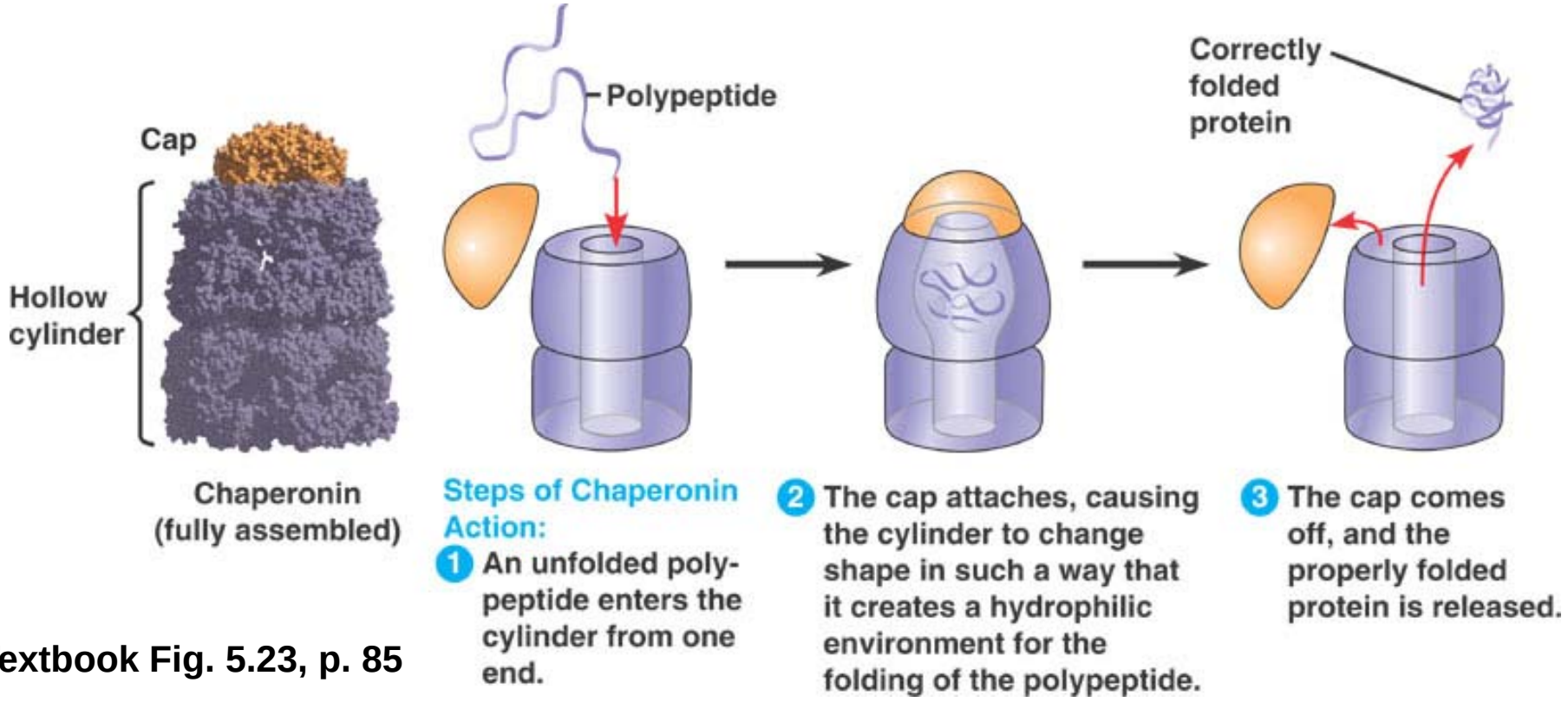
a. Controlled folding, guided by chaperon proteins and chaperonins

b. Removal (hydrolysis) of one or more segments of the polypeptide chain

c. Attachment of a prosthetic group

*

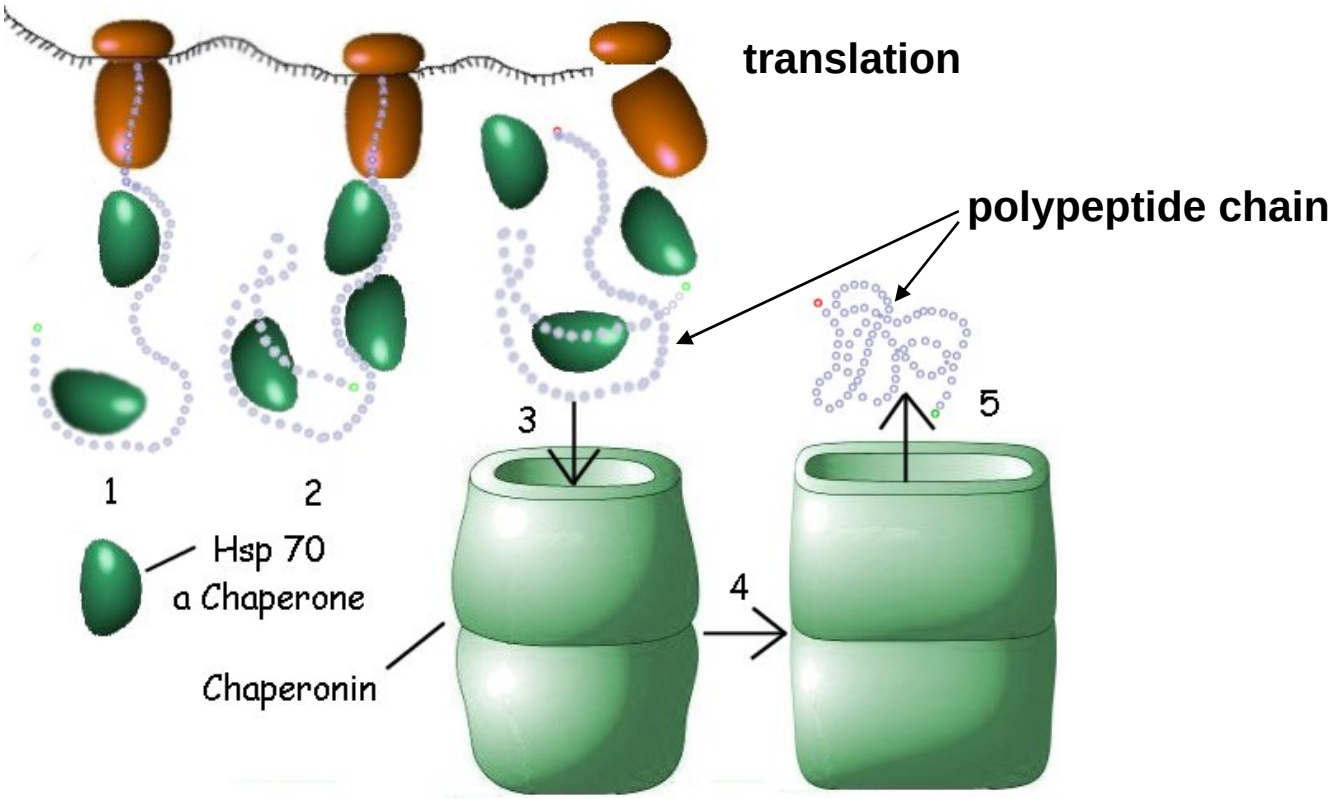
Chaperonins are large protein complexes that facilitate the correct folding of polypeptide chains.



Textbook Fig. 5.23, p. 85

Chaperonins occur in both prokaryotic and eukaryotic cells. *

Chaperone proteins are designed to bind to recently synthesized polypeptide chains in order to aid their folding, or else to direct them to a chaperonin.



altered shape of chaperonin aids protein folding

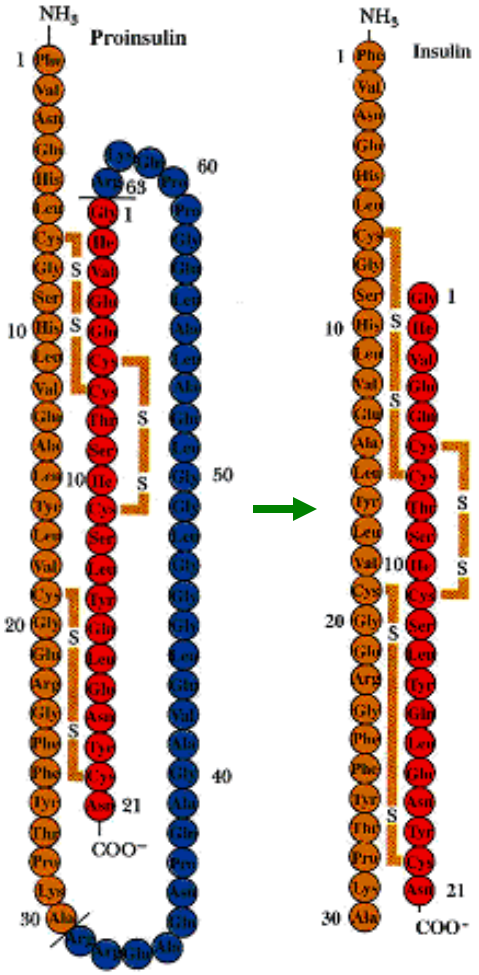
Note: some proteins spontaneously fold into a functional conformation without the requirement for any chaperons or chaperonin

Heat-shock proteins (Hsp) are a class of chaperone proteins. They are produced in cells at high concentrations as a response to stress conditions such as an excessively high temperature that might denature a broad range of proteins. They stabilize proteins against denaturation, and they help proteins that have become denatured to re-fold properly.

*

Insulin is a protein that must be trimmed in size before it can fold and function properly.

Pro-insulin, is synthesized during translation as a single polypeptide chain that contains 84 amino acids.

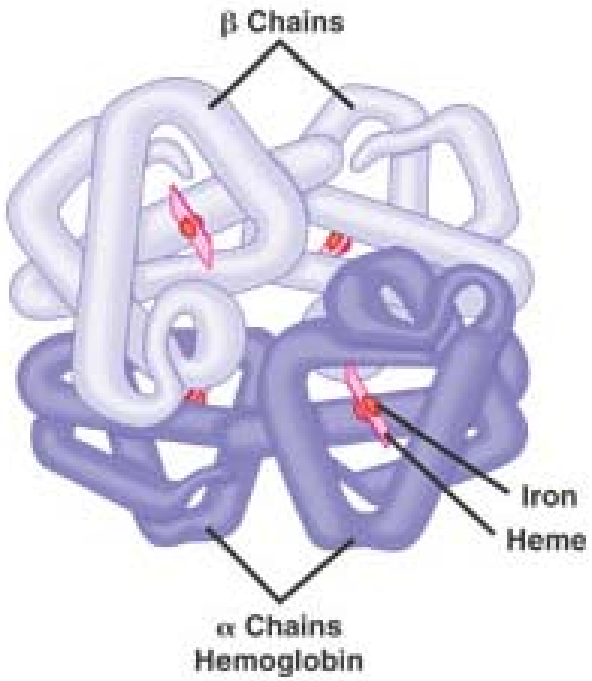


A 33-amino-acid segment in the middle of the polypeptide chain is removed by an enzyme, converting pro-insulin to a functional insulin protein that contains two polypeptide chains of 30 and 21 amino acids, respectively.

*

The disulfide bonds are important for for stabilizing the insulin molecule when the internal polypeptide segment is removed from pro-insulin.

Hemoglobin is an example of a protein that requires
- the covalent attachment of a heme prosthetic group, and
- the assembling of two different kinds of polypeptide chains.



A functional hemoglobin molecule contains two "alpha" polypeptide chains and two "beta" polypeptide chains.

The heme of hemoglobin is a small organic molecule containing an iron ion. A specific enzyme is required to covalently attach a heme to each polypeptide chain.

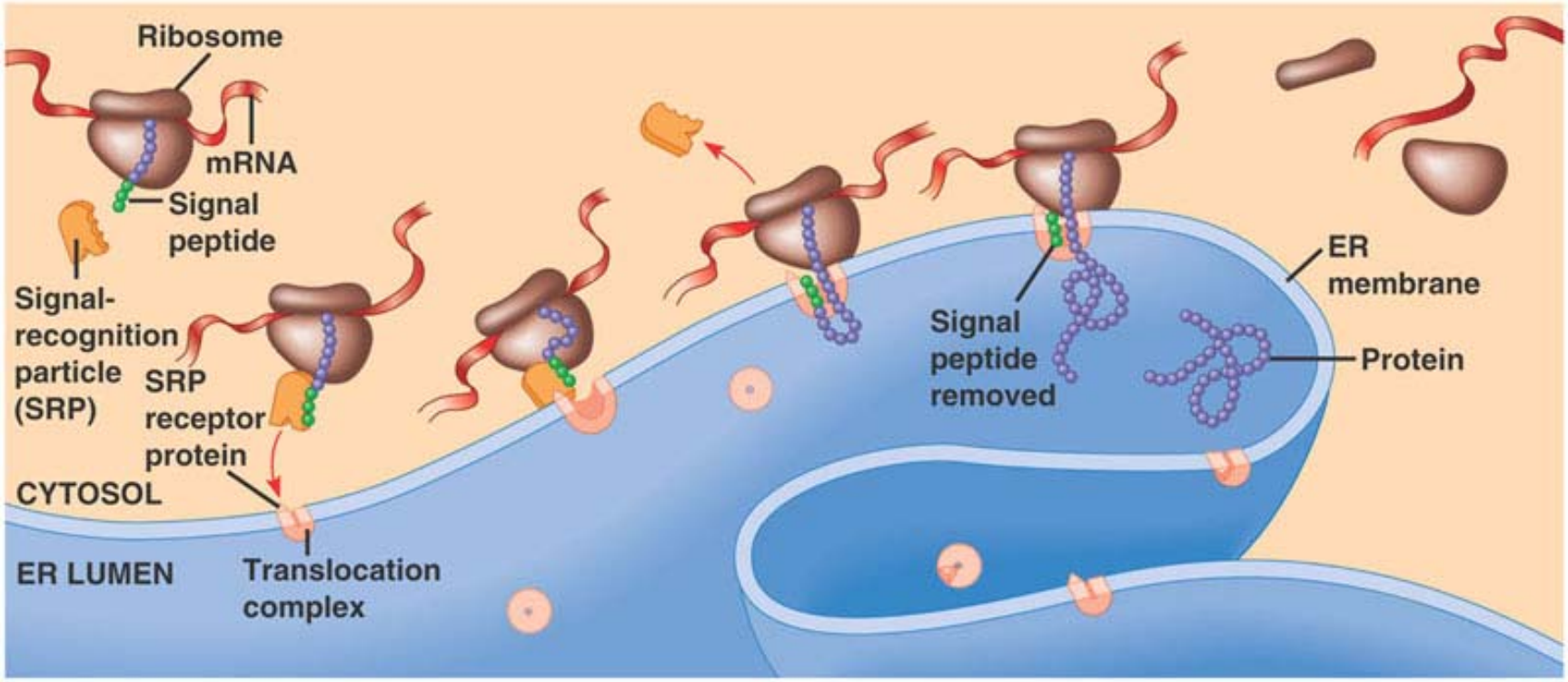
The 4 polypeptide chains of hemoglobin assemble spontaneously into a functional protein, but some other oligomeric proteins require special assembly machinery in order to assemble into a functional unit.

*

An example of translocation of a protein into or through a membrane

Targeting Proteins to the Endoplasmic Reticulum

Textbook Fig. 17.21, p. 343



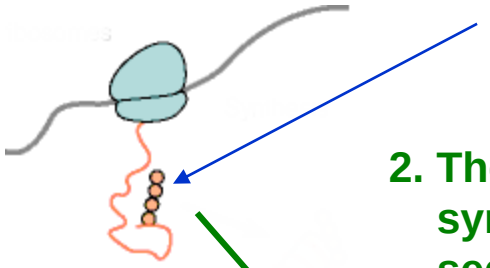
<u>Targeting</u> within a cell refers to the ability of the cell to guide or direct a component of the cell such as a protein molecule to a specific site.

Polypeptide chains with an amino-terminal signal peptide are targeted to the endoplasmic reticulum. The protein is then translocated through the membrane.

*

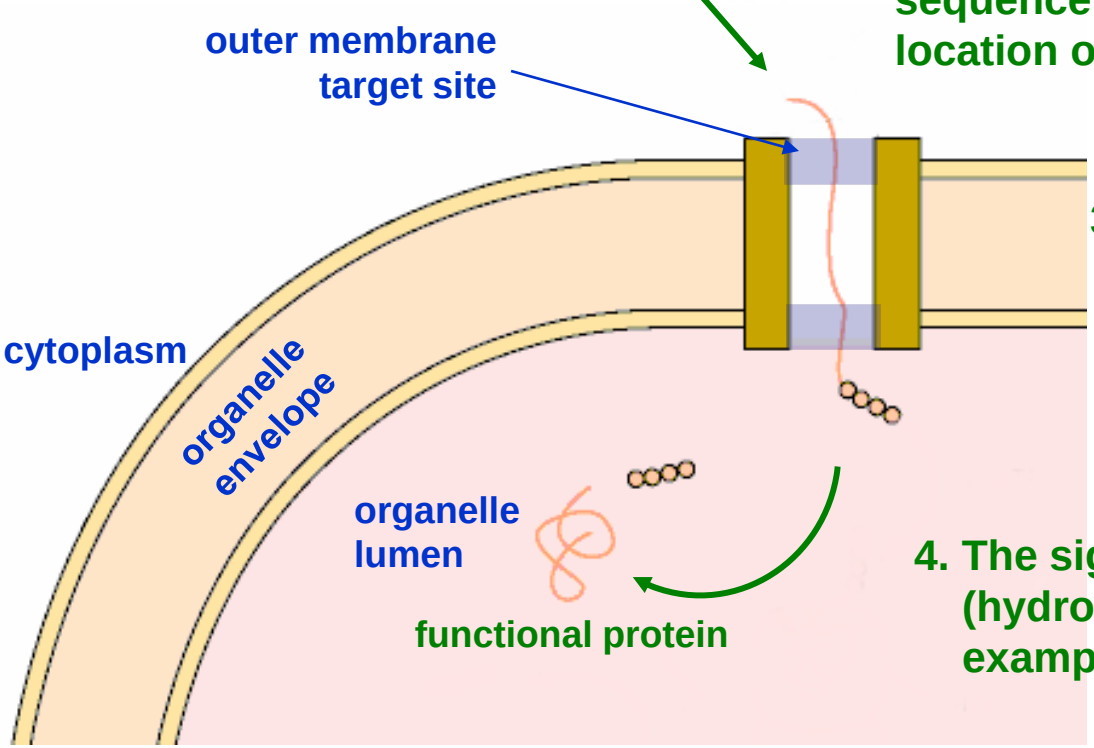
Targeting a protein to the Lumen of a Mitochondrion or Plastid

1. Translation occurs on a cytoplasmic ribosome.



N-terminal signal sequence

2. The N-terminal sequence of the recently synthesized protein, called the "signal sequence", targets the protein to a specific location on the organelle outer membrane.



3. the protein is translocated across the organelle envelope.

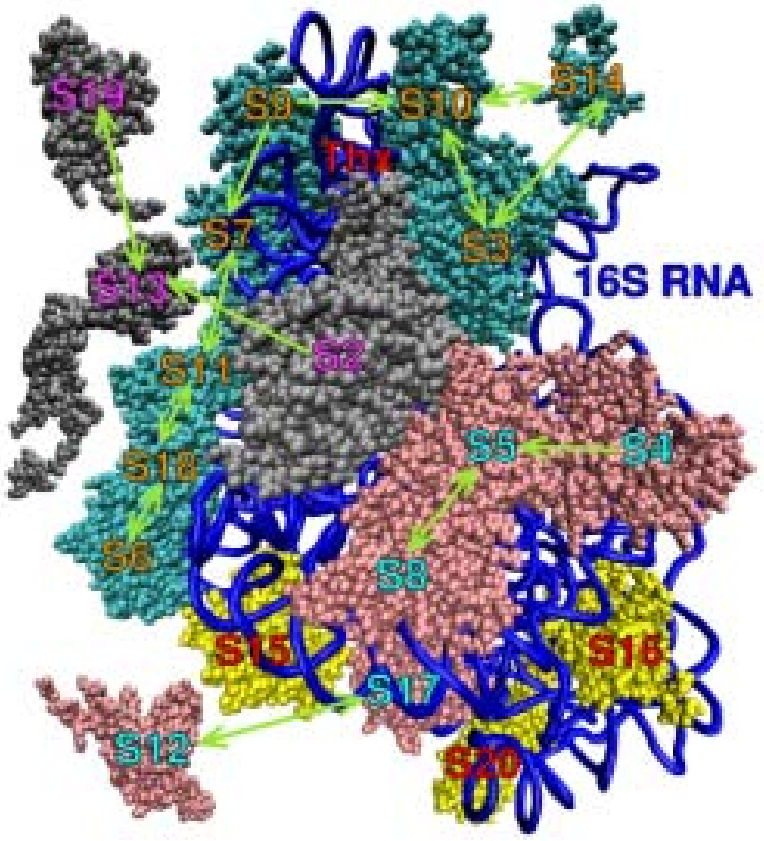
4. The signal sequence is removed (hydrolyzed) from the protein - another example of post-translational processing.

Note: Certain proteins are exported out of prokaryotic cells by a similar mechanism.

*

An example of assembly of both proteins and RNA into a multimolecular complex

Molecular Model of the Structure of the Small Subunit of a Ribosome



This image illustrates the arrangement of proteins and rRNA in the small subunit of a ribosome.

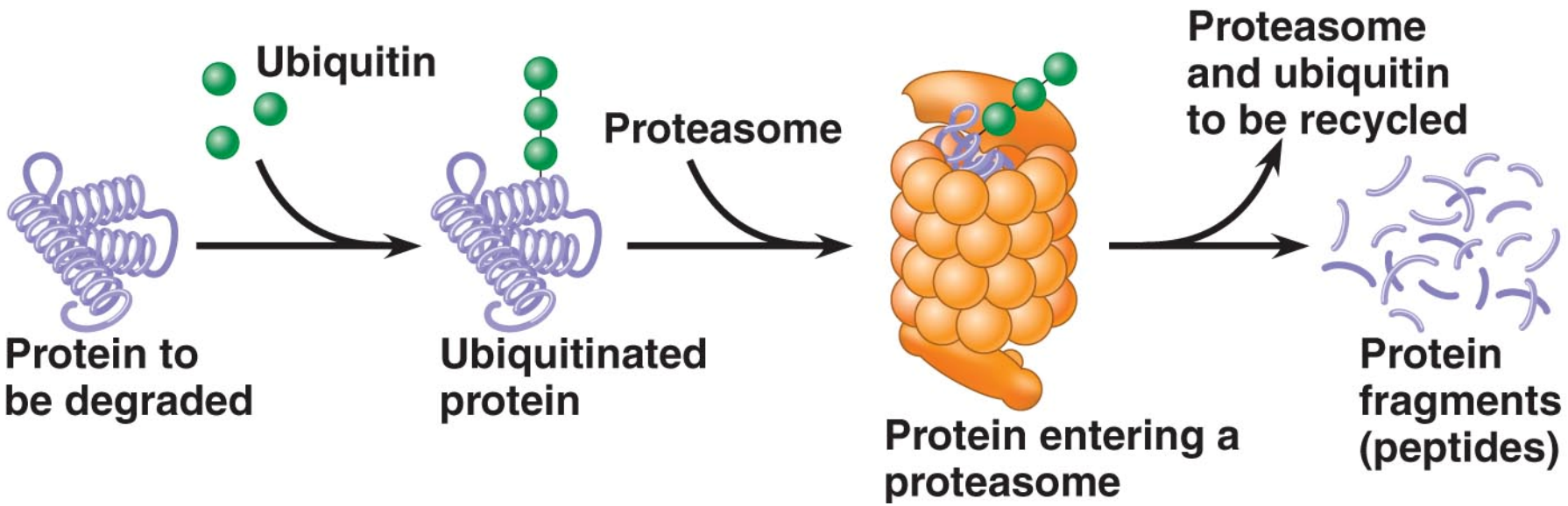
The small subunit of eukaryotic ribosomes contain over 30 different proteins and a single molecule of RNA that consists of ~2,000 nucleotides. These components are assembled into the ribosomal small subunit in the nucleolus of eukaryotic cells.

In molecular biology, assembly refers to the precise positioning of several or many macromolecules into a larger unit.

*

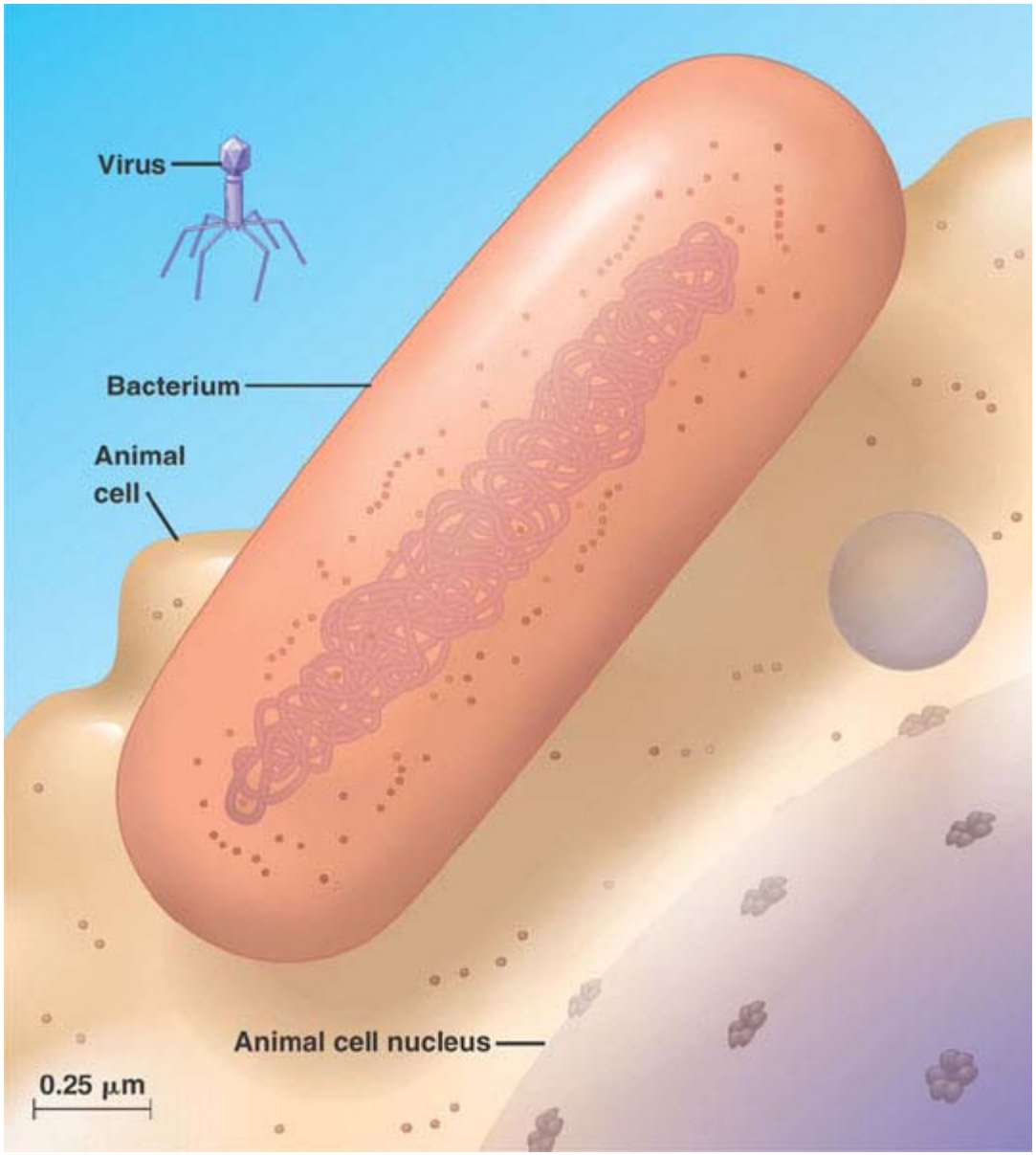
The fate of proteins in eukaryotic cells that are damaged or no longer needed

Textbook Fig. 18.12, p. 364

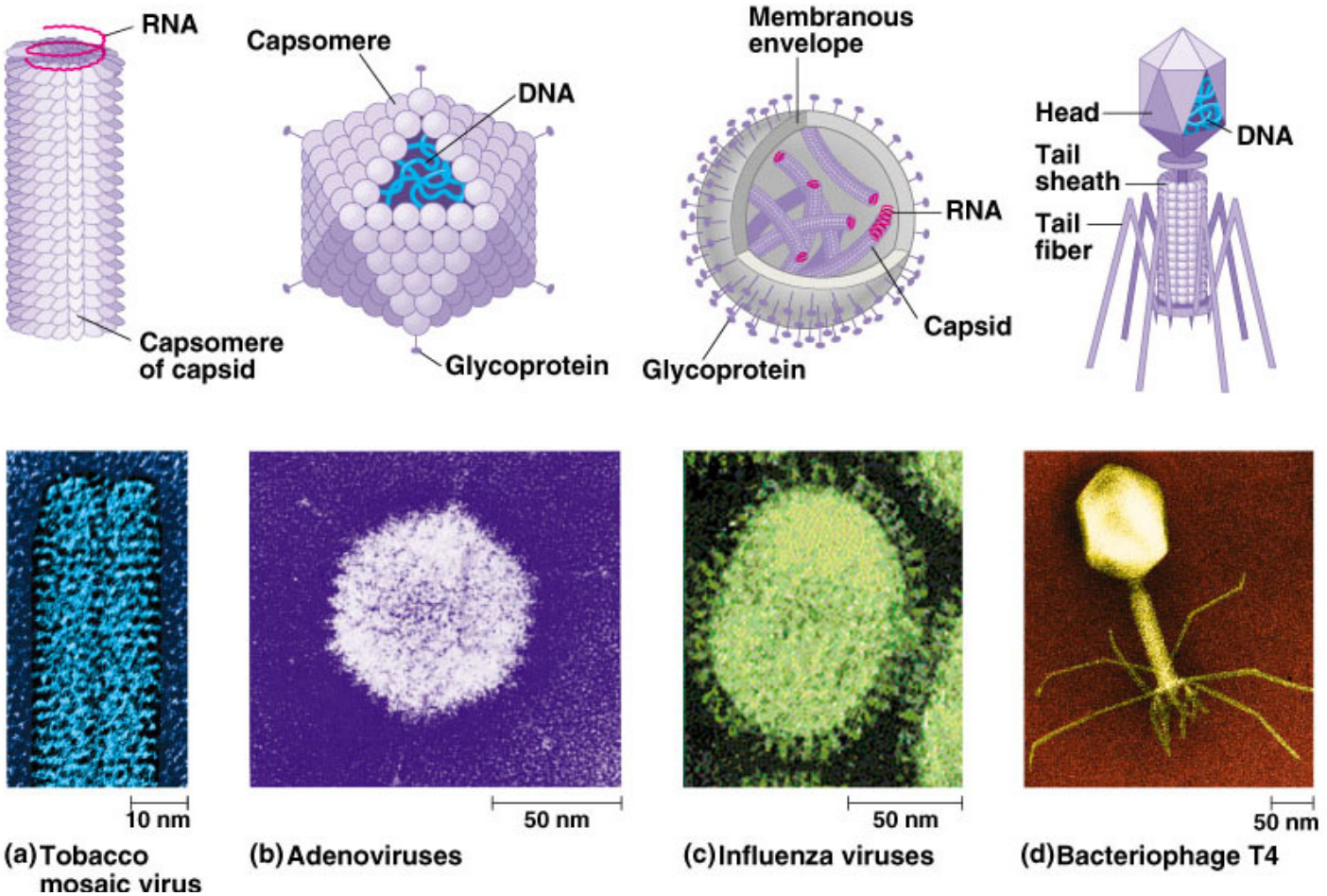


*

Relative Sizes of a Typical Animal Cell, Prokaryotic Cell and Virus



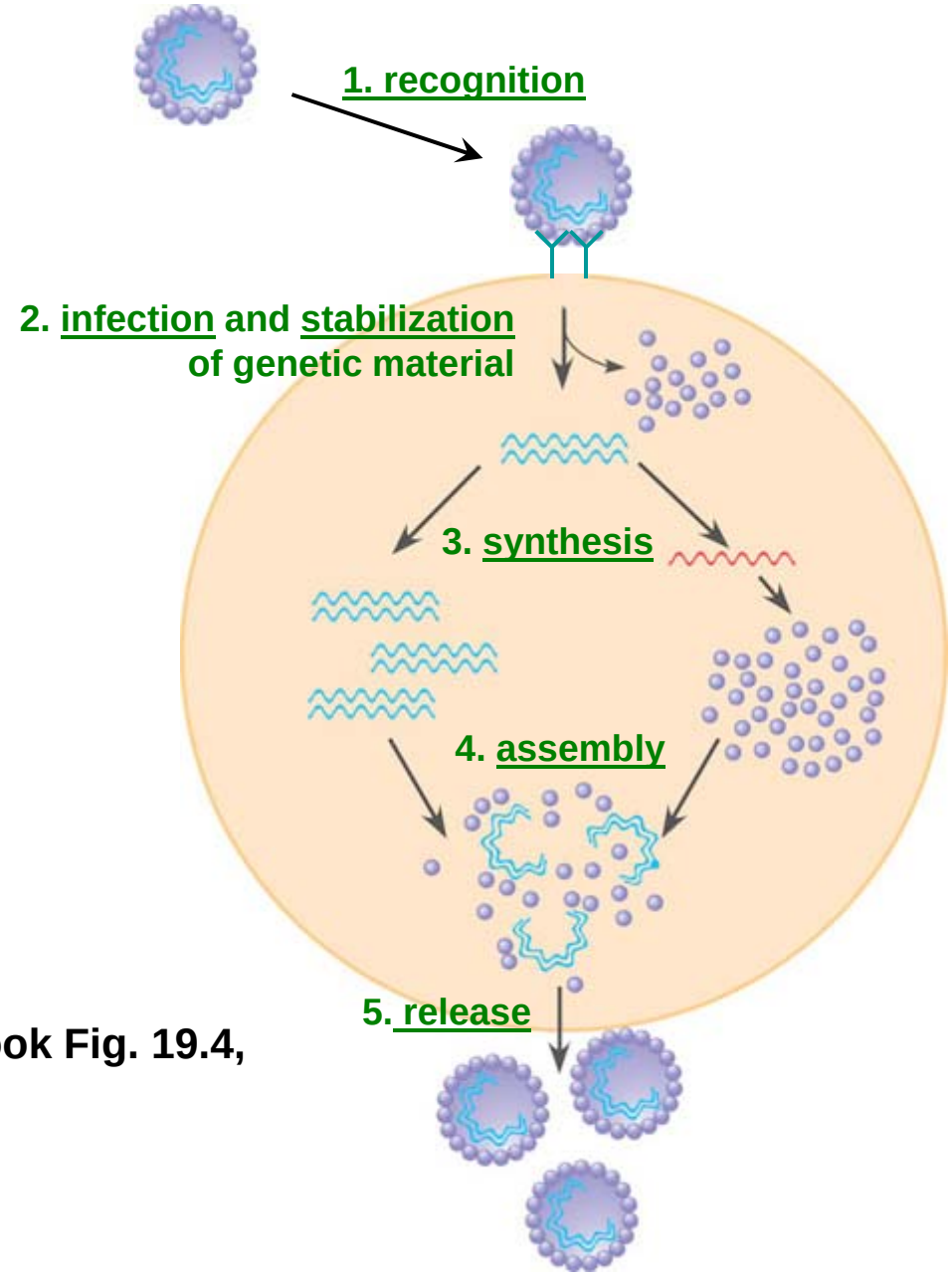
Example of the Diversity of Viral Structures



See textbook Fig. 19.3, p. 383

*

Illustration of Stages in the Life of a Virus



Modified from textbook Fig. 19.4, p. 384

*