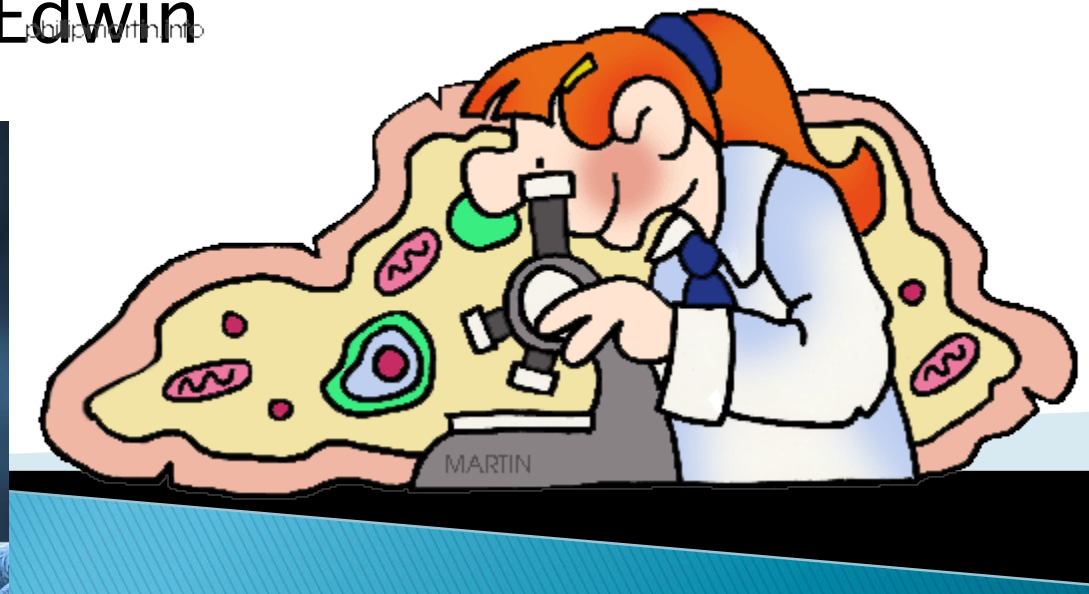
Welcome to the BIO 1A03 Midterm Review!!! ☺

Presentation by: Shyamal, Mina, Valentina, & Edwin



Agenda

Chapters Covered:

- 1: Biology and the Tree of Life (Shyamal)
- 5: Carbohydrates (Shyamal)
- 6: Lipids, Membranes, and the First Cells (Mina)
- 7: Inside the Cell (Edwin)
- 9: Cellular Respiration and Fermentation (Valentina)

Disclaimer

- "This review session is intended to benefit the students of 1A03 and is not compulsory. None of the information discussed in this review session has been confirmed by the course instructors, and it is the student's responsibility to confirm the accuracy of this information using the course lecture notes, tutorials, and text."

Who Are We?

MSU Academic Club of the Year 2012- 2013

- Some events include:
  - MMI's
  - First Year Bio Midterm Reviews
  - Anatomy Lab tours
  - Wine and Cheese

Contact Us!

- **E-mail** us at: mcmasterbiology@gmail.com
- Connect to us through our social media feeds:
  - **Facebook**: McMaster Biology Society Facebook Page
- Drop-in during **office hours** to talk to an executive member in Life Science Building (LSB) 112 from 1:30-3:30

Chapter 1

The Cell Theory

- *Cell: a highly organized compartment that is bounded by a thin, flexible structure called a plasma membrane and that contains concentrated chemicals in an aqueous solution.*

1. All organisms are made of cells
2. The cell is the basic unit of structure, function, and organization in all organisms.
3. All cells come from preexisting cells
   - Spontaneous generation: organisms appeared in these nutrient-rich media of their own accord – they spring to life from nonliving materials.
   - All-cells-from-cells hypothesis: cells produced only when preexisting cells grow and divide

Chapter 5

Introduction

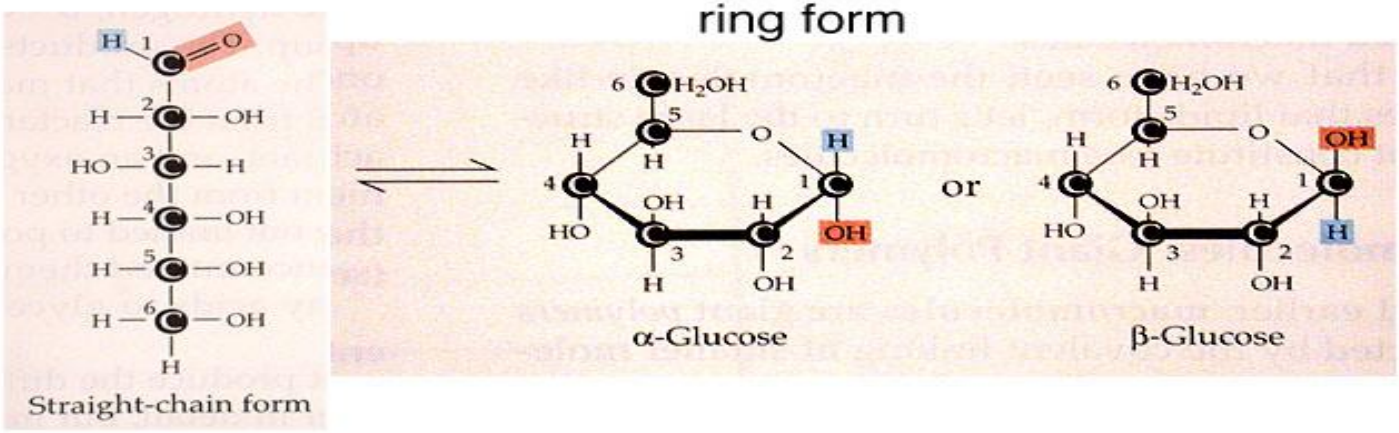
- Carbohydrates encompasses the monomers called monosaccharides, small polymers called oligosaccharides and large polymers called polysaccharides
- $(CH_2O)_n$ → n refers to the number of carbons

Terms

- Monosaccharides- one sugar, monomer
- Trioses- three carbon sugars
- Pentoses- Five carbon sugars
- Hexose- six-carbon sugar
- Glycosidic linkages- forms between hydroxyl groups

Sugars as Monomers

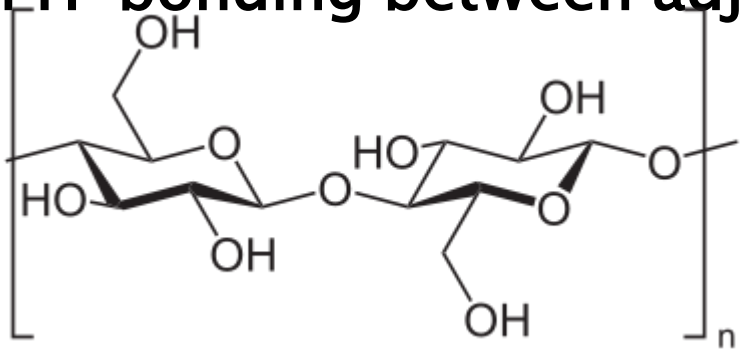
- Carbonyl group serves as one of the monosaccharides distinguishing features
  - Forming an aldehyde sugar (aldose) or ketone sugar (ketose)
- Sugars often vary through the configuration of hydroxyl groups



The Structure of Polysaccharides

- Glycosidic linkages are **covalent bonds** between two hydroxyl groups → Condensation reaction
- Starch: consists entirely of a-glucose joined by glycosidic linkages
  - Amylose: a-1,4-glycosidic linkages → linear
  - Amylopectin: a-1,6-glycosidic linkages → branched every **30 monomers**
- **Starch for plants and Glycogen in Animals**

- Glycogen: polymer of a-glucose which branches (a-1,6-glycosidic linkages) every **10 monomers**
- Cellulose: B-glucose monomers
  - **Every other B-glucose monomer flips over**
  - **Increase in H-bonding between adjacent strands**



- Chitin: N-acetylglucosamine joined by B-1,4-glycosidic linkages
  - **Every other residue is flipped**
  - **Increase in H-bonding between adjacent strands**

- Peptidoglycan: mainly found in bacteria (cell wall)
  - Two types of monomers that alternate and are linked by B- 1,4-glycosidic linkages
  - Chain of amino acids is attached to one of the two monomers
  - When the strands are laid adjacent, the amino acid groups interact

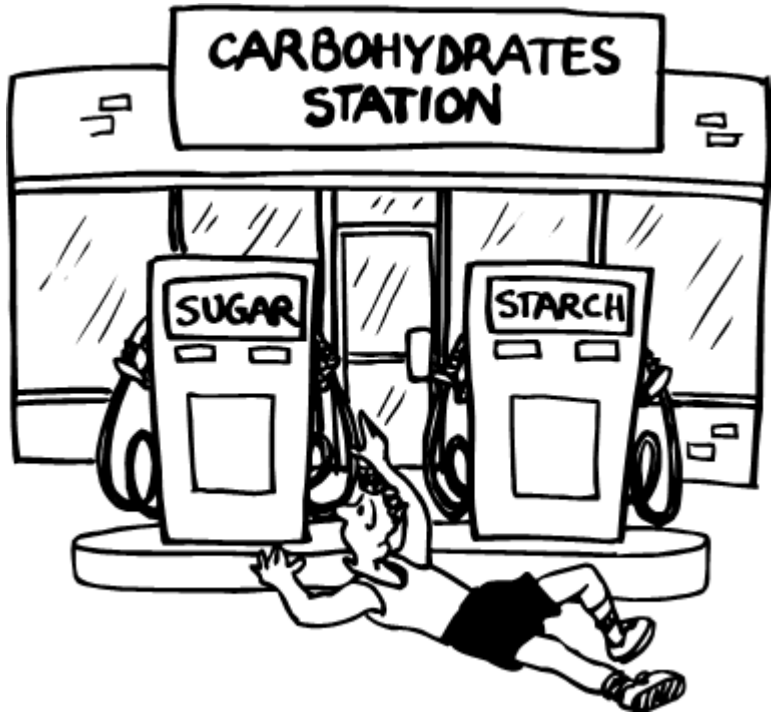
SUMMARY TABLE 5.1 Polysaccharides Differ in Structure

Polysaccharide	Chemical Structure	Three-dimensional Structure
Starch Used for energy storage in plant cells (such as in potatoes)	CH_2OH, OH, HO, α-Glucose, α-1,6-glycosidic linkage (branch)	Unbranched helix (amylose); Branched helices (amylopectin)
Glycogen Used for energy storage in animal cells (such as in liver and muscles)	$^6CH_2$, CH_2OH, α-1,4-glycosidic linkage, α-Glucose, α-Glucose	Highly branched helices
Cellulose Used for structural support in cell walls of plants and many algae	β-Glucose, β-Glucose, β-1,4-glycosidic linkage, Hydrogen bond, β-1,4-glycosidic linkage	Parallel strands joined by hydrogen bonds
Chitin Used for structural support in the cell walls of fungi and the external skeletons of insects and crustaceans	$NHCOCH_3$ group, β-1,4-glycosidic linkage, Hydrogen bond with adjacent strand forms here	Parallel strands joined by hydrogen bonds
Peptidoglycan Used for structural support in bacterial cell walls	HOH_2C, β-1,4-glycosidic linkage, $NHCOCH_3$ group, This chain of 4 amino acids forms a peptide bond with the same chain of amino acids on the adjacent strand	Parallel strands joined by peptide bonds

What Do Carbohydrates Do?

- Fibrous structural materials
  - Form fibers that give cells strength and flexibility
  - Think cell wall, chitin and peptidoglycan
  - B-1,4-glycosidic linkages are hard to break using enzymes → resistant
- Role of Carbohydrates in Cell identity
  - Glycoprotein: proteins that are covalently bound of an oligosaccharide
  - Cell-cell recognition and cell-cell signalling
  - BBM pin #

- Carbohydrates store chemical energy in cells
  - Photosynthesis: CO_2 + Water + Energy → Glucose + Water + O_2
  - Liver stores glycogen when there is excess of glucose in the body



Chapter 6

Question

When phospholipids are placed in water, they spontaneously form:

a) micelles
b) Lipid bilayers
c) Both A and B
d) Neither A and B

Answer

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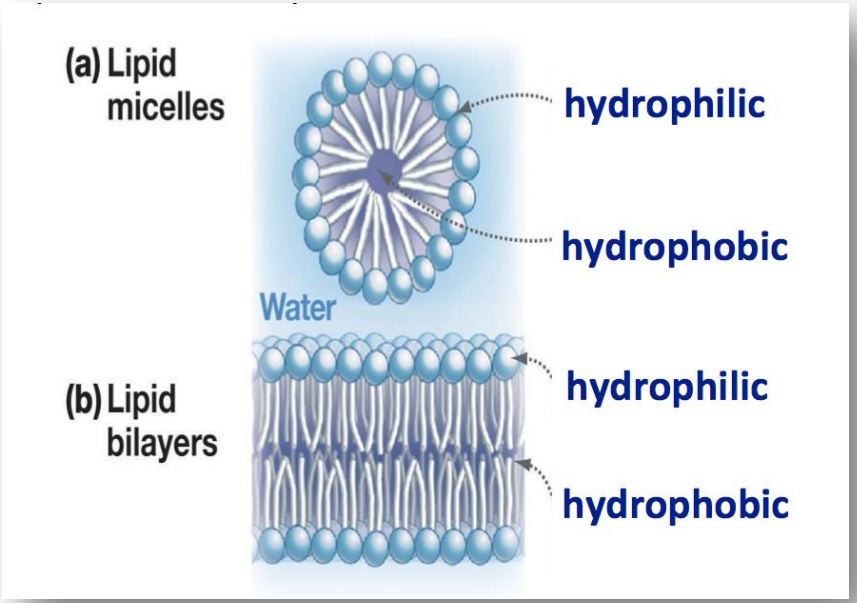

WHY ?
DOES IT REQUIRE ATP?

Fluidity of Cell Membranes

Factors that affect the fluidity of cell membranes

- ✓ Unsaturated vs. saturated
- ✓ Number of carbons in the fatty acid tails
- ✓ Temperature
- ✓ Presence or absence of cholesterol

WHY???

Question

- _____ fatty acids and _____ hydrocarbon chains increase membrane permeability

a) Saturated; long
b) Saturated; short
c) Unsaturated; long
d) Unsaturated; short

Answer

- _____ fatty acids and _____ hydrocarbon chains increase membrane permeability

a) Saturated; long
b) Saturated; short
c) Unsaturated; long
d) **Unsaturated; short**

Permeability-Question

- Which type of molecules most easily move across a membrane

a) Hydrophobic molecules like Nitrogen (N2)
b) Large polar molecules like glucose
c) Ions, like chloride (Cl^-)
d) Small, uncharged polar molecules like water

Answer

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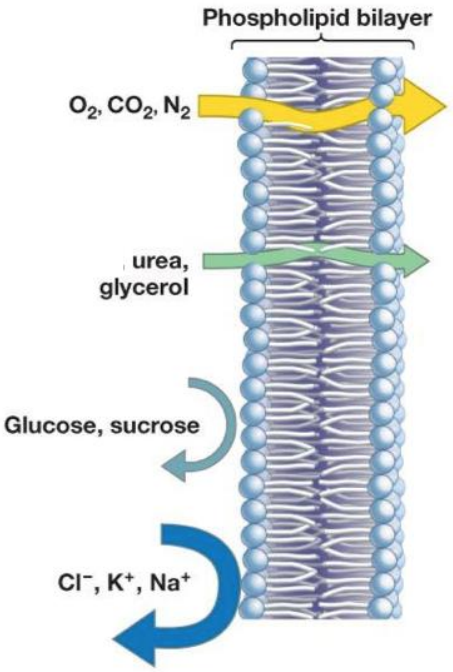

Permeability of Cell Membranes

- ✓ Small
- ✓ Non-polar
- ✓ uncharged

- ✗ Large
- ✗ Polar
- ✗ Ions

Question

- Why is the cell membrane less permeable to glucose than to glycerol

a) Glucose is larger than glycerol
b) Glucose contains oxygen; glycerol does not
c) Glycerol is non-polar, glucose is polar
d) Glucose is a charged molecule; glycerol is not

Answer

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Permeability & Fluidity Question

- At room temperature, a cell membrane has the consistency of olive oil. Cooling the membrane_____ its fluidity and _____ its permeability.

a) Increases, decreases
b) Decreases, increases
c) decreases, decreases
d) Increases, increases

Answer

- At room temperature, a cell membrane has the consistency of olive oil. Cooling the membrane_____ its fluidity and _____ its permeability.

a) Increases, decreases
b) Decreases, increases
c) **decreases, decreases**
d) Increases, increases

WHY?

Answer

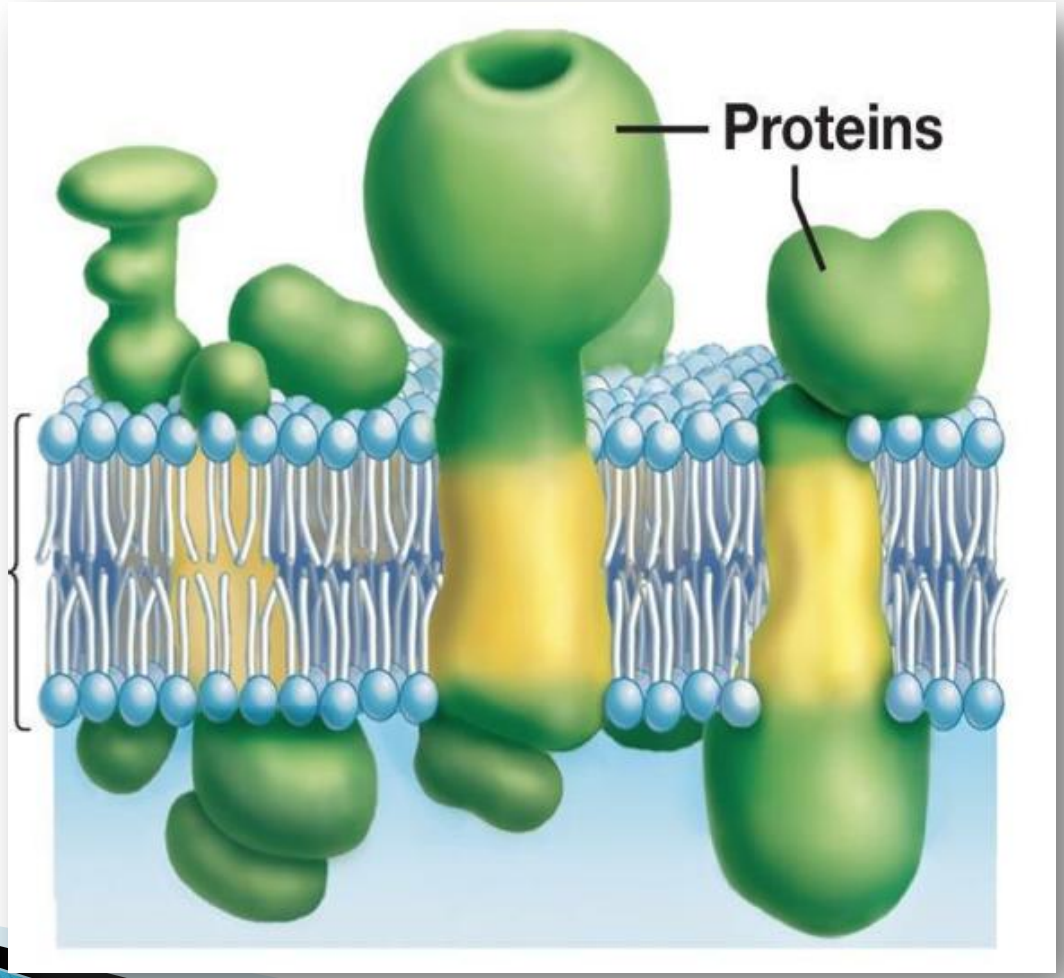
- At room temperature, a cell membrane has the consistency of olive oil. Cooling the membrane_____ its fluidity and _____ its permeability.

a) Increases, decreases
b) Decreases, increases
c) **decreases, decreases**
d) Increases, increases

WHY?

- **↓ Temp = slow movement= hydrophobic tails pack = solidfication**

Fluid Mosaic Model-Q



Question

- Which statement best describes the fluid mosaic model of membrane structure

a) The phospholipid bilayer is coated on both sides with hydrophilic proteins
b) The phospholipid bilayer contains diverse proteins, including some embedded amphipathic proteins that span the bilayer
c) Two layers of proteins are interspersed with phospholipids
d) The phospholipid bilayer has only a few proteins associated with it

Answer

- Which statement best describes the fluid mosaic model of membrane structure

a) The phospholipid bilayer is coated on both sides with hydrophilic proteins

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Transport Across Membranes

Three types of movements across the cell membrane

1. Passive diffusion
2. Passive transport
3. Active transport

High to low Conc. Gradient , No ATP needed

In other words…

- You have two main forms of movement:

i. Passive transport
ii. Active transport

- Small molecules and ions in solution are called solutes have thermal energy and are in constant random motion
- This random movement is called diffusion
- Diffusion is a form of passive transport

Membrane Proteins & Transport

- Cells have many types of channel proteins in their membranes, each feature a structure that allows it to admit a particular of ion or small molecule
- These channels are responsible for Facilitated diffusion (the passive transport of substances that would not otherwise cross the membrane)
- Facilitated diffusion/ passive transport can occur through channels or through carrier proteins, or transporters, which change shape during the transport process

Facilitated diffusion by transporters occurs

Active Transport by Pumps

- Cells can transport molecules or ions against an electrochemical gradient
- This requires energy→ ATP therefore active transport
- Pumps are membrane proteins that provide active transport of molecules across the membrane
  - Sodiu potassium pump, uses ATP to transport Na and K against their concentration gradients

Secondary Active Transport

- In addition to moving materials against their concentration graidents, pumps set up electrochemical graidents
- These gradients make it possible for cells to engage in secondary active transport or co-transport
  - The gradient provides the potential energy required to power the movement of a different molecule against its particular gradient

Question

- Distilled water is _____ relative to a solution containing dissolved salts

a) Hypertonic
b) Hypotonic
c) Isotonic
d) None of the above

Answer

- Distilled water is _____ relative to a solution containing dissolved salts

a) Hypertonic
b) **Hypotonic**
c) Isotonic
d) None of the above

Question

- A red blood cell placed in water:

a) Remains unchanged
b) Loses water and shrinks
c) Gains water and expands

Answer

- A red blood cell placed in water:

a) Remains unchanged
b) Loses water and shrinks
c) **Gains water and expands**

Question

- Which of the following is NOT true of the sodium-potassium pump ?

a) It becomes phosphorylated by ATP
b) It transports sodium into the cell and potassium out of the cell
c) It creates an electrochemical gradient across the cell membrane

Answer

- Which of the following is NOT true of the sodium-potassium pump ?

a) It becomes phosphorylated by ATP
b) **It transports sodium into the cell and potassium out of the cell**
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Question

- Bob, your lab mate grabbed test tubes full of different proteins, however being rushed, he forgets to label them, but accurately recoded the results: protein “A’ binds to an ion, diffuses across a membrane, and releases it on the other side. No ATP or other chemical energy is used. This protein is an:

a) Aquaporin
b) Gated channel
c) Ion channel
d) Ion pump

Answer

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a) Aquaporin
b) Gated channel
c) **Ion channel**
d) Ion pump

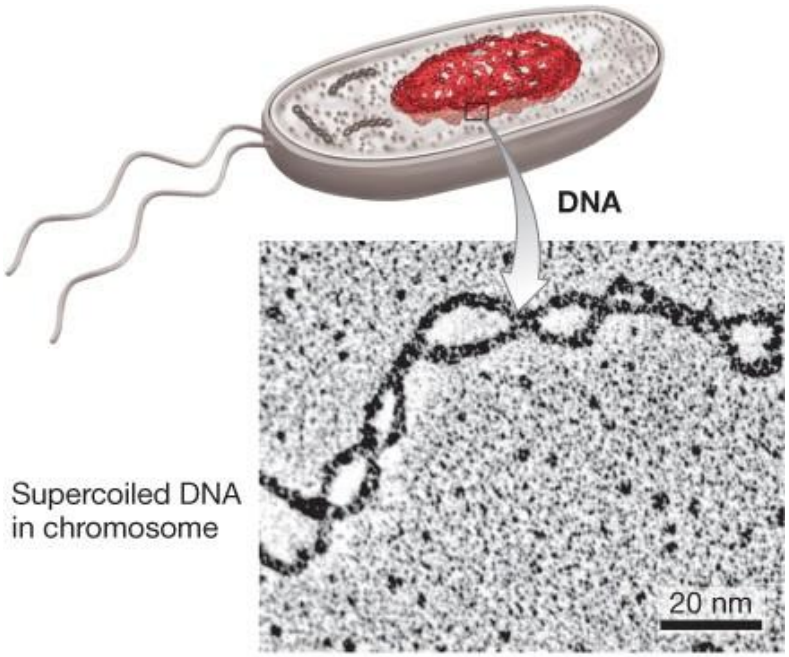
Gated vs. Ion Channels

- A gated channel : a is a channel through a membrane that is opened/closed by specific chemical or electrical events it is a TYPE OF ION CHANNEL

Chapter 7: Inside the Cell

What's Inside the Cell?

- Prokaryotes:
  - Absence of membrane-bound nucleus
  - Cell wall
  - Ribosomes (3 RNA)
  - Flagella



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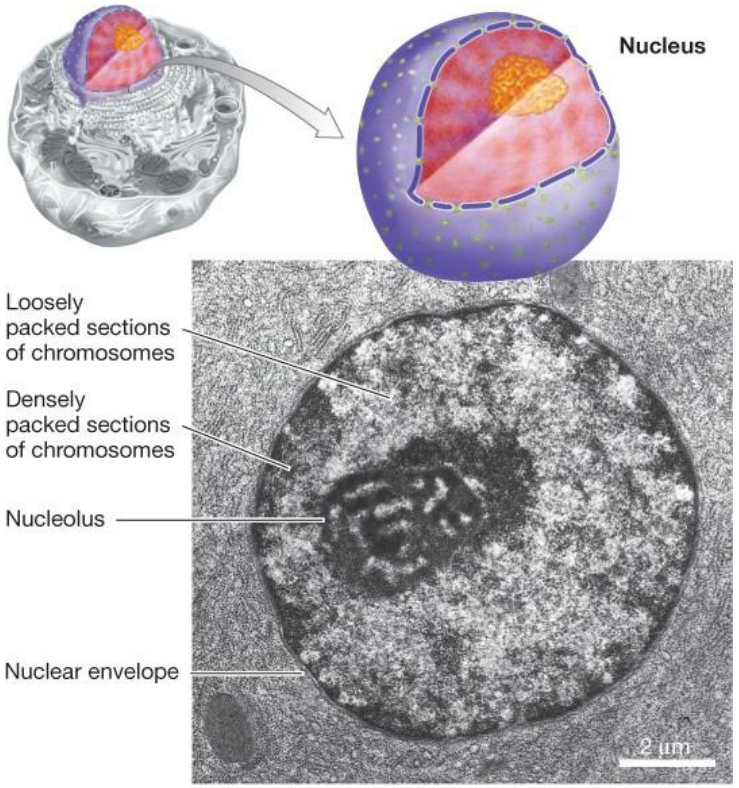
Eukaryote Organelles

- **Nucleus:**
  - Double-membrane
  - Contains pores
  - Nucleolus (rRNA production)

- **Rough ER:**
  - Has ribosomes
  - Produces and processes PROTEINS
  - “membrane factory”



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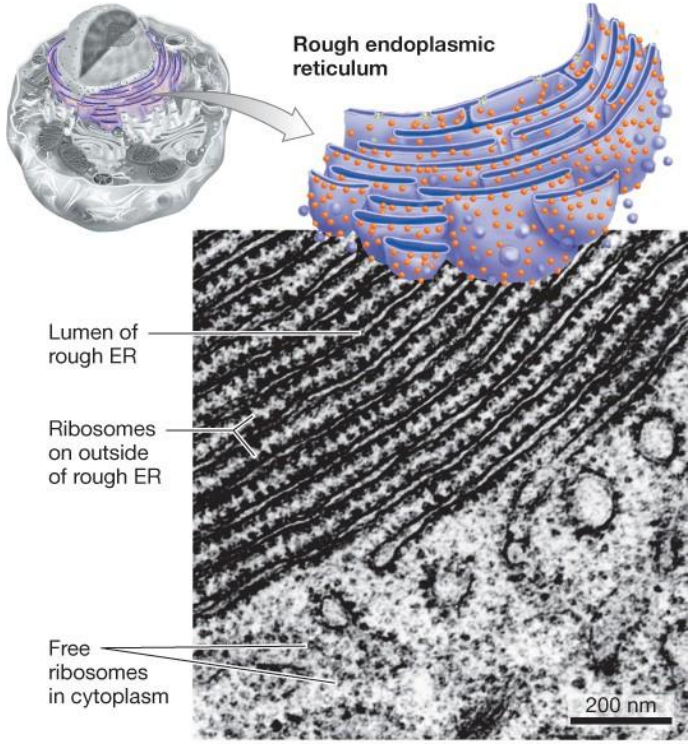

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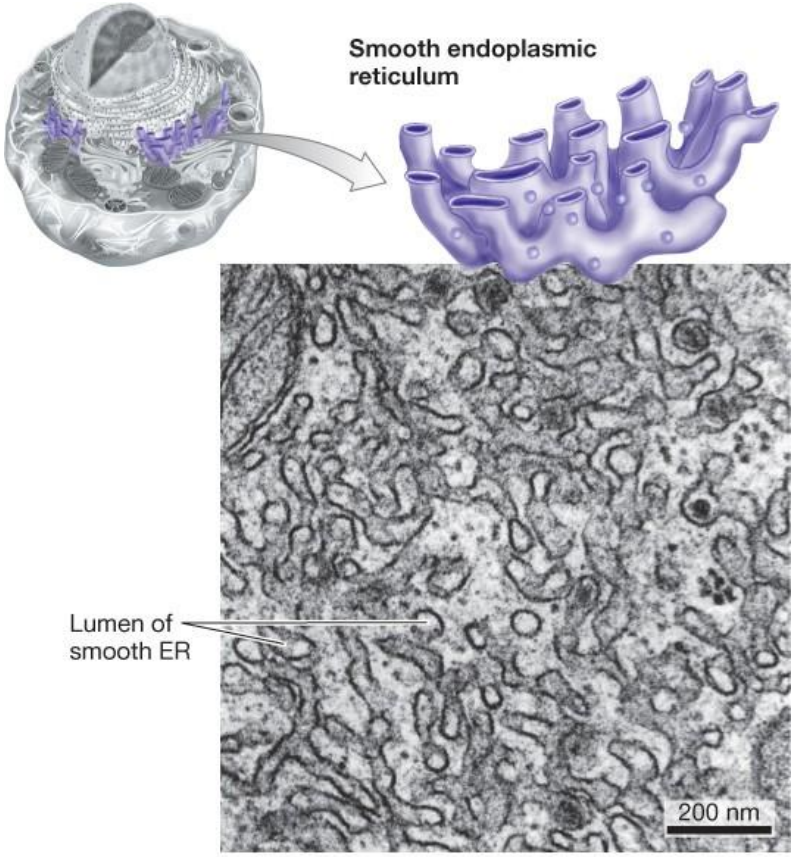
- **Smooth ER:**
  - Lacks ribosomes
  - Production of LIPIDS
  - Metabolism of carbohydrates
  - Calcium storage

- **Golgi Apparatus:**
  - *Cis* – near ER
  - *Trans* – near cell membrane



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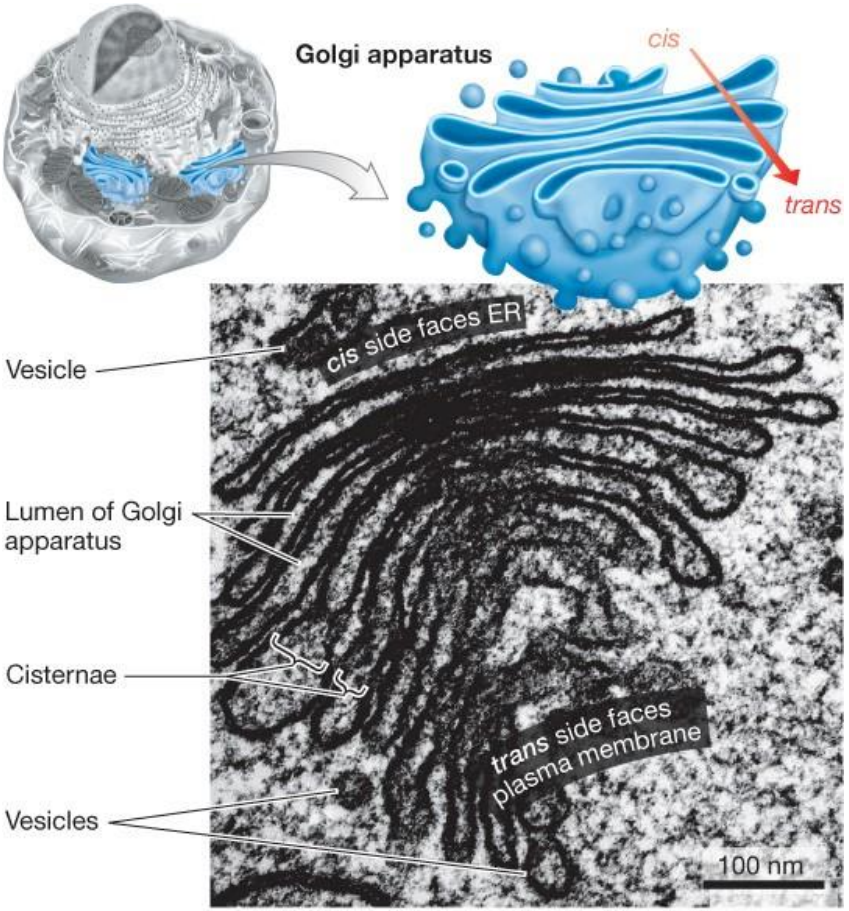

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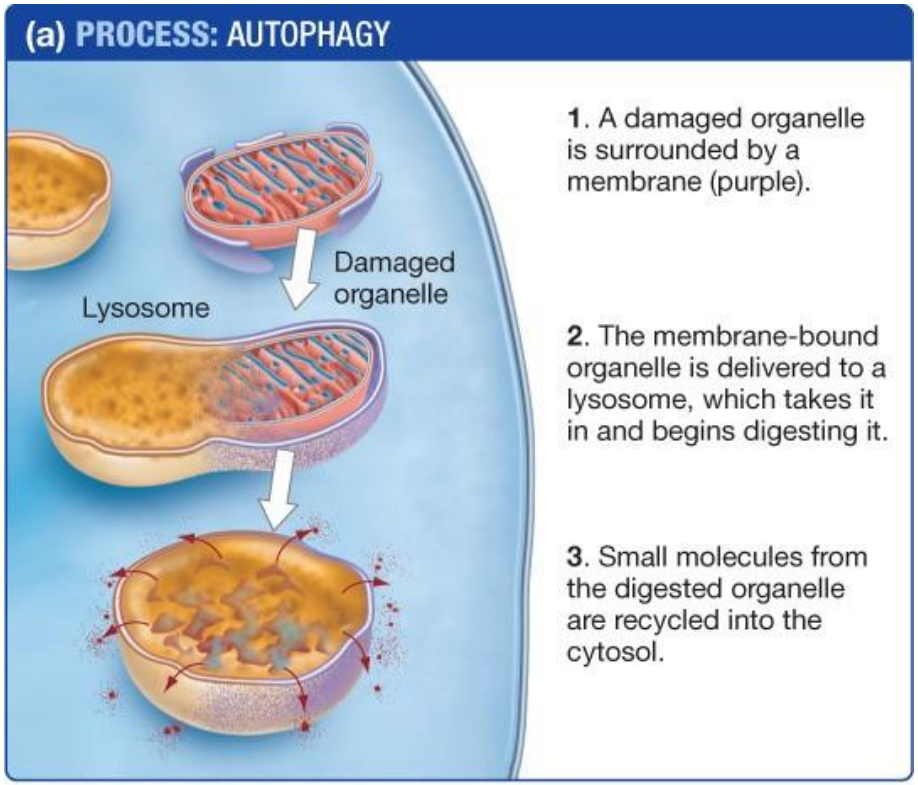
Intracellular Digestion



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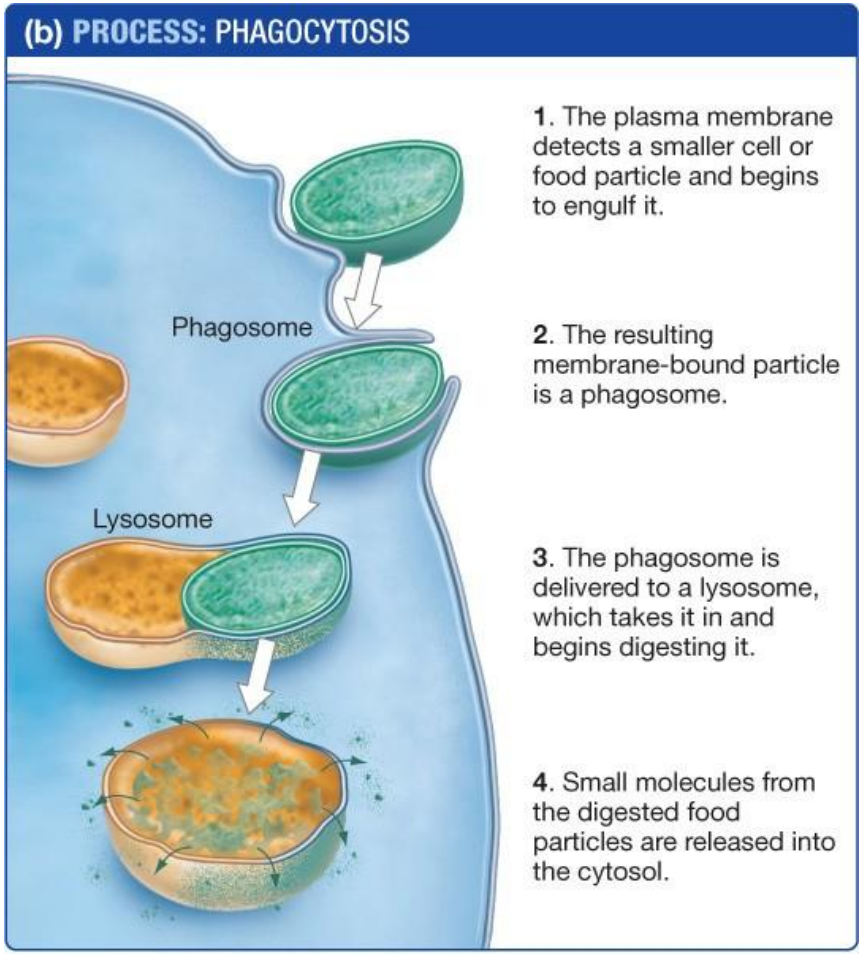

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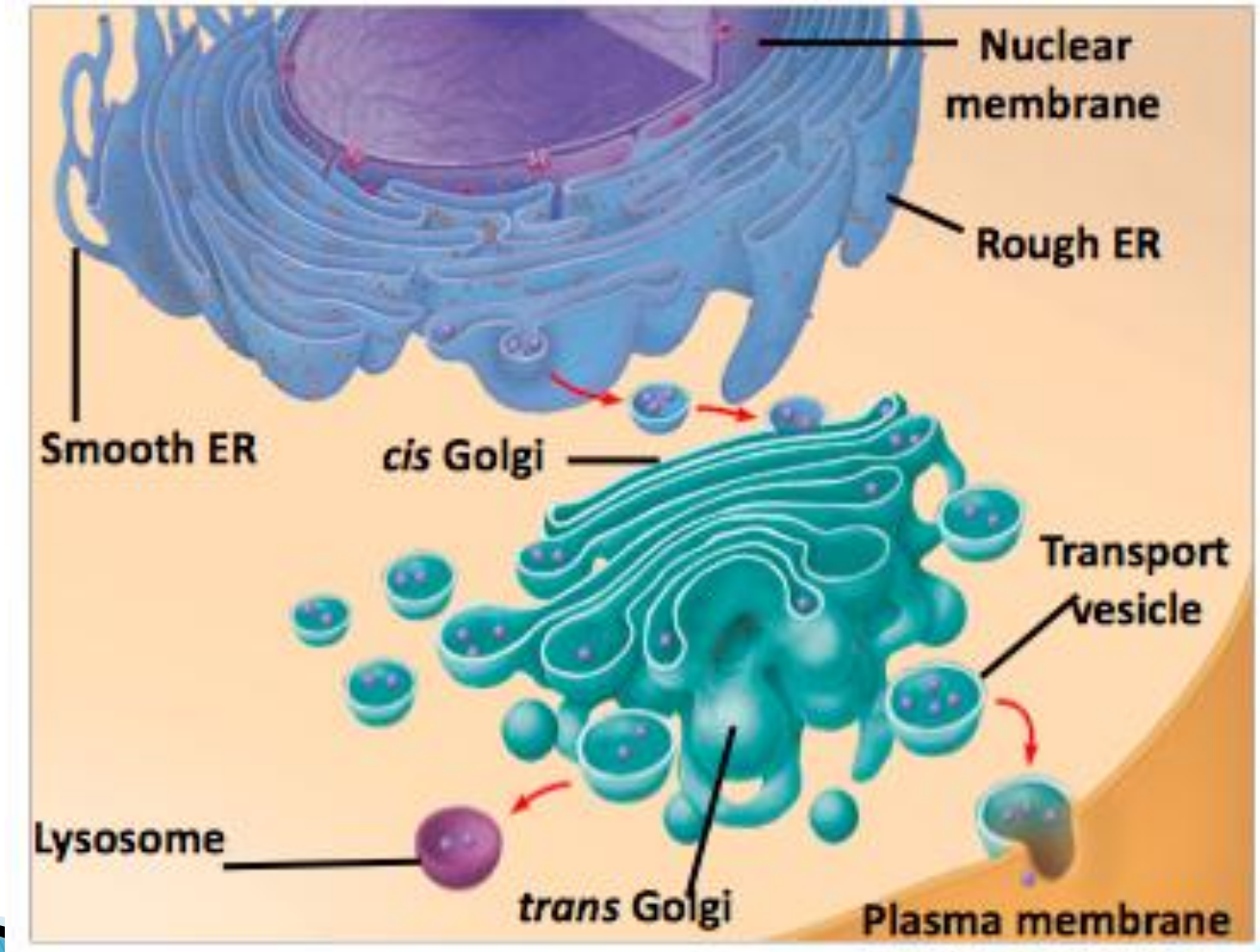
Endomembrane System



Observing the secretory pathway through pulse-chase experiments

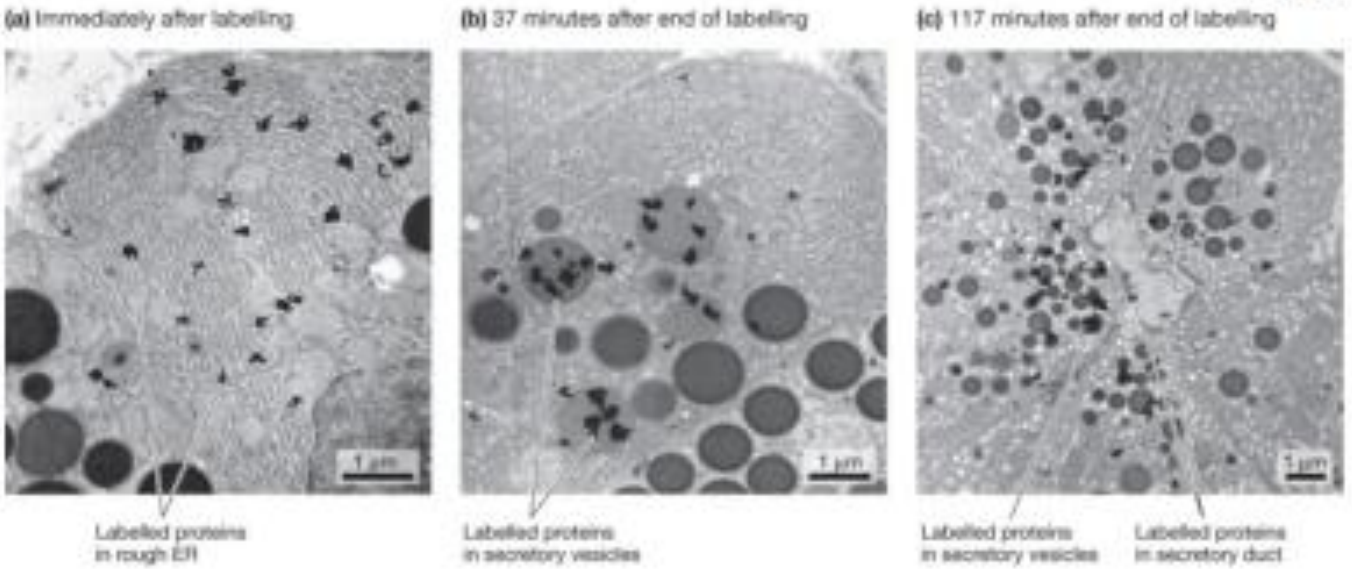
Procedure in pancreatic secretory cells:

-provide cells with 3 minute "pulse" of radiolabelled amino acid

-follow up with a long "chase" with unlabelled amino acid

-immediately analyze

George Palade

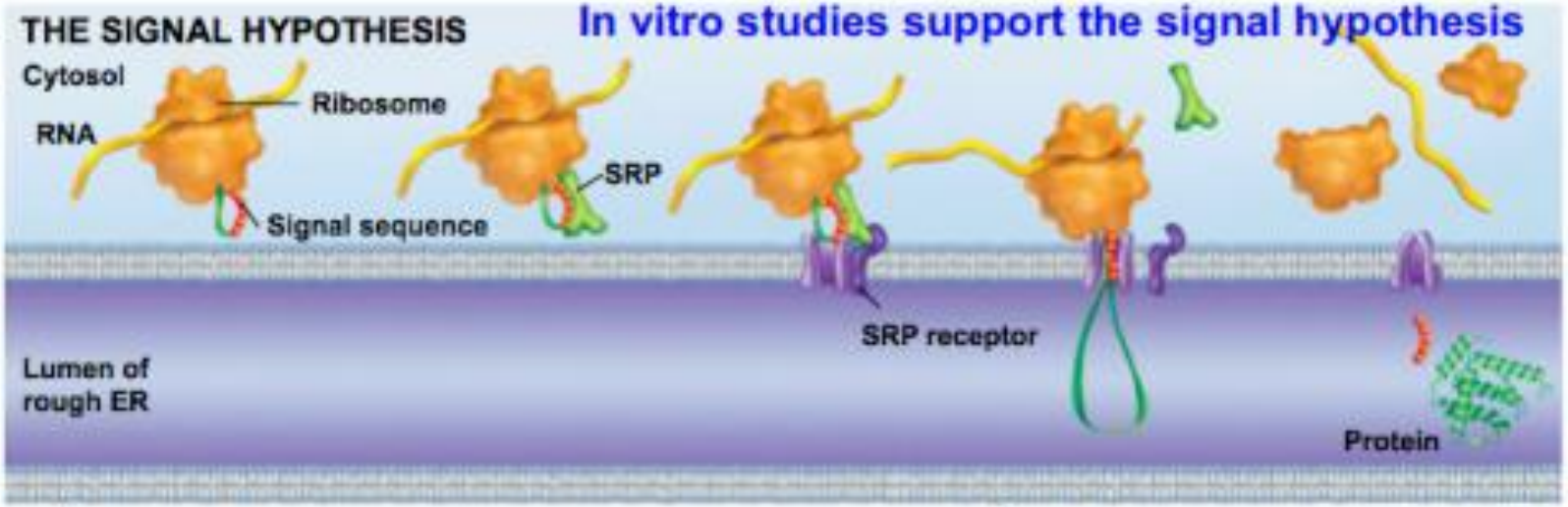


Result:

Can track radiolabelled amino acids through the endomembrane system

Signal Hypothesis

Signal hypothesis: proteins bound for the endomembrane system are synthesized by ribosomes attached to the ER
-the amino acid ***ER signal sequence*** brings the protein into the ER

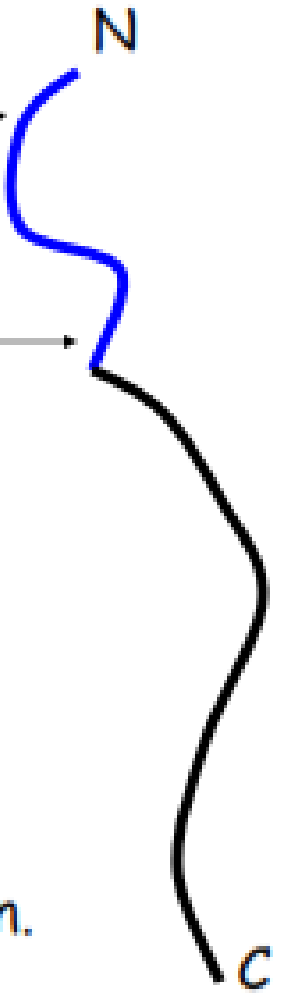


- *Polypeptides for organelles or release enter the lumen*
- *Membrane-bound polypeptides remain in the membranes*

Fig 7.27

1. Is there a peptide signal sequence?

16-30 N-terminal residues containing a
1. short positively charged domain
2. central hydrophobic domain
3. polar C-terminal domain



ER Signal Sequence on protein being synthesized directs ribosome to ER membrane

Sequence is removed during or after translation.

2. Is there a signal receptor?

Signal Recognition Particle (SRP)

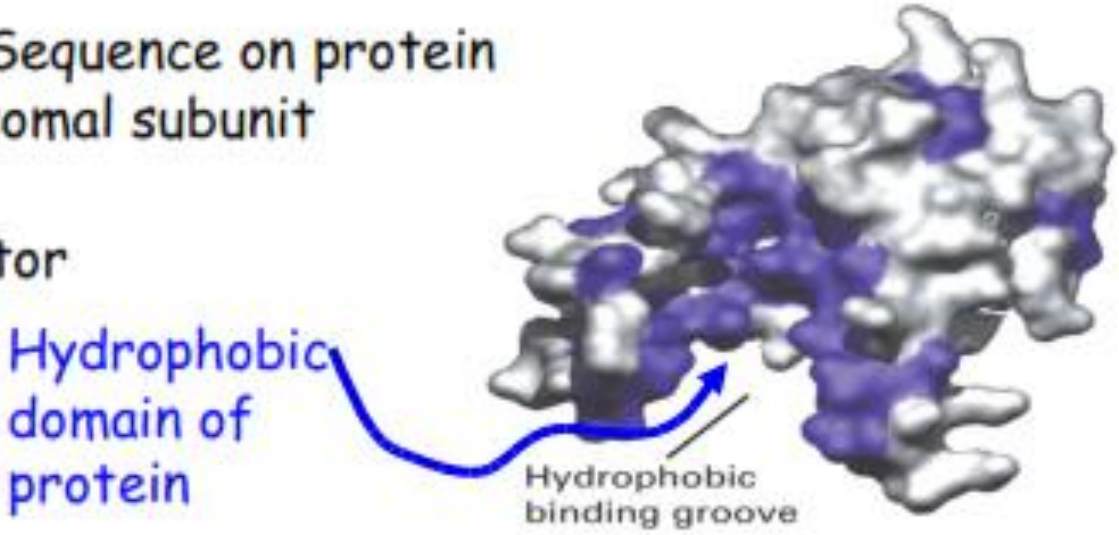
Cytosolic ribonucleoprotein particle is composed of 6 proteins and 300 nucleotide long RNA.

Translation stalls!

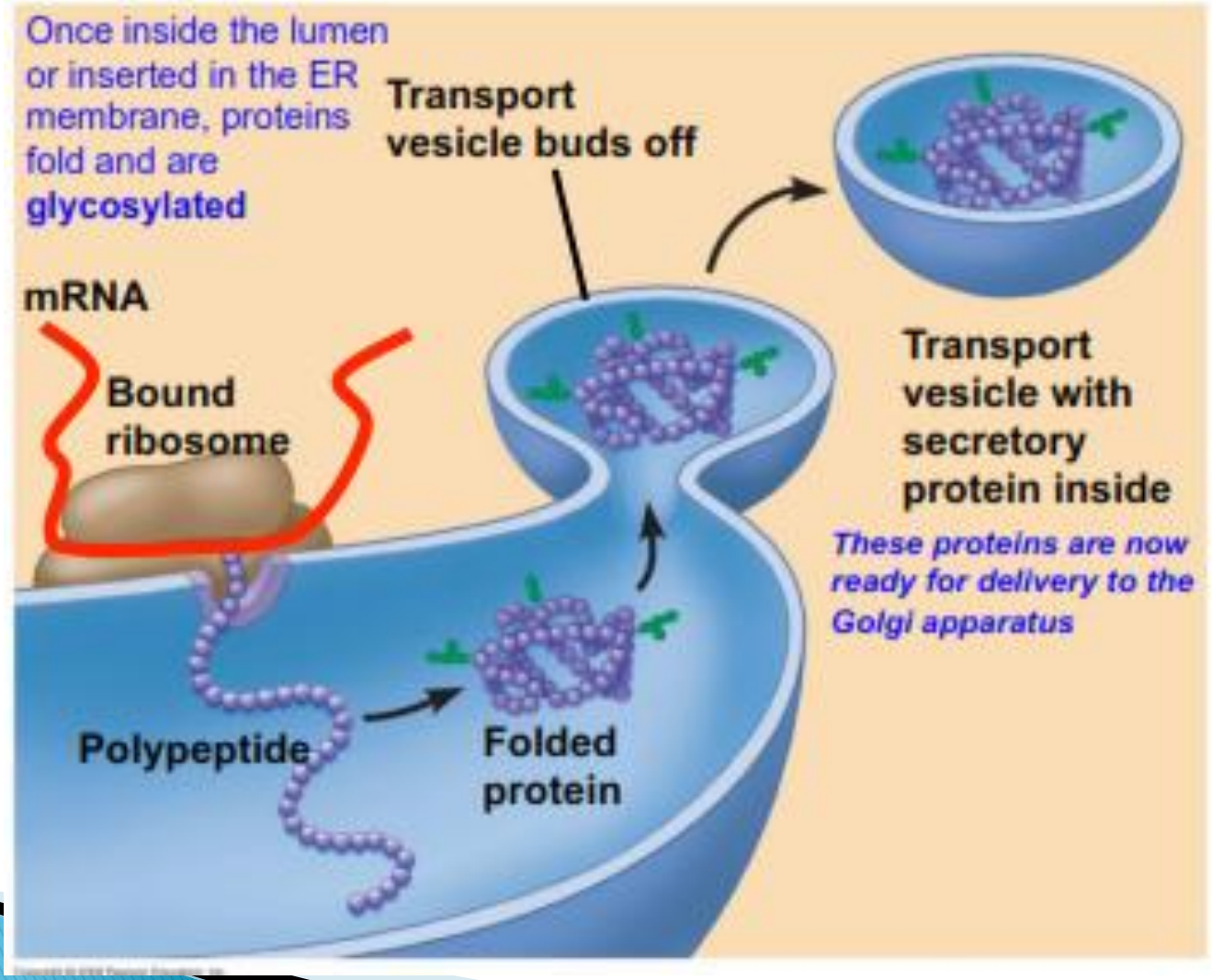
It transiently binds:

1. ER Signal Sequence on protein
2. large ribosomal subunit

3. SRP receptor



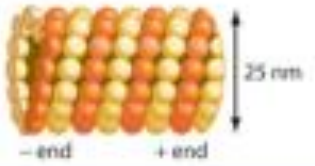
Post-Translational Modifications



Types of Filaments

SUMMARY TABLE 7.3 **Cytoskeletal Filaments**

The three types of filaments found in the cytoskeleton are distinguished by their size and structure and by the protein subunit of which they are made.

	Structure	Subunits	Functions
Actin filaments (microfilaments)	Strands in double helix 	Actin 	• maintain cell shape by resisting tension (pull) • move cells via muscle contraction or cell crawling • divide animal cells in two • move organelles and cytoplasm in plants, fungi, and animals
Intermediate filaments	Fibres wound into thicker cables 	Keratin or vimentin or lamin or others 	• maintain cell shape by resisting tension (pull) • anchor nucleus and some other organelles
Microtubules	Hollow tube 	α- and β-tubulin dimers 	• maintain cell shape by resisting compression (push) • move cells via flagella or cilia • move chromosomes during cell division • assist formation of cell plate during plant cell division • move organelles • provide tracks for intracellular transport

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Which of the following is not true of secreted proteins?

- A) They are synthesized in ribosomes.
- B) They are transported through the endomembrane system in non-membrane bound transport organelles.
- C) They are transported from the ER to Golgi apparatus.
- D) They contain a signal sequence that directs them into the ER.

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What is a possible function for cells that contain a lot of rough ER?

- A) Rapid cell division in growing bones or muscle
- B) Production and processing of fatty acids and lipids
- C) Movement via cell crawling
- D) Acquiring ions and other nutrients via specialized membrane proteins

What is a possible function for cells that contain a lot of rough ER?

- A) Rapid cell division in growing bones or muscle
- B) Production and processing of fatty acids and lipids
- C) Movement via cell crawling
- **D) Acquiring ions and other nutrients via specialized membrane proteins**

Which of the following sequences correctly lists in order the steps involved in the incorporation of a proteinaceous molecule within a cell?

a) synthesis of the protein on the ribosome; modification in the Golgi apparatus; packaging in the endoplasmic reticulum; tagging in the vesicle

b) synthesis of the protein on the lysosome; tagging in the Golgi; packaging in the vesicle; distribution in the endoplasmic reticulum

c) synthesis of the protein on the ribosome; modification in the endoplasmic reticulum; tagging in the Golgi; distribution via the vesicle

d) synthesis of the protein on the lysosome; packaging in the vesicle; distribution via the Golgi; tagging in the endoplasmic reticulum

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c) synthesis of the protein on the ribosome; modification in the endoplasmic reticulum; tagging in the Golgi; distribution via the vesicle

d) synthesis of the protein on the lysosome; packaging in the vesicle; distribution via the Golgi; tagging in the endoplasmic reticulum

THANKS FOR COMING AND GOOD LUCK!!!