

Review Sheet – Chapter3 – Cytology

PART I – Cell Membrane, Plasma Membrane

Separates two fluids – extracellular and intercellular.

What it's made of – a lipid bilayer

Each layer is a layer of phospholipids, which are long lipids with a strongly polar end. They are arranged with the polar heads to the outside and the inside, with the nonpolar R's in the middle.

Has cholesterol in this membrane.

About 5% of the surface is Glycolipids

These are phospholipids with sugars attached.

Very complicated arrangement – each cell is different.

Cells use these arrangements of glycolipids for signaling and for recognition.

Lipid rafts – about 20% of the surface area is this.

Areas where molecules are concentrated.

Used in signaling.

Think cell phone towers.

Integral Proteins

Large proteins that extend through the membrane on both sides.

Some have channels through them.

Used as gates for transport.

Peripheral Proteins

Large proteins on the outside of the membrane only. Wide variety of functions.

Microvilli

Smaller than cilia – also function in absorption. Found in absorptive cells such as in the SI

Transport – main job of the plasma membrane.

Cells are bathed in interstitial fluid – an extracellular fluid.

Has thousands of kinds of molecules in it.

O₂, food, hormones, proteins, etc.

Plasma membrane has to selectively absorb some of these materials.

Selectively permeable is about the same as differentially permeable.

This is a characteristic of all living, healthy cells.

There are two ways: active transport and passive transport.

Passive transport.

Automatic. Materials move down the concentration gradient. In other words they move from areas of greater concentration to areas of lower concentration. AKA diffusion.

Diffusion of water is called "osmosis"

Things that can readily diffuse through the membrane include:

O₂, CO₂, lipids, non-polar molecules.

Why water can diffuse (it's polar) remains a mystery.

Facilitated Diffusion: a special kind of diffusion.

For molecules that are too big.

They can diffuse through the protein channels,

They can be ferried across by other molecules.

Tonicity: hypertonic, hypotonic, and isotonic.

Isotonic is 0.9% salt, or 5% glucose.

Active transport:

Requires energy (ATP → ADP + P)

Moves materials UP the concentration gradient.

e.g. sodium pump.

e.g. vesicular transport, several kinds. Vesicles are like "vessels".

Exocytosis, out, wastes

Clathrin-clad, brings materials in.

One way pathogens can sneak in.

Phagocytosis

A way to get really large things inside.

In humans, done by WBC's

Amoeboid-like.

Pinocytosis

Takes in tiny amounts of fluid.

Very common.

A way the cell samples its environment.

Happens continuously.

Voltage

A cell membrane has a voltage across the membrane – about –50 to –100 millivolts.

Part II – Cytoplasm pgs 84 – 97

Cytoplasm and cytosol – differences.

Organelles, general definition.

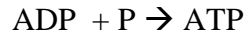
Inclusions, smaller than organelles, large chemicals, examples. Inc. glycogen in the liver,

Fat droplet in fat cells, and melanin in skin/hair cells.

Mitochondria: what they look like.

Busy cells have hundreds of them.

They store energy as ATP when sugars are broken down:



Requires O₂

Called *aerobic cellular respiration*

They release this energy as ATP → ADP + P as needed.

They have their own DNA and RNA – inherited from the mother only.

They are able to reproduce themselves.

Their DNA is very similar to one group of bacteria.

Current hypothesis is that they developed from this bacteria, which parasitized an ancient cell.

Ribosomes:

Tiny, and made of rRNA, = Ribosomal RNA

They perform protein synthesis.

Two kinds: free and membrane-bound ribosomes.

Free ribosomes float freely in cytoplasm.

Makes proteins used in the cytosol

Membrane-bound ribosomes are on ER

They make proteins for export – hormones, etc.

The two kinds of ribosomes can switch back and forth.

ER = Endoplasmic Reticulum:

Network of tubes, vessels and vesicles

Function in transport.

Two kinds: rough and smooth ER

Rough ER has ribosomes on it.

Transports the proteins that these ribosomes makes.

Common in secretory cells.

Smooth ER connects to the rough ER

No ribosomes; does not make proteins.

Catalyses reactions involving:

Use of lipids – synthesis, storage, metabolism,

Detoxification of drugs and other chemicals,

Breaks down glycogen into glucose.

Golgi Apparatus – the packagers.

Know what it looks like

Modifies, concentrates, and packages the lipids

and proteins made by the Rough ER.

Some sugars are trimmed, others are added, and proteins are tagged with their receiving address.

Lysosomes – the disintegrators

Spherical

Contain digestive enzymes

Common in phagocytes

Work in an acid environment

They break down:

Bacteria, viruses, toxins

Worn-out organelles

Non-useful tissue (read examples)

Break down bone to release Ca^{++} as needed.

Autolysis – self-destruction of the cell.

Endomembrane system – cellular version of CV system

Includes ER, Golgi apparatus, secretory vesicles, Lysosomes and cell membrane.

Other organelles include:

Peroxisomes – use O_2 to break down chemicals,

Neutralize free radicals

Very active

Self-replicating

Cytoskeleton – like the bones of a cell

Network of three kinds of rods

a) Microtubules – largest, organelles attach to them and move across them, and they are always changing. Radiate out from the centrosome.

b) Microfilaments – made of actin, change cell shape, cause movement, most common in muscle cells; “cells move when they get their act(in) together”.
Ouch.

c) Intermediate filaments, act like ropes or guy-wires to hold the cell together.

Centrosome and Centrioles

Centrosome is the general area. Near the center of the cell, and contains the Centrioles.

Centrioles – two of them, perpendicular, has two roles.

Generates the microtubule matrix.

Organizes the spindle during mitosis.

Cilia and Flagella

Not used in motility in human, as they are in primitive cells.

Cilia are on exposed surfaces of cells. Examples:

Cilia on bronchiole tubes

Oviduct

Cell move objects one way. 10-20 strokes / second.

An extension of microtubules.

How they work and are coordinated is still a mystery.

Longer, fewer ones are flagella

Flagella are used in motility, e.g. sperm.

Nucleus – several jobs. Control the cell thusly:

Contains the genetic library for the cell (except mitochondria)

Determines what proteins to be made at any time

Determines quantities of proteins to be made.

Some cells are multinucleate, e.g. large muscle cells, other

Large cells

RBC's are anucleate.

Cannot produce mRNA, therefore cannot make proteins, and therefore deteriorate after 3-4 months.

Three areas or parts to nucleus:

Nuclear envelope, nucleoli, chromatin.

Nuclear Envelope is selectively permeable, and Connected to the ER.

Has pores for rapid transport of proteins.

Nucleoli – no membrane, areas where ribosomal subunits are assembled.

Chromatin – has the DNA and other molecules as a network of fine threads.

before mitosis these threads condense shorten and thicken and are called *chromosomes*.

PART III- Cell Growth and Reproduction, pages 97 –

Two parts of a cell's life – *interphase*, when it carries on its activities, and *mitosis*, when it divides in two.

Interphase can be further subdivided into 4 suphases: G_1 , G_0 , G_2 , and S

G_1 – Cell growth, protein manufacture, and basically no activities relating to mitosis.

G_0 – Cells that do not divide and permanently in G_0

S – DNA is replicated.

G_2 – Brief phase. Centrioles replicate, and mitotic enzymes are Produced. Cell is ready to divide BUT continues its activities as a cell.

DNA Replication – basically what happens is that the DNA is uncoiled and splits down the middle- each strand produces a complementary strand until there are two exact copies of the original DNA.

Each copy has one original strand and one complementary strand. Numerous enzymes are involved.

New endcaps (telomeres) are added to eachend to protect them. The strands then condense and shrink to form chromatids. The chromatid pairs are held together by a centromere until anaphase.

Rates of cell division:

Some cells, like skin cells, reproduce almost continuously as they wear away.

Some cells, such as liver cells, stop dividing when the organ is developed but they still have the ability to divide if needed for repair.

Some cells, such as nervous, skeletal and heart muscle, rarely or never divide after maturity; repairs are made with scar tissue (a kind of CT)

Cell Division

Cell Division (M phase) has two events:

Mitosis – division of the nucleus

Cytokinesis – division of the cytoplasm.

Note: Meiosis is different – only produces half the number of chromosomes. Save for chapter 27!

Mitosis – 4 phases, prophase, metaphase, anaphase.

Cytokinesis – begins in late anaphase and is completed after telephase ends.

Control of cell division – poorly understood, involves surface area/volume ratio and numerous triggers, hormones and proteins.

Surface area/volume ratio- as the size of a cell increases the volume increases with the cube of the cell radius, and the surface area only increases with the square of the cell radius. At some point, then, there is not enough surface area to meet the cell's needs for absorption of materials from the outside and it is forced to divide, stop growing, or die.

Protein Synthesis

Explain the function of genes

Understand the differences between the two phases of protein synthesis
(transcription, translation)

Describe the roles of DNA, mRNA, tRNA and rRNA

Know a little about the composition of extracellular materials

Understand the concept of cell differentiation.

