Erasmus+
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ALIVE

Osmosis, diffusion, mitosis, meiosis

Microbiology

TRANSPORT OF SUBSTANCES ACROSS THE PLASMA MEMBRANE

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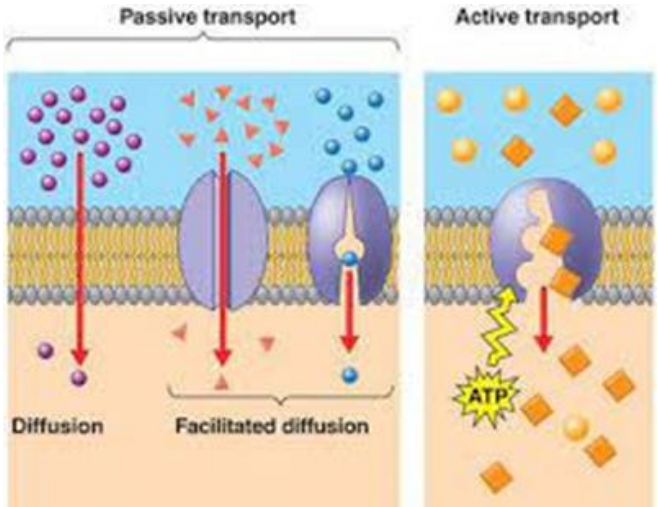
- membrane transport is a set of biological processes that allow substances of various types to cross the barrier of the cell membrane or nuclear membrane

TRANSPORT OF SUBSTANCES ACROSS THE PLASMA MEMBRANE

We distinguish 2 basic types transport of substances:

- passive transport - does not require energy consumption
- active transport - requires energy consumption (ATP)



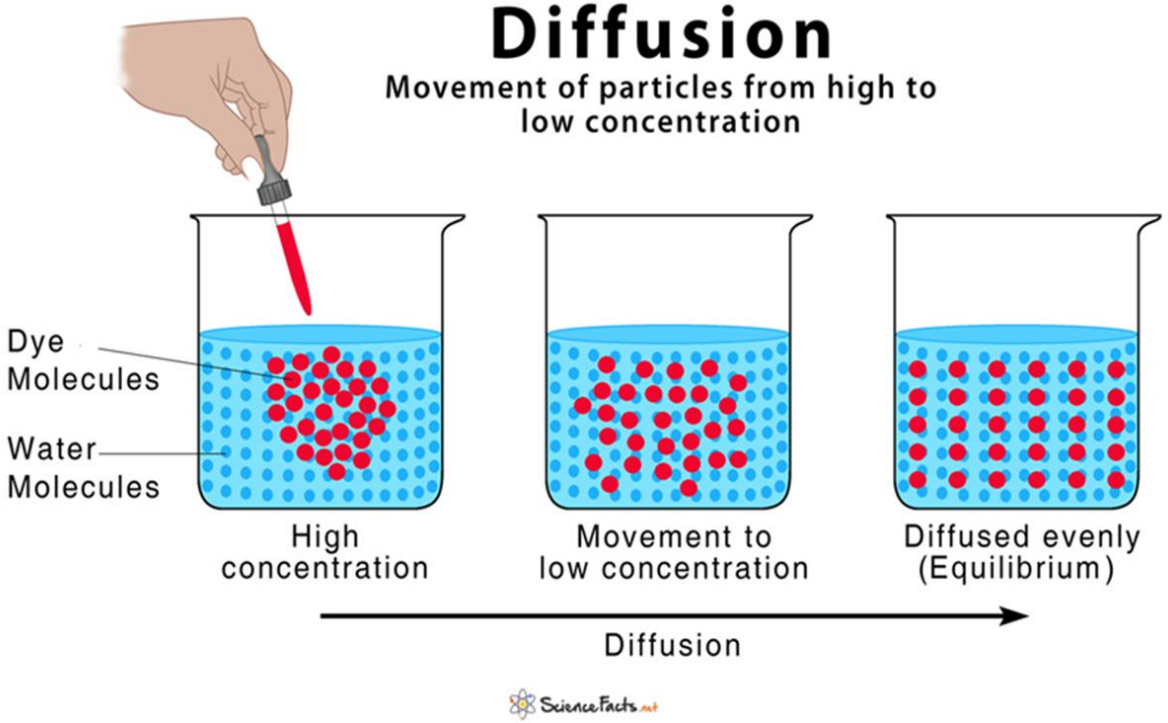
PASSIVE TRANSPORT

Diffusion

- physical process
- transport of substances (molecules, atoms, ions) in the direction of concentration gradient from a place with a higher concentration to a place with a lower concentration
- only substances for which the cytoplasmic membrane is permeable can penetrate the cell by diffusion (for example alcohol, urea, many drugs, poisons and dyes)

PASSIVE TRANSPORT - DIFFUSION

- the diffusion rate depends on the concentration gradient - on the concentration difference between solvent and solution



PASSIVE TRANSPORT

Osmosis

- transport of solvent (water) across the plasma membrane
- water passes from a place of lower concentration of the solute to a place with a higher concentration according to the laws of physics
- this process is one-way - the cell can absorb or lose water osmotically, depending on the difference in the concentration of the solution in the cell and in the external environment

ACTIVE TRANSPORT

- requires energy consumption (ATP)
- active transport takes place against the concentration gradient, it means the substance can be transferred from a site with a lower concentration to a site with a higher concentration, but with energy consumption
- the transported substance binds specifically to the transporter (transport protein) built into the membrane and is transported by it
- active transport allows the transfer of glucose, amino acids and some ions
- active transport mechanisms include ENDOCYTOSIS and EXOCYTOSIS

ACTIVE TRANSPORT

Endocytosis

- the process of engulfing the material from the external environment into the cell
- cell membrane folds and forms a vesicular structure around the material to be ingested
- cell takes in a macromolecule, such as a protein or polysaccharide, or a even another cell
- in this process, the cell membrane engulfs the substance by pinching inward, forming a vesicle around the substance, which is brought into the cell

ACTIVE TRANSPORT - ENDOCYTOSIS

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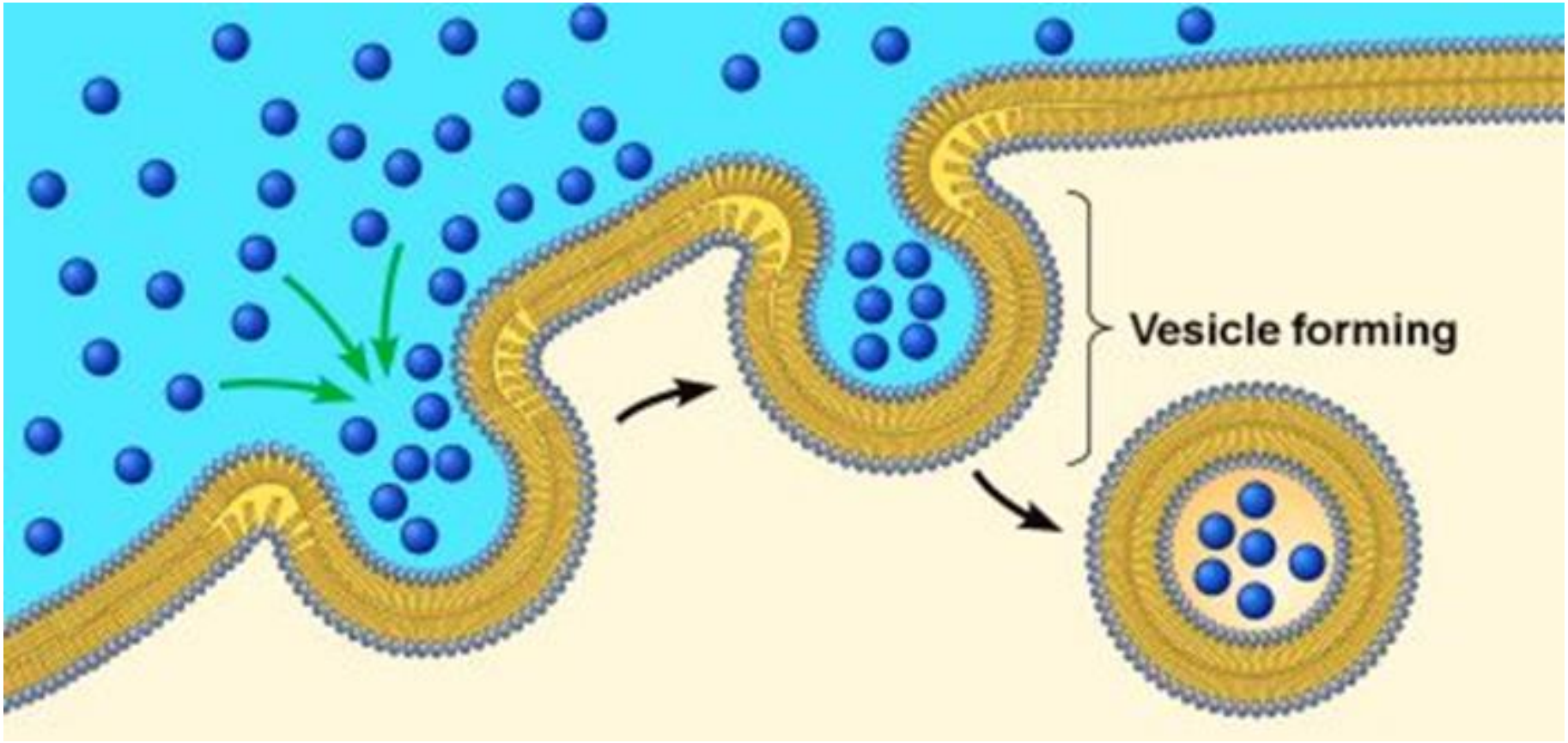

ACTIVE TRANSPORT

We know 2 forms of endocytosis: pinocytosis and phagocytosis

Pinocytosis

- the general process by which cells engulf external substances, gathering them into special membrane-bound vesicles contained within the cell.
- In pinocytosis, rather than an individual droplet of liquid traveling passively through the cell membrane, the droplet first becomes bound, or adsorbed, on the cell membrane, which then invaginates (forms a pocket) and pinches off to form a vesicle in the cytoplasm.
- It is believed that a vesicle may carry extracellular fluid to the opposite side of the cell, where it undergoes exocytosis. A droplet of fluid could thus be transported through the cell without disturbing its cytoplasm.

ACTIVE TRANSPORT - PINOCYTOSIS

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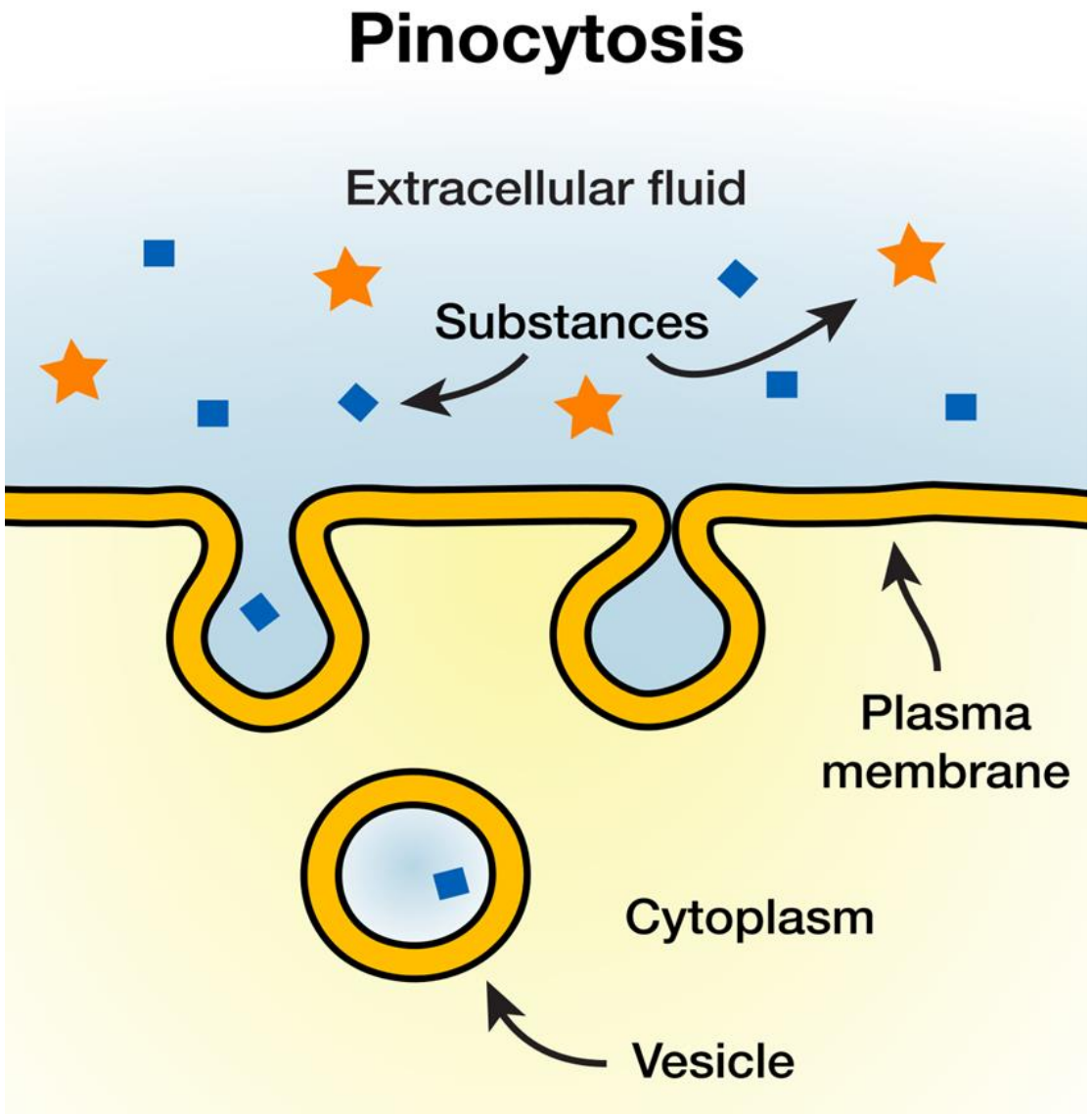
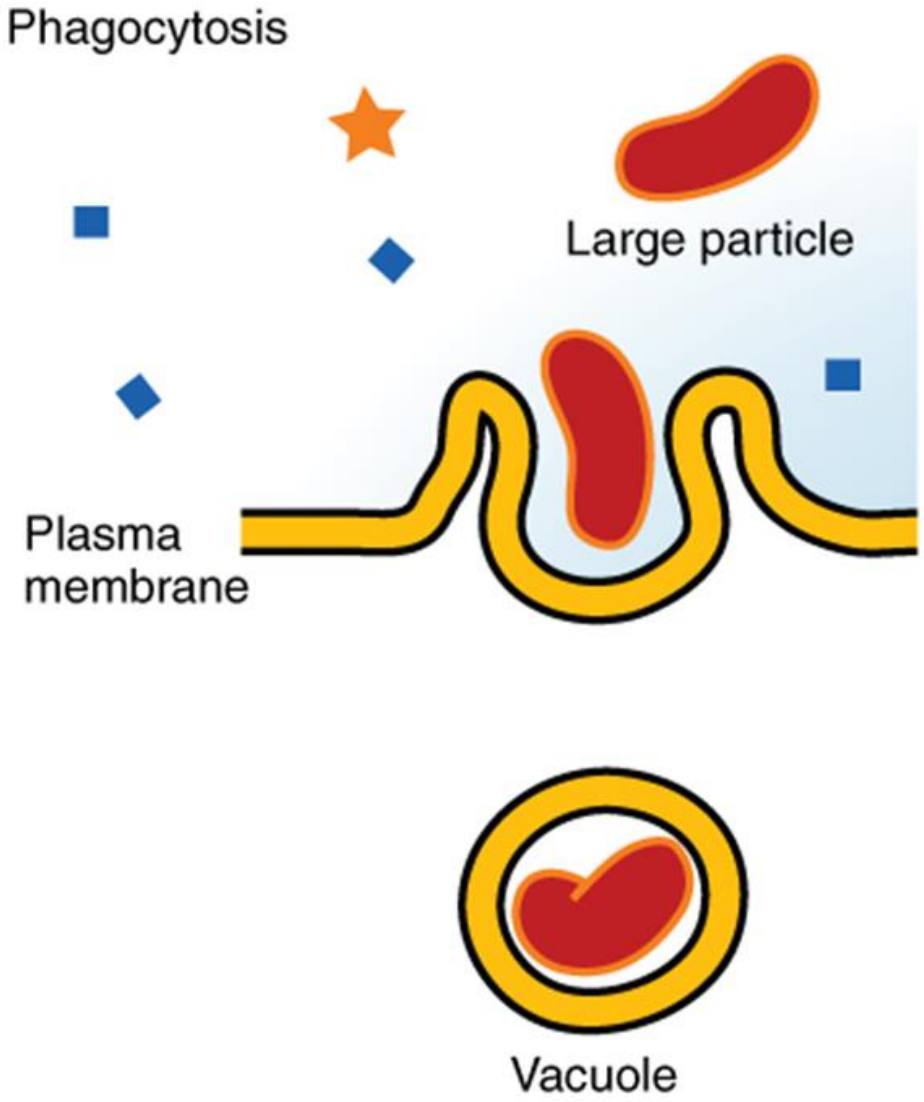


ACTIVE TRANSPORT

Phagocytosis

- or “cell eating”, the process by which a cell engulfs a particle and digests it.
- Phagocytosis is also used by cells to take in much larger particles than those that are ingested through pinocytosis.
- Some single-celled organisms, such as amoebae, use phagocytosis to ingest food particles; it is literally how they eat food.

ACTIVE TRANSPORT - PHAGOCYTOSIS



EXOCYTOSIS

- is the process of eliminating the material from the cell into the external environment
- exocytosis is a type of active transport in which a cell a cell expells a macromolecule, such as a hormone or an enzyme, or cellular waste.

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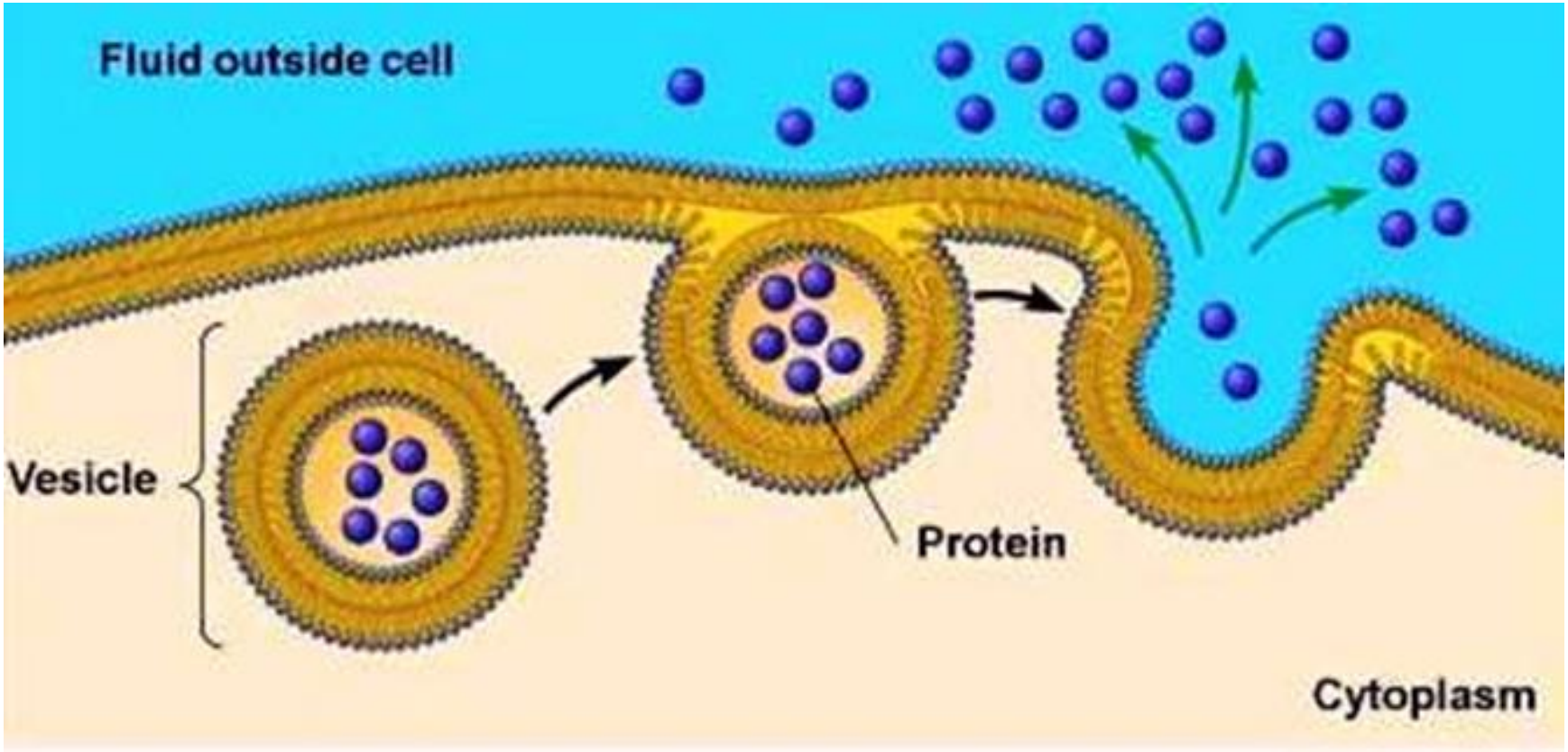
EXOCYTOSIS



MITOSIS

- Cell division is a process by which the cellular material is divided between 2 new daughter cells.
- Mitosis occurs in somatic cells of higher organisms, it is the means of population growth in unicellular organisms
- result is two daughter cells with the same number of chromosomes as the mother cell

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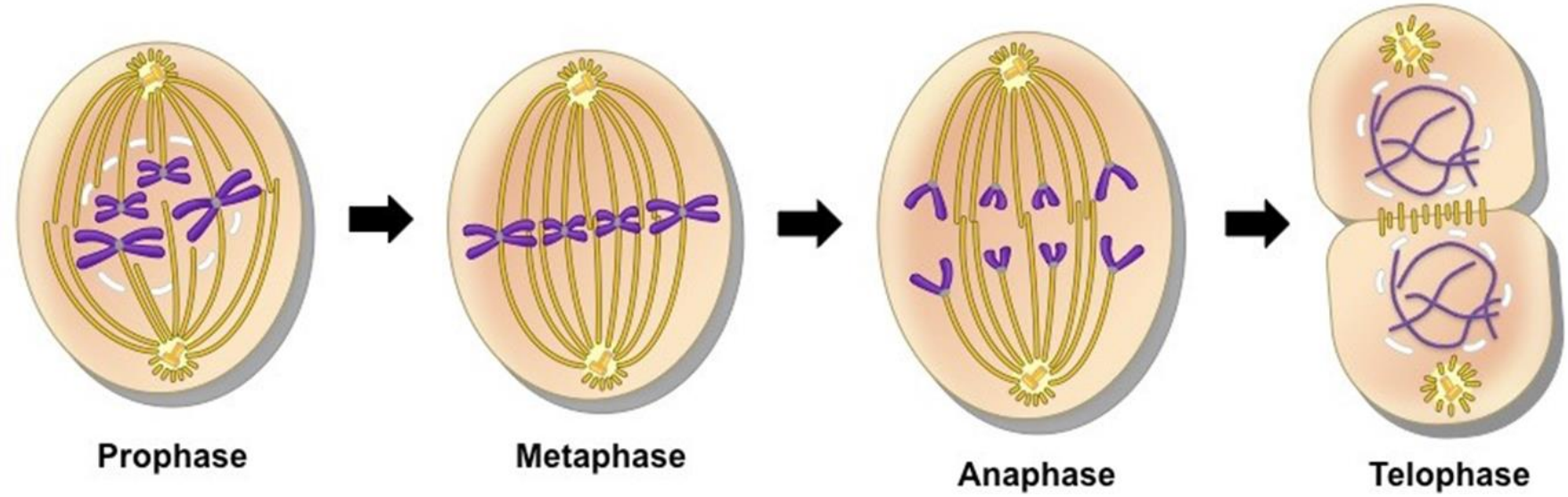
MITOSIS



MITOSIS

1. Prophase

- DNA supercoils and chromosomes condense (becoming visible under microscope)
- Chromosomes are comprised of genetically identical sister chromatids (joined at a centromere)
- Paired centrosomes move to the opposite poles of the cell and form microtubule spindle fibres
- The nuclear membrane breaks down and the nucleus dissolves

MITOSIS - PROPHASE

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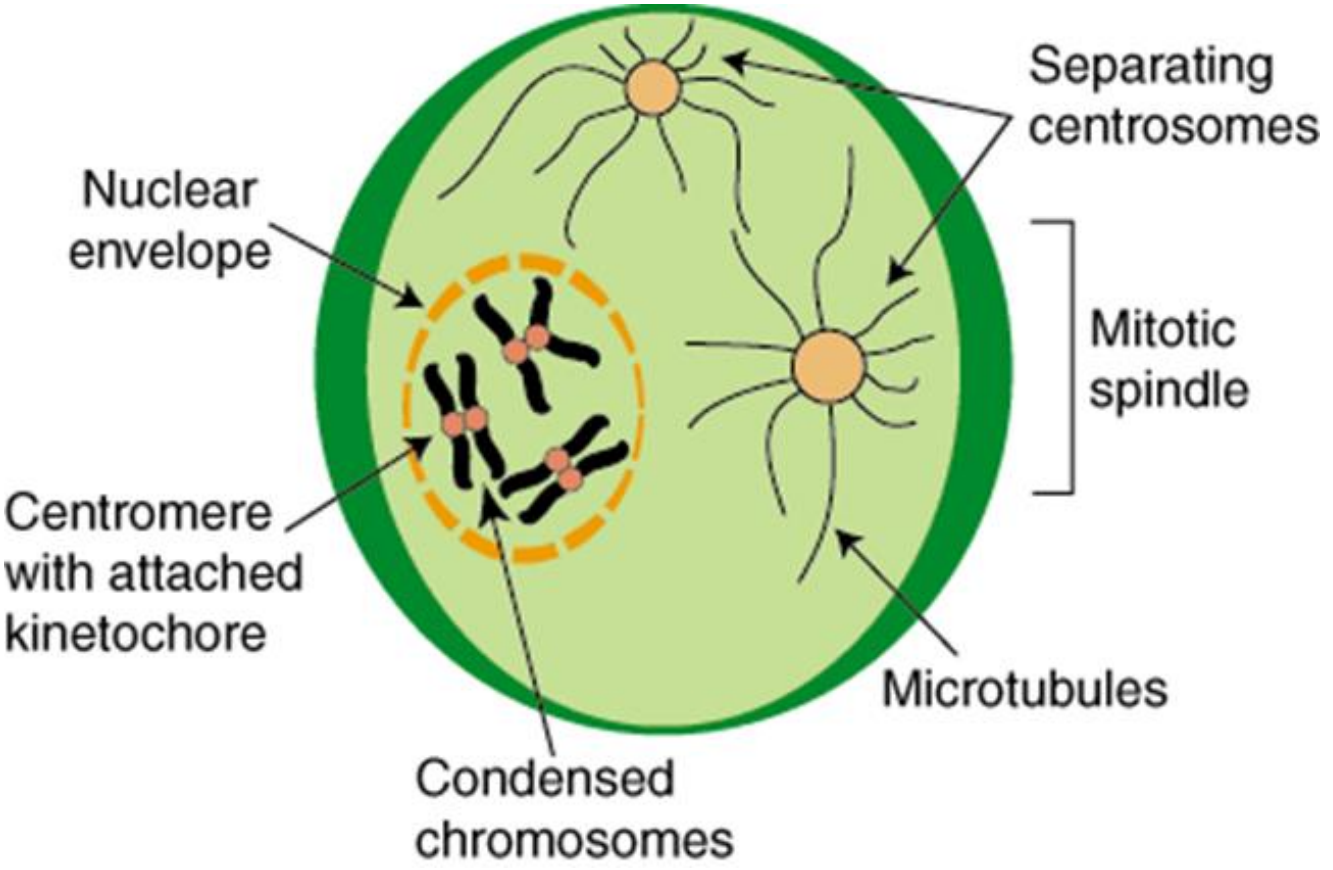
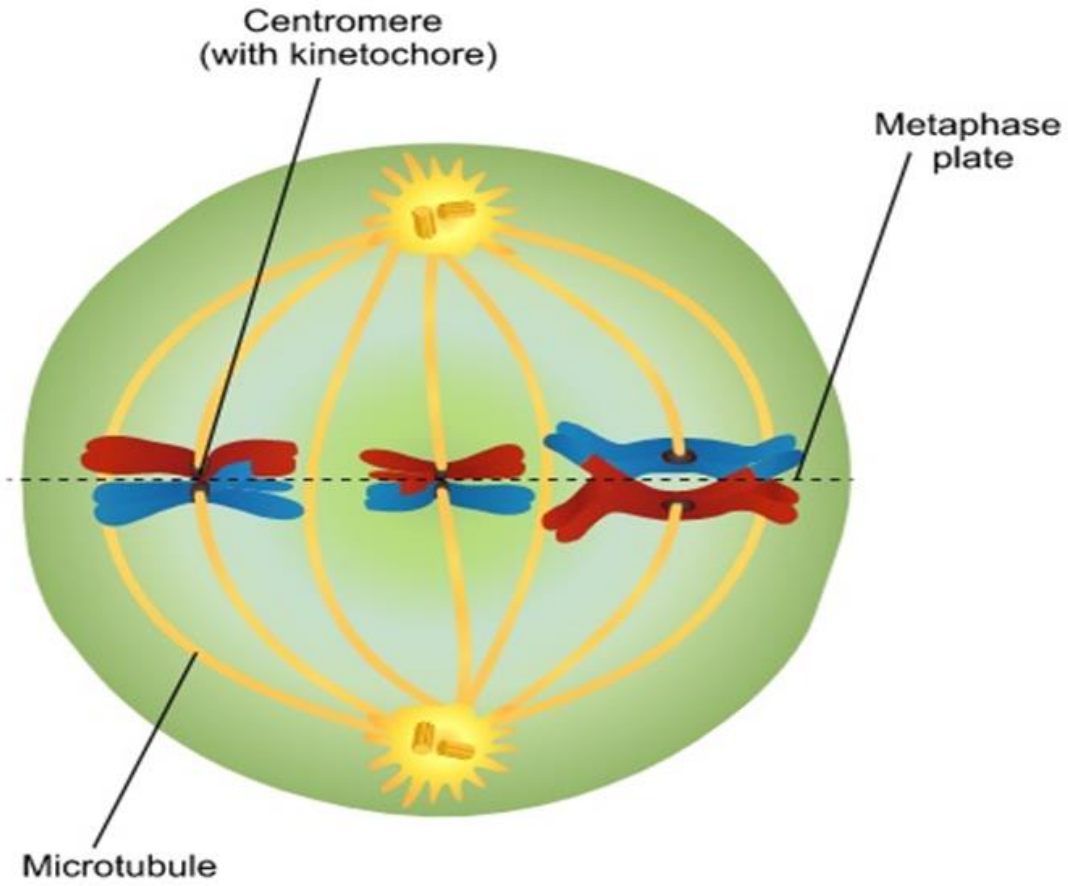


MITOSIS

2. Metaphase

- Microtubule spindle fibres from both centrosomes connect to the centromere of each chromosome.
- Microtubule depolymerisation causes spindle fibres to shorten in length and contract.
- This causes chromosomes to align along the centre of the cell (equatorial plane or metaphase plate).

MITOSIS - METAPHASE



MITOSIS

3. Anaphase

- Continued contraction of the spindle fibres causes genetically identical sister chromatids to separate.
- Once the chromatids separate, they are each considered an individual chromosome in their own right.
- The genetically identical chromosomes move to the opposite poles of the cell.

MITOSIS - ANAPHASE

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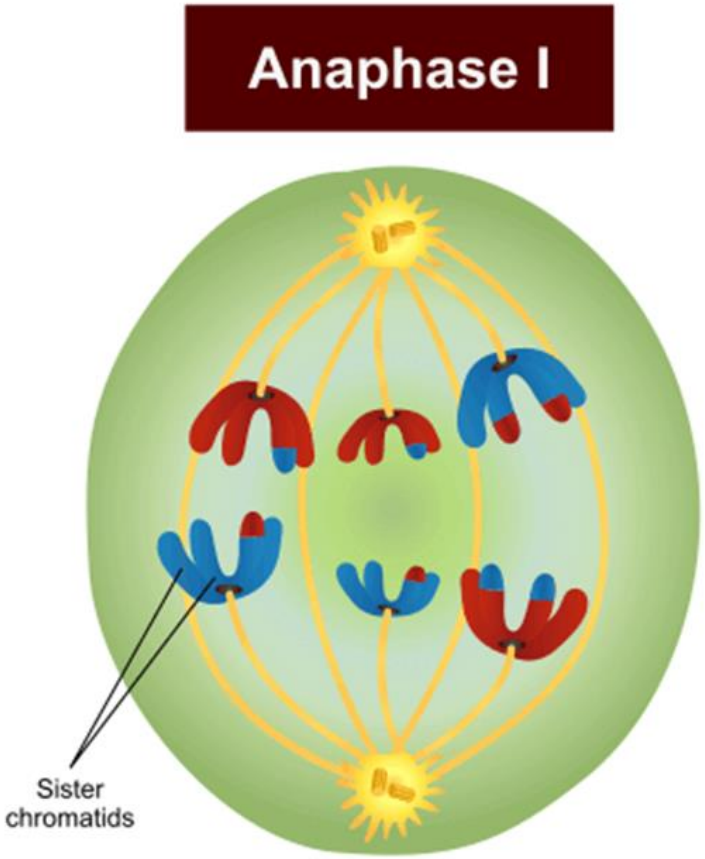

Homologous chromosomes move to the opposite poles of the cell.

MITOSIS

4. Telophase

- Once the two chromosome sets arrive at the poles, spindle fibres dissolve.
- Chromosomes decondense (no longer visible under light microscope).
- Nuclear membranes reform around each chromosome set.
- Cytokinesis occurs concurrently, splitting the cell into two

MITOSIS - TELOPHASE

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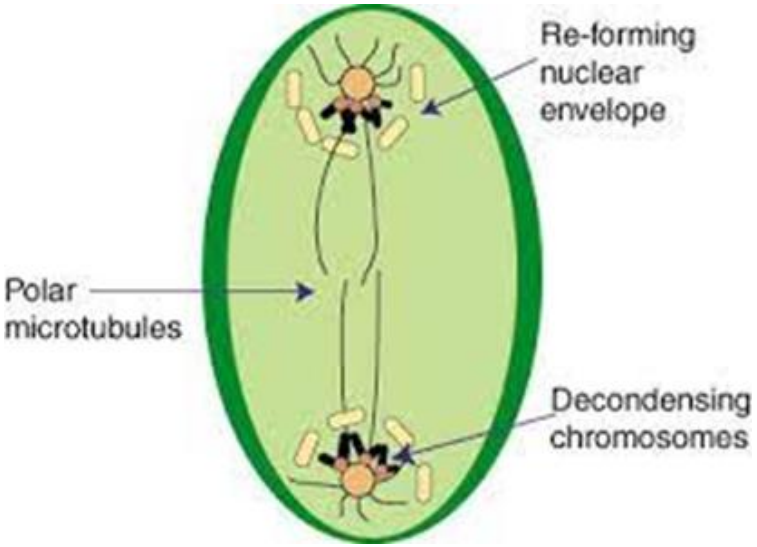

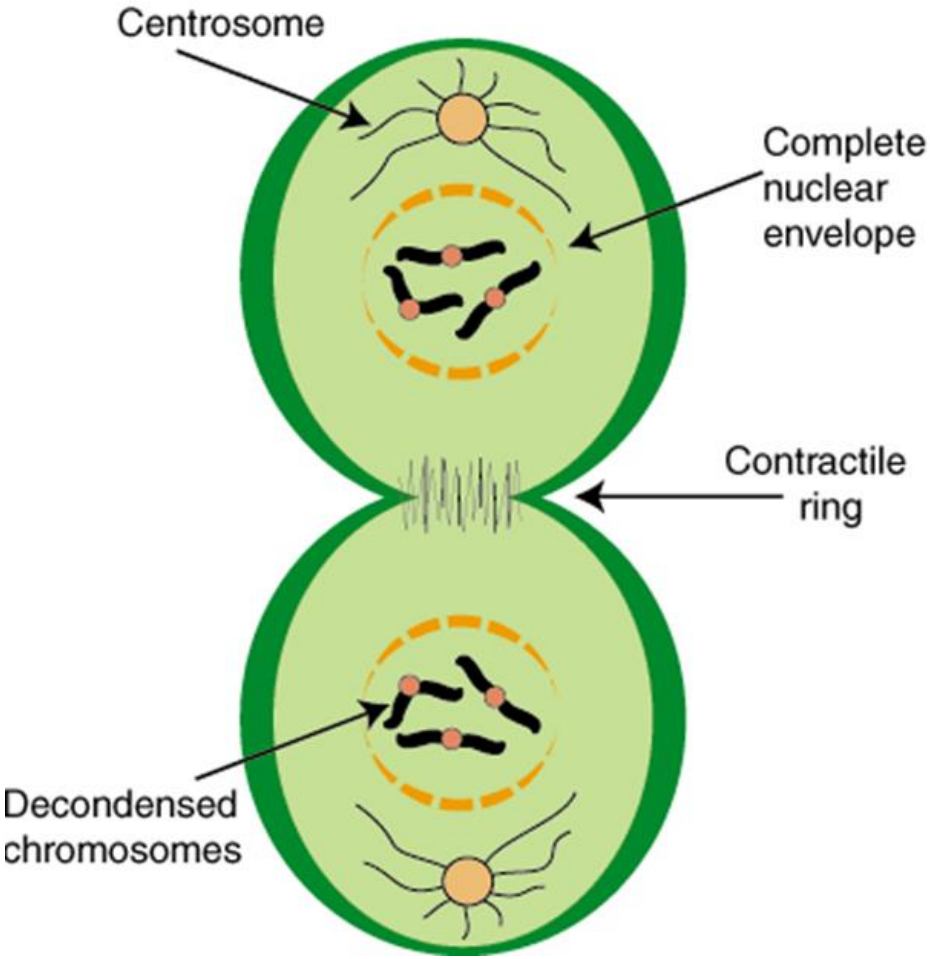

MEIOSIS

- Meiosis is the process in eukaryotic, sexually-reproducing animals that reduces the number of chromosomes in a cell before reproduction.
- Many organisms package these cells into gametes, such as egg and sperm.
- The gametes can then meet, during reproduction, and fuse to create a new zygote.
- Because the number of alleles was reduced during meiosis, the combination of two gametes will yield a zygote with the same number of alleles as the parents.

MEIOSIS

- In diploid organisms, this is two copies of each gene.
- The act of fertilization includes two cells fusing together to become a new zygote. If the number of alleles of each gene is not reduced to 1 in the gametes that produce the zygote, there will be 4 copies of each gene in the offspring.
- Before meiosis, the DNA is replicated, as in mitosis.
- Meiosis then consists of two cell divisions, known as meiosis I and meiosis II.

MEIOSIS

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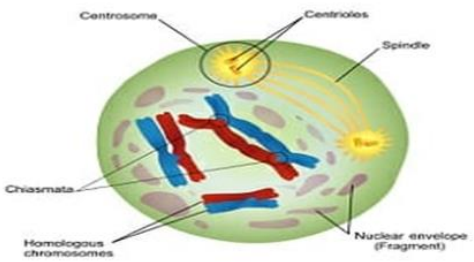
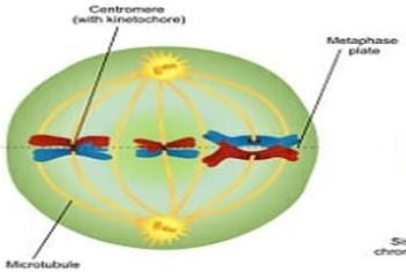
Prophase I



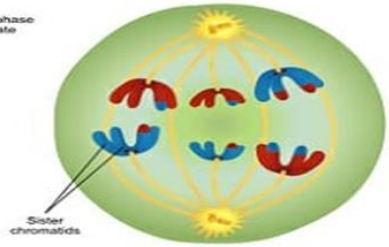
The chromosomes condense, and the nuclear envelope breaks down. Crossing-over occurs.

Metaphase I



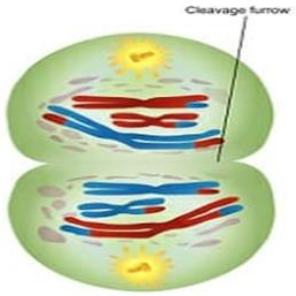
Pairs of homologous chromosomes move to the equator of the cell.

Anaphase I



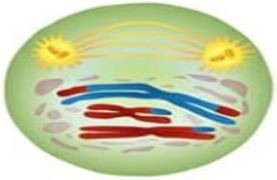
Homologous chromosomes move to the opposite poles of the cell.

Telophase I & cytokinesis

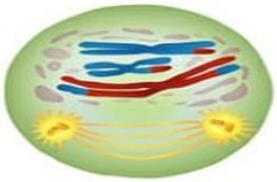


Chromosomes gather at the poles of the cells. The cytoplasm divides.

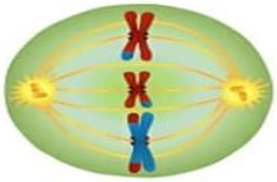
Prophase II



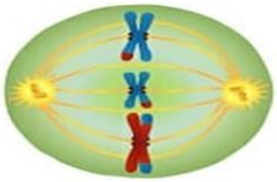
A new spidle forms around the chromosomes.



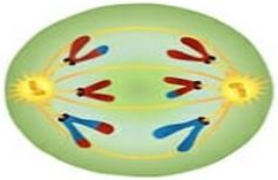
Metaphase II



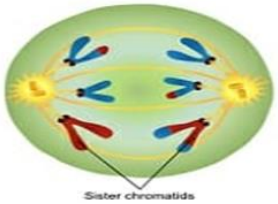
Metaphase II chromosomes line up at the equator.



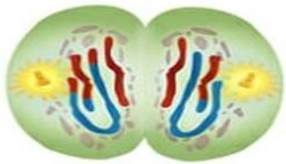
Anaphase II



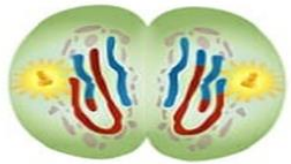
Centromeres divide. Chromatids move to the opposite poles of the cells.



Telophase II & cytokinesis



A nuclear envelope forms around each set of chromosomes. The cytoplasm divides.



PICTURES - USED SOURSES:

https://socratic.org/questions/what-is-the-relationship-between-endocytosis-and-exocytosis (slide: 5, 8)

https://slideplayer.cz/slide/14155637 (slide: 11, 12, 13, 14, 16, 17)

https://www.britannica.com/science (slide:6)

https://biologydictionary.net (slide: 12, 13, 14, 15, 16, 17)

https://medlineplus.gov/ency/imagepages/8682.htm (slide: 9)

https://biology.homeomagnet.com/mitosis/ (slide: 10)

https://ib.bioninja.com.au/standard-level/topic-1-cell-biology/16-cell-division/mitosis.html (slide: 11, 12, 13, 14, 15)

https://fsport.uniba.sk/fileadmin/ftvs/k_sk/fyziologia/Bunkovy_transport.pdf (slide: 2, 7, 8)

https://www.sciencefacts.net/wp-content/uploads/2020/01/Diffusion.jpg