

Lecture 6 – 9/17 – Dr. Hirsh Organization of Cells, continued

Cell structure of Eukaryotic cells

Lots of double-membraned organelles

Existence of an Endo-membrane system – separation of areas of cell, transport from one zone to another, localized and specialized functions within organelles

Cell structure of Prokaryotic cells

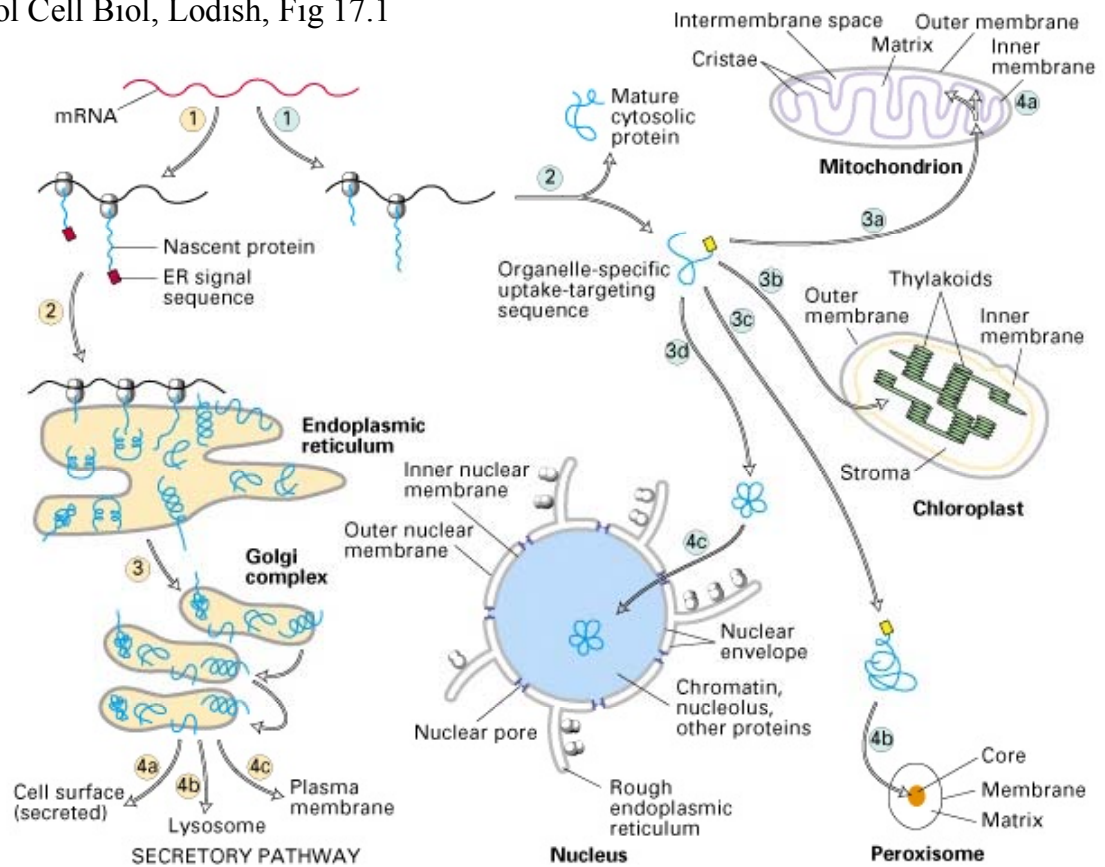
Only a nucleoid region; rest diffuse materials. Movement of materials dependent upon diffusion

Information transfer from one organelle to another

Figure 17.1 from Lodish, Mol Cell Biol

Protein Targetting/Sorting

Mol Cell Biol, Lodish, Fig 17.1



mRNA's themselves can be targeted to particular organelles/places.

Default mode is mRNA in cytosol, manufactures cytosolic proteins. Cytosolic proteins can have signaling sequences for uptake by mitochondrion, chloroplast, peroxisome.

Other mRNA's have initial signaling sequence, attach to endoplasmic reticulum along with a ribosome complex. Note ER with attached ribosomes = rough ER. Manufactured protein enters ER lumen, has targeting sequence that causes it to be transported to the *cis* face of the Golgi body. Further processed within the Golgi body, exported within a vesicle at the *trans* face of the Golgi body or can even become part of the plasma membrane through fusion. Coding for the protein's fate is done through carbohydrate attachments; the study of this field is called Protein Trafficking.

Nucleus

Double membrane surrounds it. There are pores within this structure.

mRNA's leave nucleus through these pores; proteins also enter the nucleus through the nuclear pore complex – they are targeted to do so with a Nuclear Localization Signal (NLS)

See image of octagonal (8 sided) structure elucidated through visual imaging NOT through x-ray crystallography (Yang et al, Mol Cell Jan '98)

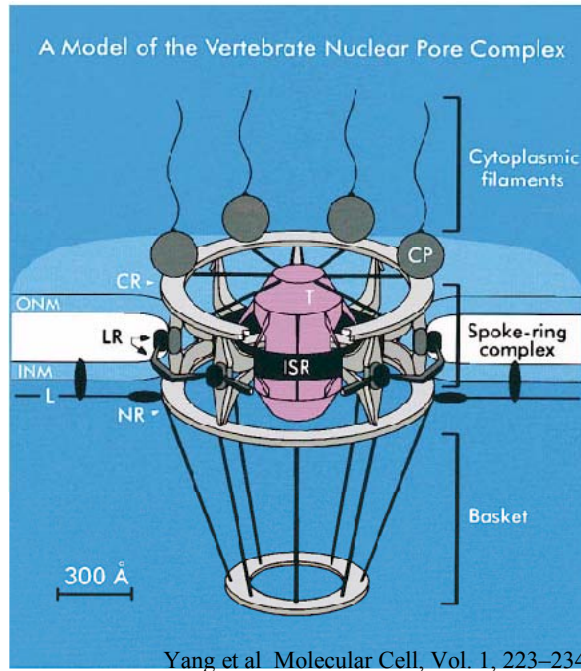


Figure 1. A Consensus Model of the Vertebrate NPC

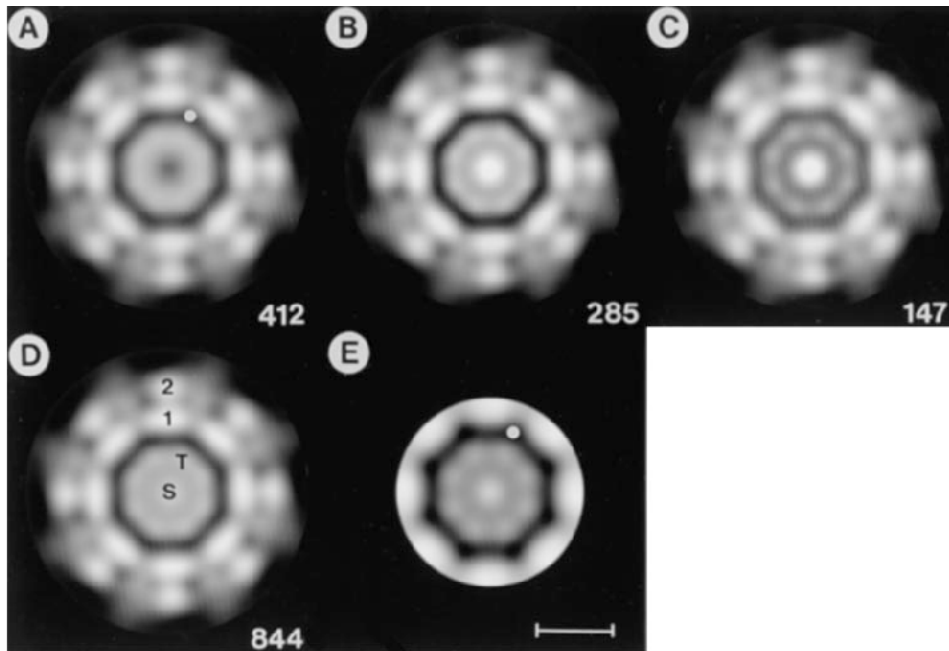


Figure 4. Classification of yNPCs Reveals the Central Transporter

Nuclear lamina proteins give nuclear envelope its precise structure, attachment point for chromatin.

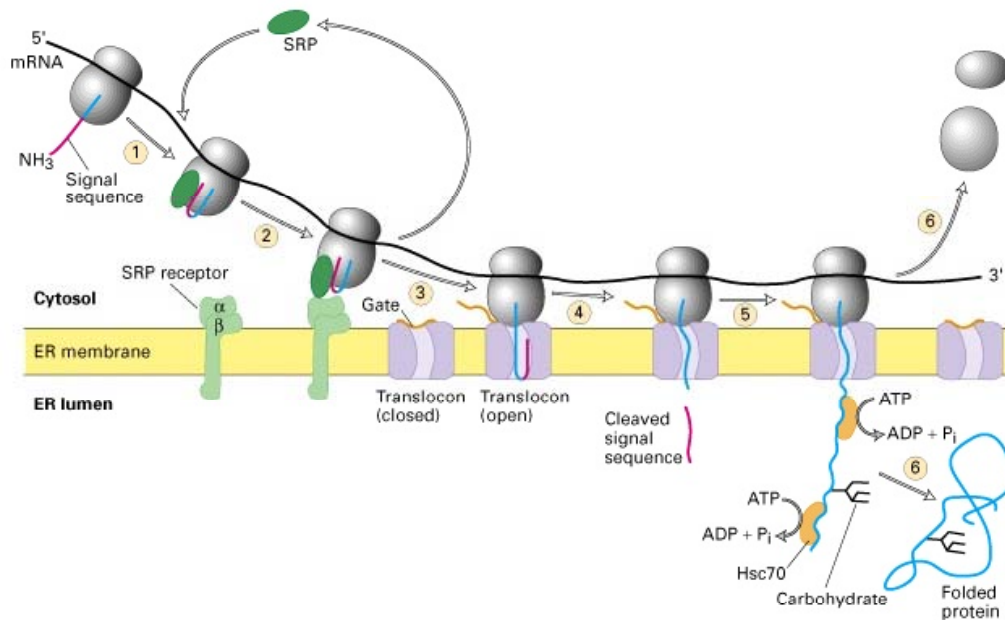
Smooth and Rough Endoplasmic Reticulum

Rough – Ribosomes are attached to ER, translating proteins into the lumen.

Amino terminal signal sequence of beginning of translated protein – signal sequences binds to SRP receptor on ER, aligns ribosome with pore in the ER. As protein elongates through the pore, the signal sequence is cleaved. ATP dependent chaperonin active proteins help fold the protein. (Here chaperonins belong to the heat-shock family of proteins first characterized in *Drosophila*) Carbohydrates are added to the protein for targeting purposes. The protein is then exported via vesicles to the *cis* side of the Golgi body – processed – then exported at the *trans* side.

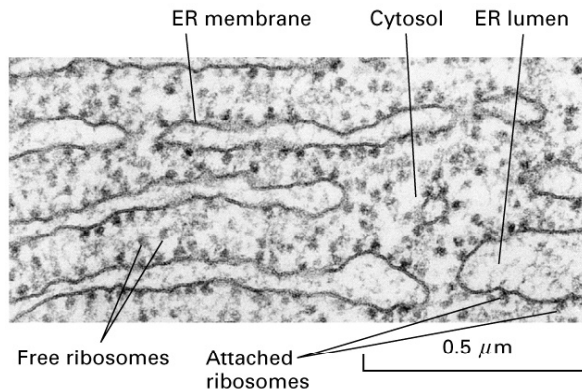
Secretory Protein Synthesis on the rough ER

Mol Cell Biol, Lodish, Fig 17.16



ER-Attached Ribosomes

Mol Cell Biol, Lodish, Fig 17.11



Mitochondria

Double membrane – inner originally from the engulfed Prokaryote organism, outer from the “host” organism.

Folded inner membrane = cristae – location of power generating reactions.

Mitochondria important in programmed cell death = Apoptosis.

Chloroplasts

Two main tasks: Light is utilized to produce ATP; Carbon Dioxide is reduced to form carbohydrates.

Cytoskeletal Components

From smallest to largest:

Microfilaments – actin monomers. As found in muscle sarcomeres, but also found throughout the cell. Actin filaments maintain the structure of a microvillus in the intestine; the base of the microvillus is anchored with intermediate filaments to the cell.

Intermediate filaments – dual fibrous subunit. Forms inner meshlike structure to stabilize cell form. Basis of nuclear lamina mesh network. Both actin microfilaments and intermediate filaments produce the characteristic shape of a red blood cell.

Microtubules – Much larger than above, manufactured from alpha and beta molecules of tubulin. Tubes have polarity; a + end and a – end. The tubule is made longer or shorter by addition or subtraction of tubulin subunits at the + end.

Cilia of protozoans have a 9 pairs plus 2 structure of microtubules running along their length. These whip through sliding action of one tubule along its adjacent tubule. This is NOT the same motion as found in Prokaryote flagella, which is a rotary motor driven by protons.

Molecular motors exist that take advantage of the directionality of the microtubule.

Dynein “walks” from the + end towards the – end of the tubule
Kinesin “walks” from the – end towards the + end of the tubule

Dyneins are utilized in cilia to slide one tubule relative to the other.

Kinesin and Dynein can bond to “cargo” molecules and “walk” a microtubule to deliver.

Specificity for cargo?

What, where, how long?

Assay of microtubules placed on slide with attached motor proteins; add ATP, tubules zip along surface.

Concept of Processivity – when something binds to something else, it stays bound for a long period of time or a short period of time. If highly processive, once bound, stays on. Assay by watching living cells – GFP bound proteins in a neuron, see proteins moving rapidly along axons.

As cells move, microtubules polymerize towards direction of motion.

Chapter 5 – Membranes

Keep aqueous substances from crossing *except* water itself.

Control flow of water passively – the cell controls the concentration of ions in and out of the cell actively, water follows.

A cell membrane is a barrier except to lipophilic molecules = a molecule with a significant hydrophobic nature, but with some hydrophilic nature so it can get out of the membrane.

The membrane is an excellent electrical insulator – consider a neuron and its action potential.

Electrical potential across the membrane drives cell processes in a secondary way.

The standard electrical potential is about 100 mv; the average cell membrane width is about 5 nm; therefore there is about a 200,000 volt/cm potential.