

Lec. Three

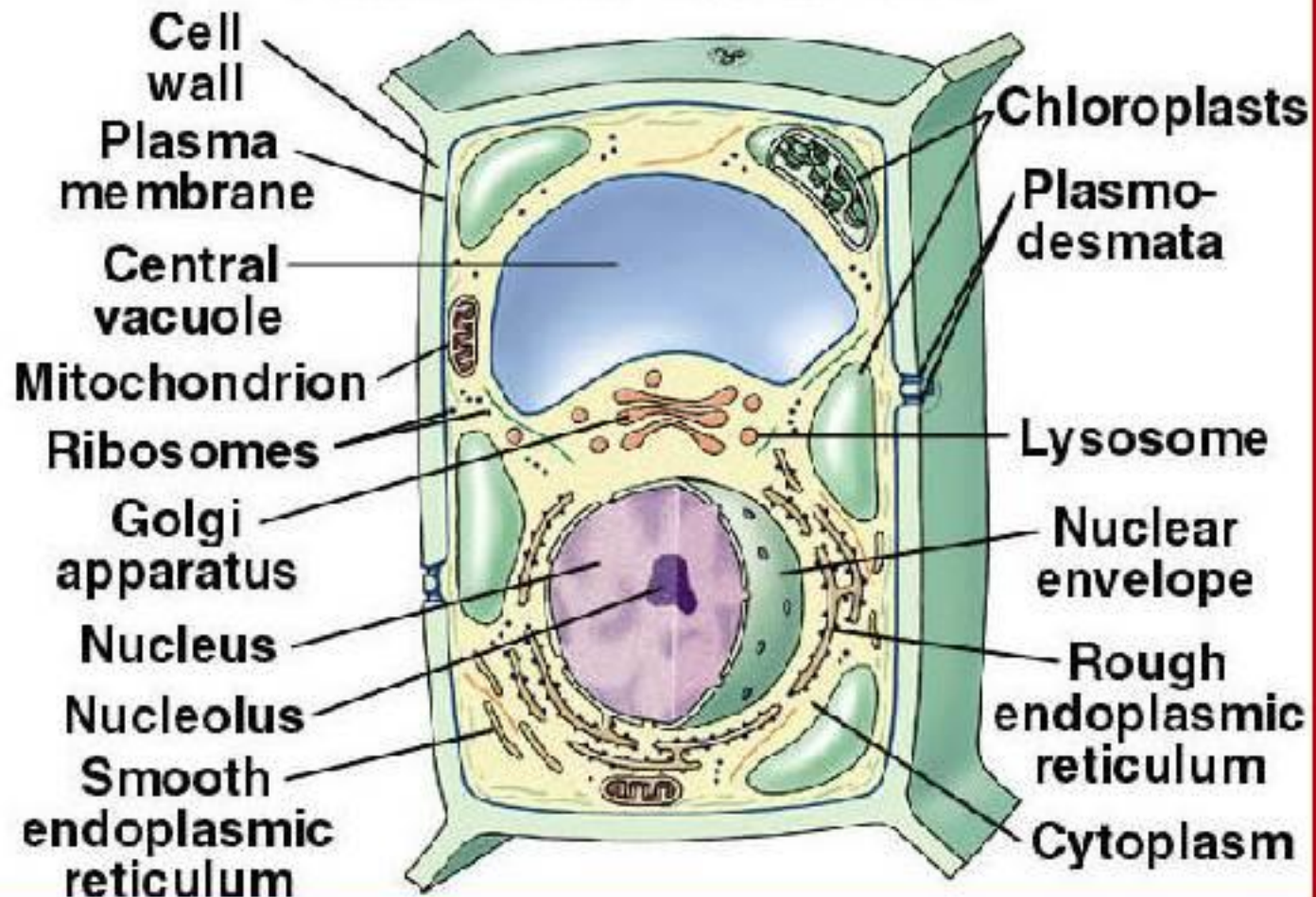
Plant Cell Wall

and

Cell Membrane

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Plant Cell Structure



Cell wall

Cell wall consist of 3 types of layers:

1.Middle lamella: This is the first layer formed during cell division. It makes up the outer wall of the cell and is shared by adjacent cells.

It is composed of pectic compounds and protein.

2.Primary wall: This is formed after the middle lamella and consists of a rigid skeleton of cellulose

microfibrils embedded in a gel-like matrix composed of : pectic compounds, hemicellulose, and glycoproteins.

3.Secondary wall: formed after cell enlargement is completed. The secondary wall is extremely rigid and provides compression strength.

It is made of cellulose, hemicellulose and lignin. The secondary wall is often layered.

Macromolecules of the cell wall

1. Cellulose – the most abundant plant polysaccharide (15-30% of the dry mass of the cell wall) Microfibrills – several dozen of (1→4) β -D-glucan chains.

Cellulose polymers associate through H-bonds. The H-bonding of many cellulose molecules to each other results in the formation of micro fibers and the micro fibers can interact to form fibers. Certain cells, like those in cotton ovules, can grow cellulose fibers of enormous lengths.

2. Callose

Differ from cellulose in consisting of (1à3) b-D-glucan chains that can form helical duplexes. Callose is made in a few cells at specific stages of development (growing pollen tubes, cell plates of dividing cells).

It is made in response to wounding or to penetration by invading fungal hyphae.

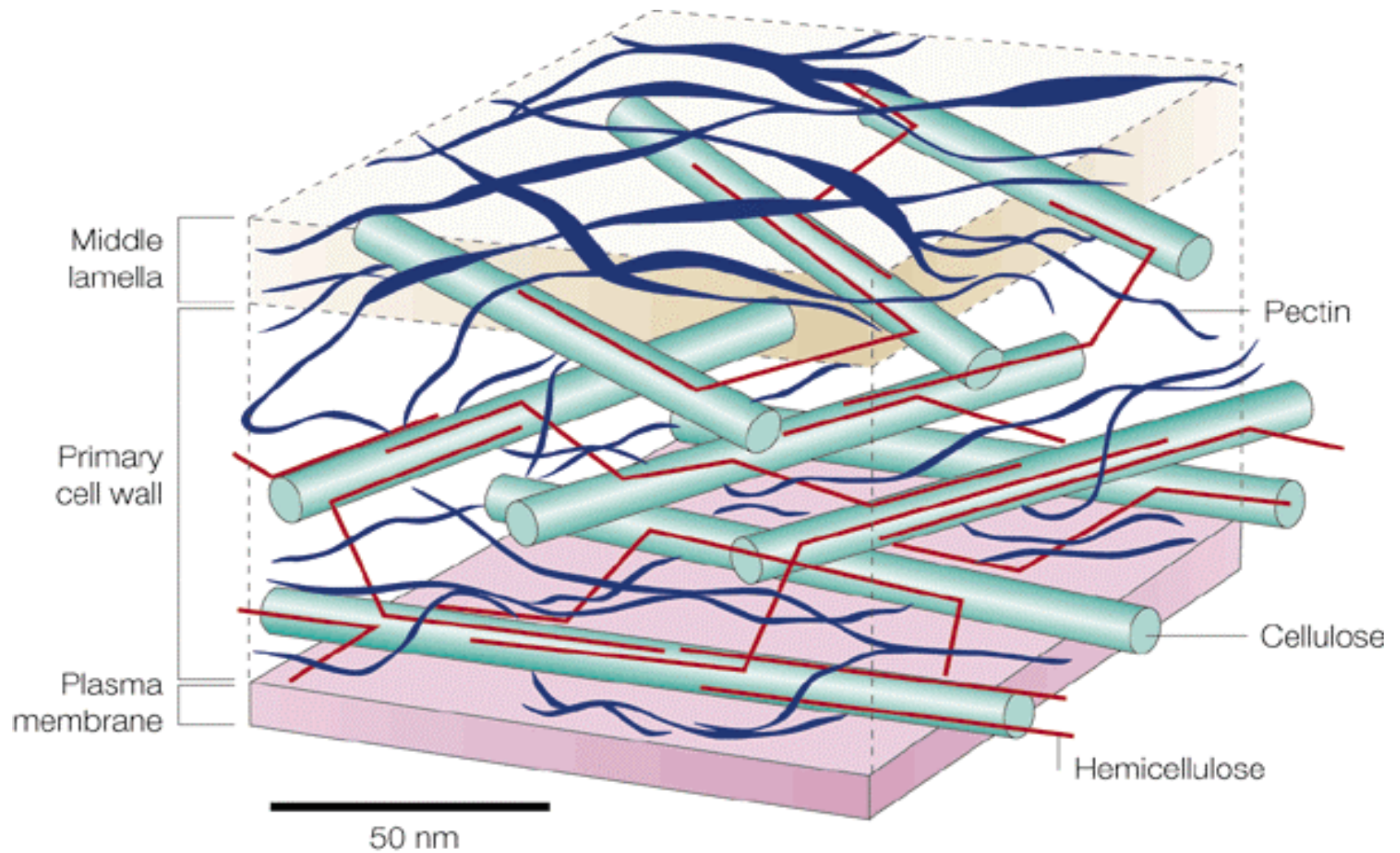
3. Pectic acid

polymer of around 100 galacturonic acid molecules - very hydrophilic and soluble - become very hydrated - forms salts and salt bridges with Ca^{++} and Mg^{++} that are insoluble gels - major component of middle lamella but also found in primary walls

4. Pectin

polymer of around 200 galacturonic acid - molecules - many of the carboxyl groups are methylated (COOCH_3) - less hydrated than pectic acid but soluble in hot water - another major component of middle lamella but also found in primary walls.

Cross-linking glycans Make hydrogen-bond to - cellulose. •XyGs – xyloglucans •GAXs - glucuronoarabinoxylans



Specialized functions of the cell wall

1.Structural:

a. Cell walls as food, feed, and fibers : Cell walls directly affect the raw material quality of human and animal food, textiles, wood, and paper and may play a role in human medicine.

b. Cross-linked matrix

2.Molecules affecting developmental pattern

3. Molecules defining cell's position within the plant.

4. Molecules of cell-cell and cell-nucleus communication

5. Defense against pathogens (impregnation with lignin)

6. Recognition of symbiotic nitrogen-fixing bacteria

Cell walls also contain functional proteins.

Enzymatic activities in cell walls include:

- Oxidative enzymes – peroxidases
- Hydrolytic enzymes - pectinases, cellulases
- "Expansins" - enzymes that catalyze cell wall

General functions of cell wall enzymes include:

protection against pathogens, cell expansion, cell wall maturation.

Cell (plasma)Membrane

Introduction

- *It is the thin layer of protein and fat that surrounds the cell, but is inside the cell wall. The cell membrane is semi permeable, allowing some substances to pass into the cell and blocking others.
- *No living cells on earth one finds without plasma membrane.
- *Cell membrane: defines cell boundaries
- *Internal membranes define a variety of cell organelles

Fluid Mosaic Model of membrane structure

*Mosaic: an object comprised of bits and pieces embedded in a supporting structure

1.membrane lipids form the supporting structure (phospholipids, glycolipids and cholesterol)

2.membrane proteins provide the bits and pieces : integral (intrinsic) proteins , peripheral (extrinsic) proteins

3.both lipids and proteins may be mobile or fluid

The Membrane Lipids

A. phospholipids

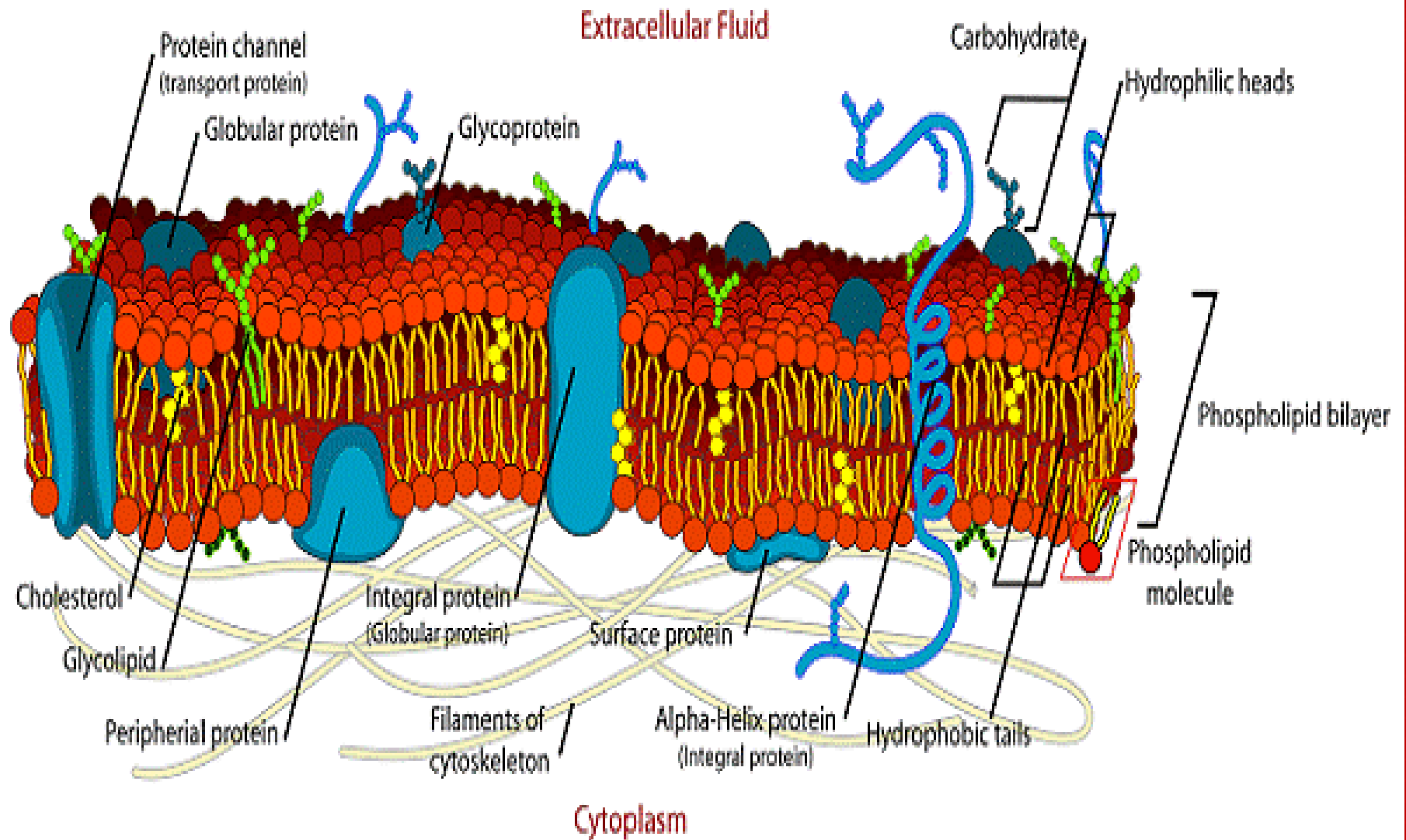
*most abundant of the lipids in membranes form a lipid layer

*Phospholipid layer may contain cholesterol; Lipid to protein molar ration is $\sim 50:1$ to $100:1$; the kind of phospholipids vary from one plant tissue to the other.

B. Glycolipids

1.least common of the membrane lipids ($\sim 2\%$)

2. always found in outer leaflet of plasma membrane



Membrane Functions

- *Form selectively permeable barriers
- *Transport phenomena
- *Cell communication and signaling
- *Cell-cell adhesion and cellular attachment
- *Cell identity and antigenicity
- *Conductivity