Lecture #19
The Cell as a Machine

Protein Targeting and Translocation

During and sometimes following protein synthesis, there is a targeting of the proteins to intracellular organelles. The common targets are endoplasmic reticulum, mitochondria, chloroplasts, and peroxisomes; and of these, the major one is the endoplasmic reticulum (ER). ER constitutes 50% of cellular membrane and is the site of secreted and membrane protein synthesis as well as lipid and carbohydrate synthesis. Proteins, immature carbohydrate chains and membrane physically move from the ER to the Golgi apparatus and from the Golgi to either lysosomes, plasma membrane or secretory vesicles. In the case of mitochondria, most of the proteins are encoded in the cell genome and only a few proteins are produced from the Mitochondrial DNA. Since mitochondria have a double membrane, proteins from the cytoplasm must be transport

Protein Synthesis and Degradation
At steady state $d[Protein]/dt = 0$ then $(r_s - r_d)dt/N_o = dV/V$
where r_s = translation rate (1 – error frequency)
r_d = degradation rate, N_o = number of molecules/cell
and V is the cell volume
Flow and counterflow of membrane from one compartment to another
Ab initio or seeded
Basic synthesis and processing in ER (carbohydrate addition)
Concentration in regions of transport (budding) (VSV-g protein)
Movement to Golgi
Snap-Snare specificity of fusion
CopI and II plus clathrin coats for fission
Movement forward and backward in Golgi
Golgi to plasma membrane (apical vs. basolateral)

Questions:
1. Polyribosomes represent an assembly line of protein synthesis on one mRNA, and clearly many copies are made in parallel. For this problem, we have induced synthesis of a protein by a stimulus. We want to determine how many proteins per cell are present at steady state if the half-time of the protein after synthesis is 30 hours and the rate of synthesis is 20 molecules per minute. (Assume that the degradation rate represents a first order decay process)
2. In the case of plasma membrane proteins, they need to be processed through the ER and Golgi before reaching the plasma membrane, which often takes 15-30 minutes. If a protein has a half-life of 10 minutes in the ER and 15 min in the Golgi, then what is the number of molecules of the protein in the ER and Golgi at steady state assuming a synthesis rate of 100 molecules per minute.