

# INTRACELLULAR COMPARTMENTS

10/23/91, 10/25/93, 10/19/94, 10/18/95, 10/23/96, 10/22/99, 23 Oct 00, 22 Oct 01, 27 Oct 03, 7Nov07, 14Nov08, 16Nov09, 15Nov10, 14Nov11  
 BKH 4<sup>th</sup>: 329-339, 5<sup>th</sup>: 323-333, 6<sup>th</sup>: 318-331, 7<sup>th</sup>: 324-335

- 1) nuclear
- 2) rough ER
- 3) smooth ER
- 4) Golgi
- 5) lysosomes
- 6) vesicles

## ENDOMEMBRANE COMPARTMENTS (P 325):

Endomembrane systems partition compartments (**reticula** = netted handbag). Elucidated by combination of EM & cell fractionation

**SUBCELLULAR FRACTIONATION STEPS:** 1) **homogenization** (usually in 0.25 M sucrose)  
 2) **differential centrifugation** Claude, Palade & deDuve, Nobel Prize, 1974

p. 331 **density gradient centrifug.** for organelles: **particles sediment at different rates thru increasingly dense medium**  
**Illustrate set up for sucrose** (etc) gradient (1.10-1.30 g/mL)(0.75-2.3 M sucrose)

p 329 **equilibrium density gradient** **CsCl gradient** is established by **spinning to buoyant level** in ultra centrifuge (for macromolecules) **particles seek own buoyant density**

p. 330 **differential centrifugation:** **sedimentation rate** depends on mass

- 1000 x g 10 min: nuclei
- 20,000 20 min: mitochondria, lysosomes, chloroplasts, peroxisomes
- 80,000 1 hour: microsomes
- 200,000 2 hours: ribosomes, viruses

## ENDOPLASMIC RETICULUM: (P 326)

**50-90% of total membrane is Endoplasmic Reticulum**

ER first seen late 19<sup>th</sup> century: secretory cell basophilic regions  
 Consist of cisternae, partitioned from cytoplasm  
 under cell fractionation, membranes break up into **microsomes**

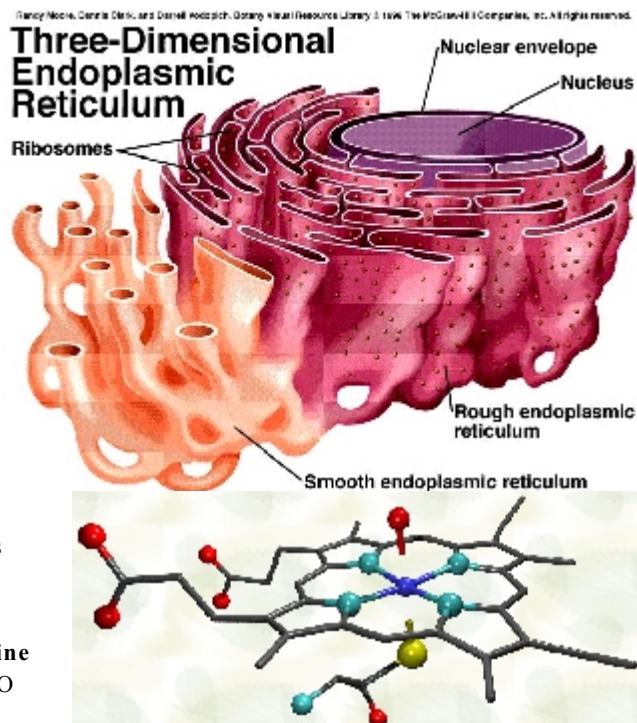
**PLASMA VS ER MEMB:** 7.5 nm thick for plasma membrane, ER: 5-6 nm

**different composition:** 2x protein, no cholesterol

**characteristic enzymes:** cytochrome b<sub>5</sub> and cytochrome b<sub>5</sub> reductase, cytochrome c reductase, glu-6-PO<sub>4</sub>ase, and cytochrome P-450.

**ROUGH ER:** lg flattened sheets, prominent in secretory cells  
 carry ribosomes on outer surface (p 326)

**SMOOTH ER:** p 326,332 tubular networks, perform multiple biochem. functions



## REACTIONS OF SMOOTH ER:

1) **HYDROXYLATION:** incr solubility in water, then excreted in urine

pathway: NAD(P)H to **cytochrome P-450**, activates O<sub>2</sub>, makes ROH + H<sub>2</sub>O

**DRUG DETOXIFICATION** (especially in the liver)

**mixed function oxidases** (or mono-oxygenases)

synthesis is stimulated by barbiturates (etc) (drugs require ever incr'ing doses)

antibiotics, narcotics, steroids, and anticoagulants are also inactivated by this mechanism.

**ARYL HYDROCARBON HYDROXYLASE** hydroxylates polycyclic hydrocarbons

Including phenylalanine to tyrosine

**CARCINOGEN ACTIVATION:** also activates smoke procarcinogen benzopyrene to carcinogen:

2) **GLYCOGEN CATABOLISM** (fig 12-3, p 332)

Glycogen stored as granules in smooth ER, cAMP triggers hydrolysis

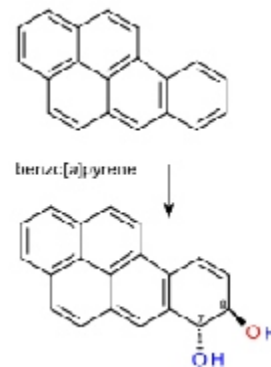
- 1 glycogen phosphorylase splits glycogen to Glucose-1-PO<sub>4</sub> by adding a PO<sub>4</sub> to the alpha 1,4 bond
- 2 phosphoglucomutase isomerizes G-1-P to G-6-PO<sub>4</sub> (allosteric reg: **AMP incr, ATP decr**)
- 3 glucose-6-phosphatase splits off PO<sub>4</sub>, allows export of glucose to blood

(no G-6-PO<sub>4</sub>ase in muscle or brain: they use all the Glu-6-PO<sub>4</sub> locally, no export)

3) **CALCIUM ISOLATION:** Sarcoplasmic reticulum in muscle fibers removes, holds Ca<sup>++</sup> fr. sarcomere

4) **FAT, PHOSPHOLIPID AND STEROID SYNTHESIS**

Leydig cells in testes replete with smooth ER: synthesis of testosterone



## MEMBRANE BIOSYNTHESIS & TURNOVER:

**Proteins:** integral membrane proteins not destined for secretion, synthesized on rER, stay attached

**Glycosylation** (marking for export) started in rER, completed in Golgi on luminal surface (inside of saccules)

**Membrane lipids:** synthesized in sER

transfer via pinched off transfer vesicles

Turnover:

radiotracer shows T<sub>1/2</sub>: phospholipids hours  
 proteins days

