Intracellular Vesicular Traffic

Chapter 13, Alberts et al.
The endocytic and biosynthetic-secretory pathways
The intracellular compartments of the eucaryotic cell involved in the biosynthetic-secretory and endocytic pathways
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Electron micrograph of clathrin-coated, COPI-coated, and COPII-coated vesicles
Utilization of different coats in vesicular traffic
Clathrin-coated pits and vesicles
The structure of a clathrin coat

(A) 

(B) 

(C) 50 nm
The assembly and disassembly of a clathrin coat
The role of dynamin in pinching off clathrin-coated vesicles from the membrane
Model of COPII-coated vesicle formation

Sar1 is a coat recruitment GTPase
GEF in this case is Sec12
The postulated role of SNAREs in guiding vesicular traffic
Dissociation of SNARE pairs by NSF after a membrane fusion cycle is completed
A model for how snare proteins may concentrate in membrane fusion
The entry of the enveloped viruses into cells
The recruitment of cargo molecules into ER transport vesicles
Retention of incompletely assembled antibody molecules in the ER
Homotypic membrane fusion
Vesicular tubular clusters
A model for the retrieval of ER resident proteins
The Golgi apparatus
Light micrographs of the Golgi apparatus
A goblet cell of the small intestine
Histochemical stains demonstrating the biochemical compartmentalization of the Golgi apparatus
The functional compartmentalization of the Golgi apparatus
Two possible models explaining the organization of the Golgi apparatus and the transport of proteins from one cisterna to the next.
Lysosomes
Three pathways to degradation in lysosomes
The structure of mannose 6-phosphate on a lysosomal enzyme
The transport of newly synthesized lysosomal hydrolases to lysosomes
The recognition of a lysosomal hydrolase
Phagocytosis by a macrophage

Phagocytosis by a neutrophil
Initiation of Immune Responses

Complex environment
- Viruses
- Bacteria
- Fungi
- Parasites
- Allergens
- Self antigens
- Donor antigens
- Maternal/fetal antigens
- Food

Barrier/Sensor

Protective response
- Infection Susceptibility/ Resistance
- Allergy/ Asthma
- Autoimmunity/Tolerance
- Transplant

Immune System
Life Cycle of Dendritic Cells from Birth to Death
Phases of DC maturation

1. Phagocytosis
2. Cytokine/Costim/Chemokine
3. Protein degradation
3. Antigen presentation
4. Migration
5. T cell activation
Phagocytosis
Pinocytic vesicles form from coated pits in the plasma membrane.

The formation of clathrin-coated vesicles from plasma membrane.
Caveolae in the plasma membrane of a fibroblast
A low-density lipoprotein (LDL) particle

Normal and mutant LDL receptors
Possible fates for transmembrane receptor proteins that have been endocytosed
The receptor-mediated endocytosis of LDL

- LDL binds to LDL receptors on the plasma membrane.
- Coated pits form around the receptor-ligated LDL, initiates endocytosis.
- LDL is internalized into the cytosol as coated vesicles.
- Coated vesicles uncoat, releasing LDL into the recycling endosome.
- LDL is transported to the lysosome for degradation.
- LDL receptors are returned to the plasma membrane through budding off transport vesicles.

Red - transferrin R
Green - opioid R
The endocytic pathway from the plasma membrane to lysosomes
The sequestration of endocytosed proteins into internal membranes of multivesicular bodies
Transcytosis
Storage of plasma membrane proteins in recycling endosomes

- **Unstimulated cell**
  - Insulin receptor
  - Glucose transporter
  - Intracellular pool of glucose transporters in specialized recycling endosomes

- **Insulin-stimulated cell**
  - Insulin
  - Signal
  - Signal causes re-localization of glucose receptors to plasma membrane to boost glucose uptake into the cell
Epithelial cells have two distinct early endosomal compartments but a common late endosomal compartment.

The basolateral and the apical domains of the plasma membrane communicate with separate early endosomal compartments.
The constitutive and regulate secretory pathways
The three best-understood pathways of protein sorting in the trans Golgi network.
The formation of secretory vesicles
Exocytosis of secretory vesicles
Alternative processing pathways for the prohormone pro-opiomelanocortin
Electron micrographs of exocytosis in rat mast cells
Exocytosis as a localized response
Two ways of sorting plasma membrane proteins in a polarized epithelial cell

(A) DIRECT SORTING OF MEMBRANE PROTEINS IN THE TRANS GOLGI NETWORK

(B) INDIRECT SORTING VIA ENDOSONES
Model of lipid rafts in the trans Golgi network
The formation of synaptic vesicles

1. Delivery of synaptic vesicle components to plasma membrane.
2. Endocytosis of synaptic vesicle components to form new synaptic vesicles directly.
3. Endocytosis of synaptic vesicle components and delivery to endosome.
4. Budding of synaptic vesicle from endosome.
5. Loading of neurotransmitter into synaptic vesicle.
6. Secretion of neurotransmitter by exocytosis in response to an action potential.