

The Cell

(4.1)

1665 - Robert Hooke - "cells"

1674 - Leeuwenhoek
"animalcules" ☺

★ our knowledge of cell has been a function of our TECHNOLOGY;

LM's - light microscopes

1) MAGNIFICATION - ratio of object's image size to real size 1,000 x's max

2) RESOLUTION - clarity of image
minimum distance 2 points can be separated.

- viewing organelles NOT possible with light microscopes. (in any detail)

EM's

- 1950's

- beam of electrons

- 100 times better than LM's

TEM's

- transmission electron microscope

- show internal structure of cells

- image displays a pattern of transmitted electrons

- stain with heavy metals.

- kills cell

SEM - scanning electron microscope
- kills cell
- 3-D
- topography

(2)

CYTOLOGY - the study of cell structure

* Cell Fractionation

- technique for studying cell structure and function.

- broken up cells spun in a CENTRIFUGE
- largest to bottom - repeat

4.2

All cells have:

- (1) Plasma Membrane
- (2) Cytosol - semi fluid, jelly-like substance
- (3) DNA - chromosomes
- (4) Ribosomes - make proteins

Eukaryotic Cells ("true nucleus")

- DNA enclosed by nucleus (double-membrane)

Prokaryotic Cells ("no true nucleus")

- DNA is concentrated in nucleoid (a region)

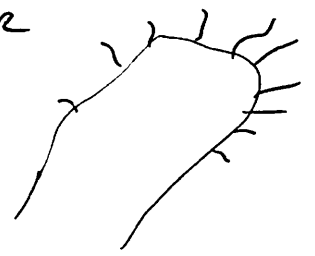
Cytoplasm - region between plasma membrane and nucleus

CYTOSOL - jelly-like substance in cytoplasm.

★ Some random prokaryotic structures:

(1) Fimbriae - attachment structures
on surface of some prokaryotes

(2) Capsule - jelly-like
outer coating of many
prokaryotes.



→ Membrane-bound organelles
absent in prokaryotes.

→ Eukaryotes (10-100 μm) are larger
than prokaryotes (0.1 - smallest) (1-5 μm avg)

SURFACE AREA to Volume Ratio

- SA must be large enough to
accommodate VOL

★ - so cells are small (even in large
organisms) and frequently elongated

⇒ MICROVILLI

increase surface area
without much of an increase in volume.

NOTE - Plasma membrane also participates
directly in the cell's metabolism
because many ENZYMES are built
into the membrane



Cells Parts (beyond Intro Bio)

(4)

- Centrosome - region where the cell's microtubules are initiated; contains pair of centrioles.

- Cytoskeleton

- a) MICRO TUBULES
- b) MICRO FILAMENTS
- c) Intermediate Filaments.

- Peroxisome

- produces H_2O_2 as byproduct of metabolic activity.

- Nuclear Envelope

- double membrane enclosing nucleus; continuous with ER

→ NUCLEOLUS

- non membranous structure → produces ribosomes; A nucleus has one or MORE nucleoli.

→ CHROMATIN - DNA & protein.

Animal cells have but plants do not:

(1) Lysosomes

(2) Centrosomes, with centrioles

(3) Flagella (except in some plant sperm)

In plant cells:

⑤

① Central Vacuole

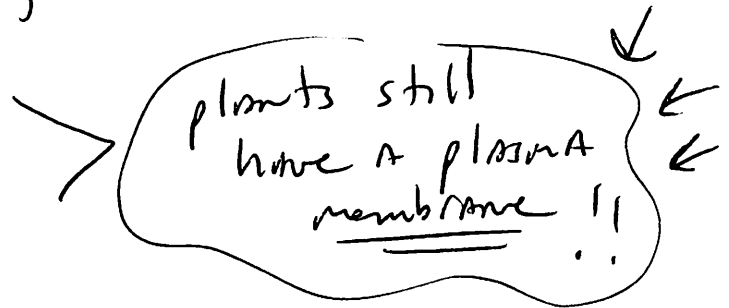
- enlargement $\rightarrow$ growth
- storage
- hydrolysis of macromolecules

② Chloroplast

- photosynthetic organelle - double-membraned

③ Cell wall

- cellulose
- maintain shape



④ Plasmodesmata

- channels through cell walls that connect the cytoplasm of adjacent cells.

4.3

NUCLEUS

- Nuclear Envelope (double) 20-40 nm space
- PORES - 100 nm diameter
 - $\rightarrow$ PORE COMPLEX
- NUCLEAR LAMINA - protein filaments on inner side of envelope.
- Chromosomes - DNA + proteins
 - Chromatin condenses to be visible during cell division.

• Nucleolus

- rRNA is made
- combined with proteins to make ribosomes which get exported to cytosol.

Ribosomes

— protein synthesis

(cells with lots of protein synthesis have prominent nucleoli and lots of ribosomes)

(for internal use) • Free — in cytosol

(for export mostly) • Bound — on E.R. or nuclear envelope.

4.4

Endomembrane System

- nuclear envelope
- endoplasmic reticulum
- Golgi apparatus
- lysosomes
- vesicles and vacuoles
- plasma membrane

- ★ • synthesis & transport of proteins
- metabolism & movement of lipids
- detoxification

Endoplasmic Reticulum (ER)

- half the total membrane in many cells
- network of membranous tubules and sacs (CISTERNAE)
- internal cavity called LUMEN

- Smooth ER - no ribosomes
- Rough ER - ribosomes attached

Smooth ER

- synthesis of LIPIDS (oils, phospholipids, steroids like sex hormones) - cells that secrete sex hormones have lots of smooth ER

• in liver cells that detox drugs and poisons (adds -OH groups to make them more soluble $\Rightarrow$ DRUGS/alcohol INDUCE production of smooth ER, thereby increasing tolerance)

- stores calcium ions (i.e. in muscle cells)

Rough ER

- produce SECRETORY PROTEINS
- most are Glycoproteins (carbs attached)
- kept separate from those produced for internal use

- vesicles bud from the
"transitional ER"

↳ TRANSPORT VESICLES

★ rough ER is a membrane "factory"
for the cell (including membrane proteins
and phospholipids from enzymes built
into the ER membrane)

GOLGI Apparatus (sacs - "cisternae")

• proteins MODIFIED, stored, and sent
to other destinations.

- "stacks" of coalescing vesicles
with a CIS (receiving) and trans (export)
side.

• carbohydrate regions of glyco proteins
MODIFIED

• phospholipids MODIFIED

• manufactures macromolecules like
polysaccharides (i.e. pectin)

GOLGI → lots unknown

"cisternal maturation model" ??

• Golgi adds ID tags like phosphate groups - for sorting and shipping !! ☺

(9)

Lysosomes

- sac of hydrolytic enzymes to digest macromolecules.
- acidic internal environment where enzymes work best.

Phagocytosis (i.e. amoebas or macrophages (WBC))
→ food vacuole merges with a lysosome.

Autophagy - cell recycles its own organic material

lots of "FUSING"!

→ if you lack the enzymes in lysosomes, big problems like Tay-Sachs.

Vacuoles

(10)

- (1) Food vacuoles
- (2) CONTRACTILE vacuolar - protists
- (3) Hydrolytic
- (4) Storage - proteins, pigment
- (5) CENTRAL VACUOLE
 - mature plants
 - cell sap

Quiz on FRIDAY on 4.1 → 4.4

Quiz on MONDAY on 4.5 → 4.7

↑
CHANGE