

→ Cell is the smallest unit of matter that can carry on all the processes of life.

→ Invention of microscope enabled Robert Hooke (1665) and Anton Van Leeuwenhoek (1675).

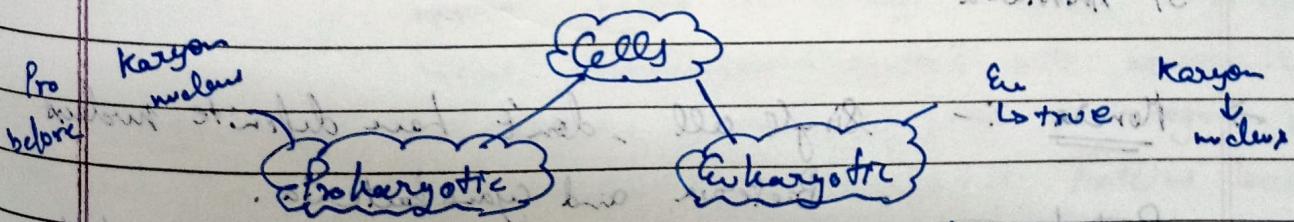
→ Cell theory - Cells only come from other cells. in 1840

- All living things are composed of one or more cells.
- Cells are basic units of structure and function in organisms.
- Cells come only from replication of existing cells.

→ Cell Theory was proposed by Matthias Schleiden and Theodor Schwann in 1839.

New version of Cell Theory

- Cells carry genetic material passed to daughter cells during cellular division.
- All cells are same in chemical composition.
- Energy flow occurs within cells.



- Unicellular organisms → multicellular organisms
- Single chromosome → Multiple chromosomes.
- No nucleus, mitochondria, cell organelles → Internal organelles present, membrane-bound nucleus
- e.g.: all form of cells except viruses.
- e.g.: Bacteria, blue green algae.

→ Internal structures of cell → cell organelles

→ Organelle → cell component which performs a specific function in that cell.

→ Cell is surrounded by cell membrane.

→ Nucleus, mitochondria, and chloroplasts are surrounded by double membranes called envelope.

membrane → fluid mosaic

made up of → proteins and phospholipids

→ Proteins in membrane can be used to transport substances across the membrane.

Eg: by facilitated diffusion or by active transport.

→ In 1982, Margulis and Schwartz proposed a system which used the 5 kingdoms classification of living organisms. The prokaryote and eukaryotic kingdoms.

1) Monera (Prokaryotic)

2) Protista

3) Fungi

4) Plantae

5) Animalia

→ Monera: - Single cell, don't have definite nucleus.

Bacteria and cyanobacteria.

→ Protista: - They were autotrophic and heterotrophic.

Motile, non motile, unicellular, multicellular.

Eg: Blue green bacteria.

This will be covered in : bio.

bio

bio

bio

Prokaryotes : • All but have nuclear membrane.

• Prokaryotes resemble the ancestor of plants, animals and fungi.

• Eg : Algae, protists, blue algae.

Fungi : • Heterotrophic, non-motile.

• Do food digested outside the body of organism, and products of digestion absorbed.

Eg : Yeast, mushrooms.

Plants : • Autotrophic, non-motile.

layer

Plasma Membrane : • Outer Covering of animal cell.

• Allows entry and exit of some materials in and out of cell.

• Called selectively permeable membrane.

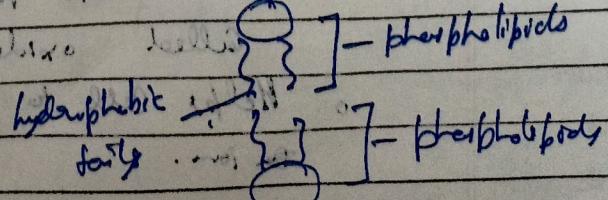
* Fluid mosaic model of membrane structure was proposed by S.J. Singer and G.L. Nicolson in 1972.

Structure of plasma membrane

- Contains lipid bilayer with hydrophobic tails inside the bilayer while hydrophilic 'polar' heads are in contact with aqueous soln.
- The membrane proteins, intrinsic or integral proteins are deeply embedded and peripheral proteins loosely attached/float in the environment of fluid phospholipid bilayers with a hydrophilic "head".

water molecules of solution

water molecules of solution



- Mitochondria
- Cylindrical, double membrane structure that is composed of outer and inner membrane.
 - inner membrane → cristae
 - tube like projections → tubules.
 - Mitochondria are sites of aerobic respiration.
 - Energy from organic compounds is transferred to ATP molecules to be used.
 - Have their own DNA; and new mitochrondria arise only when existing one grows & divides.
 - They are semi-autonomous organelles.

- Cytoplasm
- fluid content inside plasma membrane (i.e.) organelle free sap. No nucleus.
 - Made up of cytosol, substance outside nucleus which is not nucleus is known as cytoplasm.
 - Cytosol = jelly-like substance.
 - Organelles are suspended in it.
 - Metabolic reactions take place inside cytoplasm where substrate interacts.

Junctions

Produce energy used

Simple molecules and nutrition, transport to the interior (mitochondria) which are processed and produce energy charged molecules.

- These charged molecules mix up with oxygen and ATP molecules to produce energy. This process is called oxidative phosphorylation.
- Helps cell to maintain the concentration of calcium ions.
- oxidative phosphorylation

Ribosomes

- o Site of protein synthesis.
- o Larger subunit (60S)
- o Smaller subunit (40S)
- o It is a cisternal unit.
- o Nucleus of equal parts of protein and RNA.
- o Found in mitochondria in animal cell and chloroplast in plant cell.

Endoplasmic Reticulum (ER)

- o Interconnected system of membrane-bound channels in cytoplasm.
- o ER consists of flattened, membrane-bound sacs called cisternae.
- o Rough ER.

↳ Number of small ribosomes

are attached to outer surface of membrane

It is site of protein synthesis.

Smooth ER

↳ Ribosomes may be absent forming smooth ER.

Smooth ER

↳ Rough ER is concerned with the transport of protein

bcz of presence of ribosomes on its surface.

↳ Smooth ER is a site

where the synthesize of non-protein substances like phospholipids and glycolipids, steroid hormones, etc.

Golgi apparatus

- o Complex cytoplasmic structure made up of cisternal.

Functions

- o Takes part in membrane transformation, secretion and production of complex biomolecules.
- o Eg: synthesis of protein from ER.

Lysosomes (Cytolytic bags)

- o Lysosomes are small spherical organelles.
- o Site of protease digestion.
- o Site of food digestion in cell.

o formed from pieces of Golgi apparatus that breaks off.

o Rare in plant cells.

functions

- o Lysosome membrane does contain an enzyme which breaks down macromolecules.

and digest worn out components; also known as acidic bags.

(Withdrawing the Golgi apparatus)

→ In autophagic process, mitochondria and ER undergo digestion in lysosomes.

It serves extracellular and

intracellular digestion, hormonal secretions etc.

* CYTOSKELETON

Cytoskeleton maintains the shape of cell, and helps

cell to move.

Cytoskeleton

Microfilaments

Microtubules

Contractile prop. is rigid

Made of actin

Common in motile cells.

* CYTOSKELETON & FLAGELLA

* NUCLEUS

Found in eukaryotic cells.

Largest cell organelle

Basic structural and functional unit of living organisms.

Diameter = $10 \mu\text{m}$.

Contains cell's genetic material.

Regulates the growth and reproduction of cell and carries hereditary characters.

Regulates gene expression.

* CELL WALL

Structural layer surrounding the cell just outside cell membrane.

Function is to protect cell.

Can be tough, flexible and rigid.

* CENTRIOLE

Consists of bundles of microtubules at right angle to each other.

Each bundle consists of fibres in characteristic arrangement.

At start of mitosis or meiosis centriole divides.

One half moves to each end of all forming the spindle.

Spindle fibres are later shortened to pull chromosomes apart.

- made up of cellulose and protein
- In bacteria, is made up of peptidoglycan.
- Prevents over expansion of cell when water enters.

* Chloroplast

- Cell organelles found in plant cell - conducts photosynthesis.
- Found in cytoplasm in numbers varying from 1 to 100.
- 3 to 10 μm in diameter.
- Interval within chloroplast is called stroma.
- Stroma contains of many flattened fluid filled sacs called Thylakoids.
- Thylakoids form stacks called grana at each interval.
- Photosynthesis takes place inside Thylakoids membrane.

* Vacuole

- Enclosed compartments filled with water containing inorganic and organic molecules - including enzymes in soln.
- In mature plant vacuoles tend to be very large.

- Provides structural support.
- Functions such as storage, waste disposal, protection, growth etc.
- Central vacuole in plant cells enclosed by a membrane called tonoplast.
- Functions
- Storage bags for enzymes, sugars, proteins, in plant.
- Involved in transport of materials within the cytoplasm.

(Plant Cell)	(Animal Cell)
• Rigid cell wall made of cellulose	• Cell wall absent.
• Presence of chloroplast.	• Absence of chloroplast.
• Cell wall \rightarrow Plant cells are larger	• Animal cells are smaller
• Vacuoles present	• Vacuoles absent
• Cell division \rightarrow Centrioles and Centrosomes are absent.	• Centrioles, Centrosomes are some present

Components of cell

- Lipid
- Phosphate
- phospholipid
- Glycolipid.
- Carbohydrate
- Protein
- Vitamin

Prokaryotes

- o 1 to 10 μm in diameter.
 - o 10 to 100 μm in diameter.
 - o Internal compartments o Several different kinds of organelles about.
 - o DNA is free in cytoplasm as nucleoid.
 - o DNA is present in nucleus.
 - o Mitosis in somatic cell and DNA replicates meiosis in gametes.

Proteins → macromolecules

composed of N, C, H, O and

~~S. novi~~ ~~A.~~ ~~Sted. t. w. P.~~

Amino acids units linked by peptide bonds

Carboxyl group (COOH) and Amino group (NH₂)

~~Based on~~ ~~intended~~ ~~o~~

have wanted).

Quaternary

Primary - Amino Acid sequence

- sequence of diff. amino acids.
- Amino acids linked through peptide linkage
- linear, unfolded
- Carbonyl group + Amino acid

- o linear, unfolded state
- o Carboxyl grp + Amino acid

Ward 10
Ward 11

Eukaryotes

- 0.90 to 1.00 mm in diameter.

- ## Secondary (Ultra-structure)

- o Coiled peptide chain
 - o folding and H-bonding leads to formation of helix structure.
 - o Rigid tubular structure.

Al₆La

Béla

Alpha — *Beta*
Nelis *vitellina* *pro* *Nelis*

~~should do today~~

Spiral chain with two or more series of one peptide chain

amino acids, ~~higher~~ sustained by
linked highly w/ one of the H-bonding
H-bonding interactions ~~in the~~ Eg: muscle

Tertiary Structure

- o involves folding of chain (helix)
 - o forms globules
 - o Alpha-helices and Beta-helices are folded into compact globules
 - o It is folded into and irregular form and it has helical and non-helical segments
 - o Bond involved in folding are disulfide, N-bond, hydrophobic

Enzymes

Microtus *gibberi*, admirabilis

~~lower end soft~~

After work at 6:30

Structure

Globular proteins

- Consists of 2 or more peptide chains
- This association of sub-units into large size molecules is referred to as the quaternary structure.

e.g.: Haemoglobin → oxygen binding blood protein.

→ the α and β chains are held together by ionic and π -bonds.

The two pairs are then joined with the help of hydrophobic forces, π -bond.

∴ four polypeptide chains fit together.

Protein

- Building and repair of body tissues
- Source of energy

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Metabolism

- Set of chemical reactions that happen in cells of living organisms to sustain life.

Metabolism

Catabolism

Breakdown

Organic matter

e.g.: Respiration

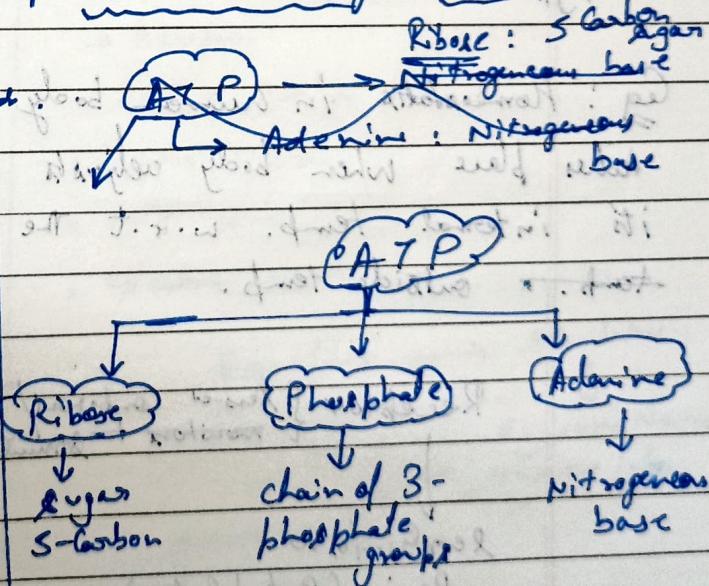
Anabolism

uses energy

to construct all components

→ Energy trapped and stored in form of ATP.

Cellular Energy - ATP



- ATP → Energy currency of all functions
- Regenerated from ADP

- Chemical work → ATP supplies energy to synthesize macro molecules.

• Transport work: ATP supplies energy to ~~synthesise~~ pump substances across plasma membrane.

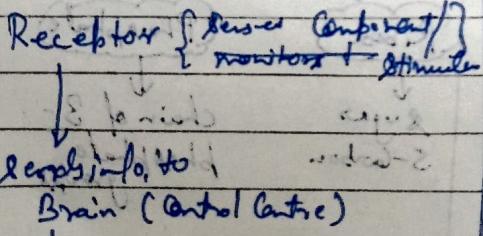
• Mechanical work: ATP supplies energy for cellular movements.

Homeostasis

→ Process of keeping the internal body environment in steady state w.r.t changes outside the body.

→ Achieved by the help of nervous and endocrine system. These actions are co-ordinated by hypothalamus.

Eg: Homeostasis in human body takes place when body adjusts its internal temp. w.r.t the temp. outside temp.



Generates response in response to stimulus

Sends signal to effector

Change occurs after receiving signal.

Endotherms

- Animals which maintain fairly const. temp.
- Normally maintain a fairly const. body temp. at 35-40°C.
- Warm-blooded animals.
- Produce heat through internal means.
Eg: birds, mammals.

Ectotherms

- Animals that have variable body temp.
- Cold-blooded animals
- Cannot regulate their own body temp.
- Absorb heat from surroundings in order to warm their body.
Eg: Reptiles, Amphibians.

Vasoconstriction

Arterioles near skin constrict

Decrease in internal diameter of blood vessels

Lets blood flow through Capillaries in dermis surface

Heat loss reduced

Nodilation

Arterioles near skin dilate

Increase in internal diameter of blood vessels

More blood flows through Capillaries in dermis surface.

Heat loss from skin by radiation. Temp is raised.

Blood

- Transport carbohydrate in animals
- Restricted amount [80-120 mg]
- hypoglycaemia (low level)
- Hyperglycaemia (high level)
- Blood sugar controlled by pancreas.
- Pancreas has glucose receptors, which monitor concentration of glucose.

Endocrine cells in pancreas

~~Hormones~~ secrete

→ Insulin :- stimulates the uptake of glucose for respiration.

→ Converts glucose to glycogen in liver (glycogenesis).

∴ Decreases blood glucose.

→ Gluconeogenesis :- Helps in breakdown of glycogen into glucose in liver (glycogenolysis). Increases blood glucose.

Somatic → Contraction of skeletal muscle

autonomic → Activation of smooth, cardiac muscles.

body detects changes (intact/extra)

→ Gas Receptors generates nerve impulse

↓
to coordination centre

and then

↓
Response from CNS

↓
Sensory effector

This is reflex arc.

CNS — Spinal Cord

None

Brain

cell

↓
Components involved in reflex arc

o Receptor

o Sensory Neuron

o Motor Neuron

o Inter Neuron

o Effector

Receptor → Stimulates

↓
Sensory Neuron receives info

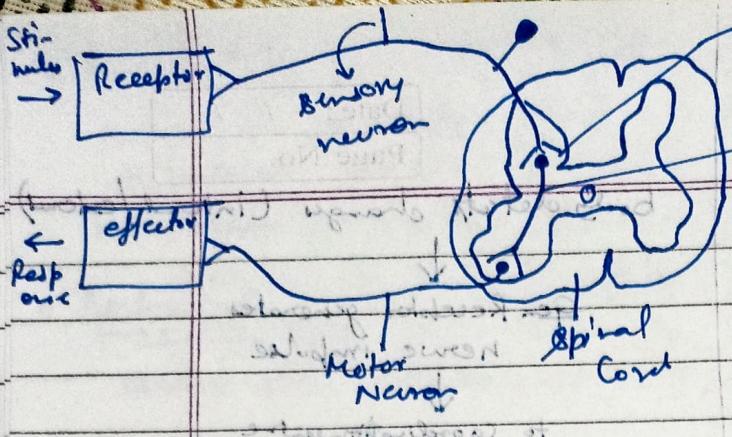
↓
Sends message
to inter neuron

↓
it transfers and
interprets impulse

↓
Motor Neuron

↓
Sends info to effector

↓
Motor Neuron sends signals
Sends instructions to effector.



Cell Division

- Responsible for growth and reproduction.
- Division in unicellular leads to reproduction of entire organism.
- 3 types → Mitosis, Meiosis, Binary fission.

Binary fission {Cell Div in Prokaryotes}

Chromosomes attached to inside of cell membrane

makes a copy of it

resulting in ~~identical~~ chromosomes identical

attached inside same cell

Then the cell continues to

grow, to double the size of it

After that it, cell will

begin to form clusters of chromosomes

Finally, cell splits into two new cells.

integrin center

interior

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Cell Division in Eukaryotes

• Starts at other protein.

Cell cycle: Phases & life of cell

3 phases

1. Interphase

2. Mitosis

3. Cytokinesis

Interphase

• Longest phase in cell cycle.

• Interphase is the "resting

phase" also known as

• During this phase cells carry out regular functions like respiration and enzyme production.

• Cells grow, develop and mature in this stage.

3 phases of interphase

→ G₁ phase (First Gap/Growth phase)

• Period of normal metabolic activities

• Cell organelles grow, and amount of cytoplasm also increases.

• Synthesis of RNA, proteins lead to further growth of nucleus and cytoplasm.

• Offspring grows to mature size

→ S-phase of Synthetic phase

• Replication of DNA and synthesis of histone proteins occur.

G₂ phase (Second gap/Growth phase)

- Cell makes the cell organelles ~~for~~ and substances it needs ~~to~~ for cell division.
- Synthesis of RNA and protein continues to take place.
- Time during which cell prepares to divide.

Mitosis

- Mitosis is somatic cell division as it takes place inside the cell.
- Mitosis includes division of nucleus (Karyokinesis) and division of cytoplasm (Cytokinesis).
- Takes place in Eukaryotic cell.
- Exact replica of parent cell leads to product of two daughter cells.
- Daughter cells have same are identical both quantitatively and qualitatively containing no. of same no. of chromosomes.

Four phases

- Prophase
- Metaphase
- Anaphase
- Telophase

*Prophase

- Chromosomes become thicker and visible.
- Centrioles move to opposite sides of nucleus.
- Nucleolus disappears.
- Nuclear membrane disintegrates.

*Metaphase

- chromosomes arrange at equator of cell.
- Aster becomes attached to the spindle fibres by centromeres.
- Centrosome divides into two chromatids - attached with the centromere.

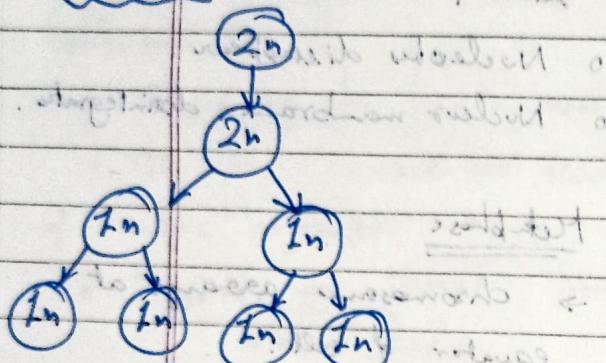
*Anaphase

- Chromatids of each chromosome is separated and form two chromosomes.
- Contraction of spindle fibres take place - which pull daughter chromosomes to opposite poles.
- Chromosome develops the shape J/V acc. to the position of centrosome - were in chromosome.

• Telophase

- Chromosomes unwind
- Spindle fibre disintegrates
- Nucleolus reappears.
- Cell membrane forms
- Nuclear envelope
- Cell divides.

• Meiosis



Meiosis - I: Homologous pairs are separated

Meiosis - II: Sister chromatids of each chromosome is separated

↳ Meiosis → special type of cell division necessary for sexual reproduction.

- Meiosis produces cell-like gametes or spores
- Male gamete → sperm
- Female → egg

- One diploid cell containing two copies of each chromosome.

One copy from father
One copy from mother
for further 2 more copies.

for haploid cells.

Date: / /

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- Homologous pairs of chromosomes come together before meiosis begins an event that does not occur in mitosis.
- This is called synapsis.

• Cell that undergoes meiosis I is primary spermatocyte or oocyte.

• Each pair of homologous chromosomes is called a tetrad.

(a) Prophase I

(b) Metaphase I

(c) Anaphase I

(d) Telophase I

Prophase I

- Chromosomes coil tightly and are visible.

- Nuclear membrane & nucleolus disintegrate.

- Synapsis of homologous chromosomes occurs forming tetrad.

- Kinetochore fiber forms on the chromosomes.

- Chromosomes in tetrad exchange segments by the process called crossing-over.

Metaphase I

→ Tetrads becomes aligned in the center of cell attached to spindle fibres.

Anaphase I

→ homologous chromosomes separate.

Telophase I

- Cleavage furrow forms beginning the process of Cytokinesis (cell division).
- Resulting daughter cells are haploid (1N).

Miosis II

sister chromatids of each chromosome are separated.

1 Chromosomes are seperat do not replicate before beginning of meiosis II. will divide chromosomes into two Haploid cells called gametes.

2 Each diploid cell from

meiosis II will go through

Second division forming

four gamete Haploid cell

It has 4 phases:

Prophase II

Spindle form begins and chromosomes begin moving towards poles.

Metaphase II

Chromosomes become aligned in center of cell attached to spindle fibres.

Anaphase II

chromosome separate and begin moving to the poles.

Telophase II

Cleavage furrow formed begins cytokinesis.

(a) Prophase II

(b) Metaphase II

(c) Anaphase II

(d) Telophase II

Biology notes

- o 1 to 10 μm in diameter.
- o 10 to 100 μm in diameter.

- o @ simple division followed by DNA replication

- o Nucleus - DNA is free inside the cytoplasm as nucleoid.

- o Internal organelles are absent.

- o Usually haploid

- o Mitosis in somatic cell, Meiosis in gametes.

- o DNA is inside the nucleus.

- o Cell organelles are present.

- o Diploid or polyploidy.

Diploid

- Diploid Cells Contain 2 complete sets of chromosomes ($2n$).

- Diploid cells undergo mitosis by which daughter cells which are exact replicas.

Haploid

- Haploid cells contain half the number of chromosomes (n).

- Haploid cells undergo meiosis by which daughter cells which are exact replicas.
- a type of cell division process, where diploid cells divide to give 2 haploid germ cells which further merge with another haploid cell at fertilization.

Mitosis

- Occurs in somatic cell.

- Takes place in both sexually as well as asexually reproducing organisms.

- o No. of chromosomes after division.

- o 2 daughter cells are formed.

- Each daughter cell has same no. of chromosomes as that of parent cell.

- Occurs continually.

- Daughter cells are alike and similar to parent cell.

Meiosis

- Occurs in reproductive cells.

- Occurs in sexually reproducing organisms.

- o 4 daughter cells are formed

- Daughter cells have half the number of chromosomes as that of parent cell.

- Occurs during gametogenesis only.

- o Daughter cells are dissimilar to parent cell.

Plant Cell

- Rigid cell wall formed from cellulose is present.

- Presence of chloroplast

- Bigger in size

- Cell vacuole is present

- Centrioles and centrosomes are absent

- Cell division is by plate form

Animal Cell

- Cell wall is absent.

- Absence of chloroplast.

- Smaller in size

- Cell vacuole is present.

- Centrioles and centrosomes are present.

- Cell division is by contract.

- Division of nucleus which occurs during cell division in sequential way.
- May occur without being followed by cytokinesis.
- Spindle form occurs and movement of chromosomes takes place.
- Division of cytoplasm that occurs after karyokinesis.
- May occur without being followed by karyokinesis.
- Here disengaged microtubules are used but no chromosomal movement occurs.

Chromosomal crossover or crossing over is exchange of ~~chromosome~~ genetic material b/w homologous chromosomes that results in recombinant chromosomes.

Synapsis is pairing of two homologous chromosomes that occurs during meiosis.

Chiasma → point where sister chromatids exchange their genetic material during chromosomal crossover during meiosis.

Chromatid: Daughter strand of a duplicated chromosome