النادي الطبي

تَنوير

BIOLOGY

Lec no :

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وَقُل رَّبِّ زِدْنِي عِلْمًا

The cell cycle

Cell division → The main Purpose of it is Continuing of life

Mitosis (Mitotic division)

- In **Somatic cell** (non reproductive cell) (خلايا جسمية)
  - nonreproductive cells have 2 sets of chromosomes.
  - مالهما دخل بالتكاثر مثل خلايا الجلد، العين ....

2n → Diploid → خلية فيها double number of chromosomes.

2n → 2n, 2n → Daughter cells → Genetical, identical to each other & identical to mother cell.

• The purpose of it: increase the number of cells without any change.

Meiosis (Miotic divison)

- In sex cell (reproductive cells) (خلايا جنسية) → Gametes (have half as many chromosomes as somatic cells)
  - Ovary in female.
  - testicle in male.

2n → Diploid (ثنائي) → Meiosis I

1n, 1n → 2 daughter cells are haploid (احادي) (halfing the number of chromosomes).

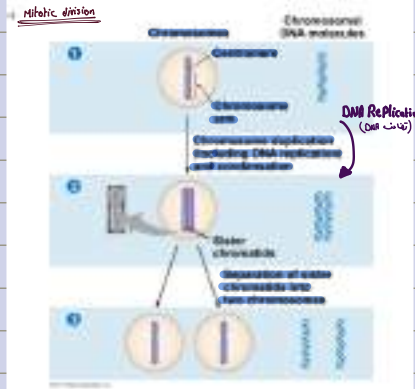
→ Meiosis II → The purpose of it is Just increase the number of cells

1n, 1n, 1n, 1n → 4 cells which are haploid (احادي). They are Called Gametes → sperm in Male / egg in female

They are non-identical to each other & non-identical to mother cell.

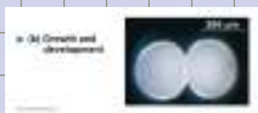
• The purpose of it is: genatic variation & produce large number of Gametes

• The Cell must be replecate on DNA before cell division. (cell cycle دورة حياة الخلية)



• The Purpose of cell divison are:

1. Development from a fertilized cell → Reproduction from a zygote
2. Growth
3. Repair. → إزالة وإصلاح
4. Asexuel Reproduction → التكاثر اللاجنسي → مثل تكاثر البكتيريا



• Most cell division results in daughter cells with identical genetic information, DNA.

• **Genome**: genatic makeup. → المحتوى الجيني
  - Consist: single DNA molecule (prokaryotic cell) / number of DNA molecules (eukaryotic cells)

• **DNA** molecules in a cell are packaged into chromosomes.

• Eukaryotic chromosomes consist of chromatin.
  - chromatin: a complex of DNA & protein that condenses during cell division.

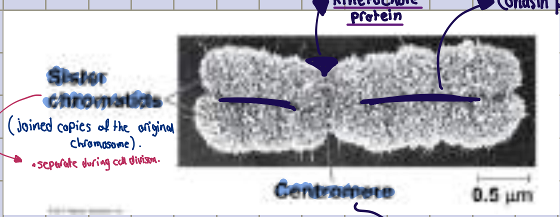
• every eukaryotic species has a charactestic number of chromosomes in each cell nucleus.

Chromatin → chromosomes (2 sister of chromatids). (when cell division)
→ each sister chromatid carry one copy of DNA.

• **Somatic cells**: (nonreproductive cells), have two sets of chromosomes 2n. (خلايا جسمية)
• **Gametes**: (reproductive cells), have half as many chromosomes an somatic cells 1n. (خلايا جنسية)

• The structure of chromosomes:

Kinetochore protein (centromere بطانة)
Cohasin protein (gluing)
- if it is Active → يربط 2 sister chromatids
- if it is notActive → تنفصل 2 sister chromatids



Sister chromatids (Joined copies of the original chromosome). • separate during cell divison.

Centromere: is the narrow "waist" of the duplicated chromosome, where the 2 chromatids are most closely attached

• Chromosome is thicker & shorter than chromatin. → visable under the Microscope

• **Kinetochores**: are protein complexes associated with centromeres.

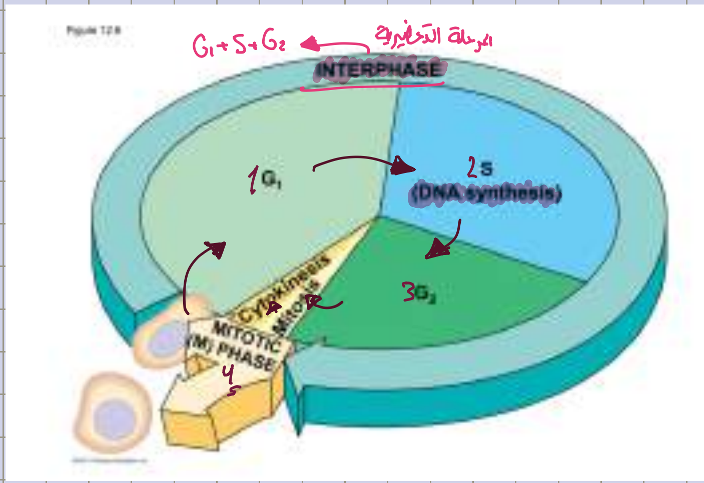
• Eukaryotic cell divison consists of :-

1. Mitosis (the division of the genetic of the nucleus).
2. Cytokinesis (the division of the cytoplasm).

• اهم مرحلتين M , S

* cell cycle :-

• it discovered by Flemming in 1882.
• it's clockwise direction
• تسبق ال Meiosis + Mitosis



• (M) = MITOTIC PHASE = Mitosis + Cytokinesis

it is similar to plant & Animal cells. — it is different to plant & Animal cells.

- Mitosis before cytokinesis

- G_1 phase → first gap / growth 1
- S phase → synthesis
- G_2 phase → second gap / growth 2

- In G_1 ⇒ 1. Increase the volume
  2. Duplicated all organils ما عدا DNA + centrosome
  3. building anythings that is used in S.

Cell Cycle = Interphase + Mitotic phase

90% of the cell cycle — 10% of the cell cycle.

لانها عبارة عن عملية تحضيرية لدخول الخلية لمرحلة Mitotic phase (الانقسام)

نعني تحضير الخلية لها تدخل ال Mitotic phase بعد المرحلة الأكل دون اي ناقلة

• S is the longer one (11-12) hours.

- In S ⇒ 1. Replecation DNA + centrosome
  ↳ أكثر وحدة بتوخذ وقت لانها بنضاعف DNA فبتحتاج إلى Accuracy (الدقة)
  2. Proofreading (centrosome + DNA تدقيق)

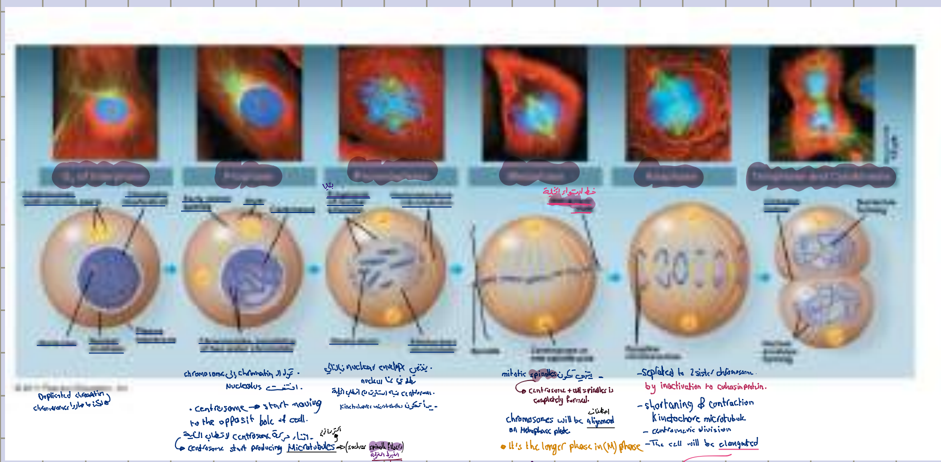
• Mitosis takes more time than Cytokinesis.

- In G_2 ⇒ 1. Checkup to all things that used in MITOTIC PHASE

→ Mitosis is divided into 5 phases :-

1. Prophase ⇝ المرحلة الابتدائية
2. Prometaphase
3. Metaphase ⇝ المرحلة الاستوائية
4. Anaphase ⇝ المرحلة الانفصالية
5. Telophase ⇝ المرحلة النهائية

→ Cytokinesis ⇝ the later stages of Mitosis.



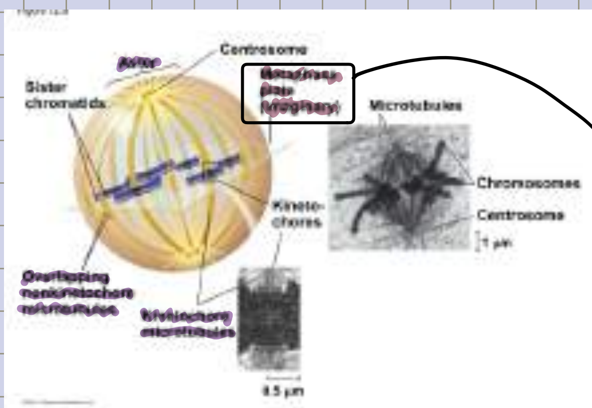
Centrosome is called Microtubules Organizing center

- The microtubles shorten at their Kinetochore ends.

Sister Chromatids = Daughter

• spindle ⇒ centrosome + 3 type of microtubule are completly formed (controls chromosome movement during mitosis).

(the shortest) cell membrane + centrosome بين ← Aster
بربط centrosome ← Kinetochore
↳ Kinetochores protein
nonkinetochore ← Overlapping
(Kinetochore و Aster)
ما يرتبطوا بأشي (جايين فوق بعض)



→ An imaginary structure at the midway point between the spindle's 2 poles.

• The Rait of Mitosis in the child more than in the yonger or olderly people

• microtubles ⇝ centrosome حول

• Metaphase is the longer phase in (M) phase

→ **Cytokinesis :-** it's differ in Animal cell from plant cell, because plant cells contains a cell wall.

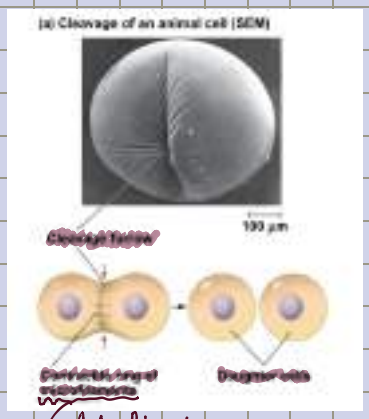
- Cytokinase being during anaphase or telophase.

In Animal cells ← → In plant cells

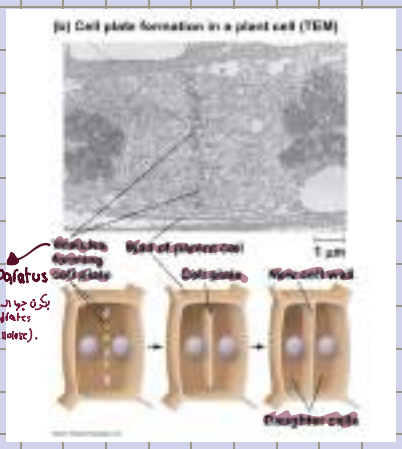
- الخلايا اللي بتوجد من النباتات عشان تنمو وتتطور من خلال مراحل فيه هو mitosis

→ Apical tips (القمم النامية)

Shoot tips — Root tips



→ Actin filment



- The eukaryotic cell cycle is regulated by a molecular control system.

- The frequency of cell division varies with the type of cell.
  - These differences result from regulation at the molecular level

For example: 1. Human skin cells divide frequently throughout life.

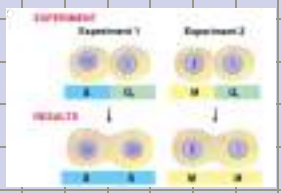
2. Some of the most specialized cells (nerve cells & muscle cells) do not divide at all in a mature human.

3. Liver cells maintain the ability to divide but keep it in reserve until appropriate need (such as to repair a wound).

- We are studing the machanisms of regulation at molecular level not only to understand the life cycles of normal cells but also to learn how cancer cells manage to escape the usual controls.

- The cell cycle appears to be driven by specific chemical signals present in the cytoplasm.

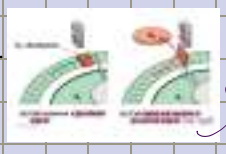
* The results of fusing a G_1 cell with a cell in the S or M phase of the cell cycle suggest that molecules present in the cytoplasm during the S or M phase control the progression to these phases.



* The cell cycle control system :-
  - It is clockwise direction
  - It is regulated by internal & external controls

- Checkpoints :- are points where the cell cycle stop until a go-ahead signal is received

1. G_1 checkpoint :- is the most important.



If the cell doesn't receive the go-ahead signal, it will exit the cycle, entering into a nondividing state called (G_0 phase).

2. G_2 checkpoint

3. M checkpoint

• The cell cycle clock :-

• The cell cycle maintains its rotatin direction clockwise by same proteins.

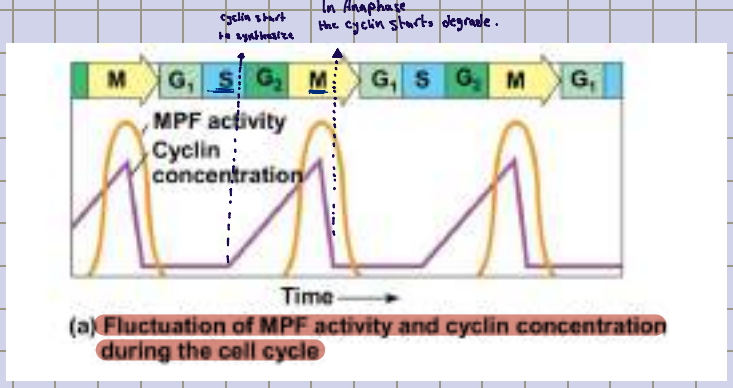
All signals in cell cycle are internal signals that made in cytoplasm

These proteins are :-

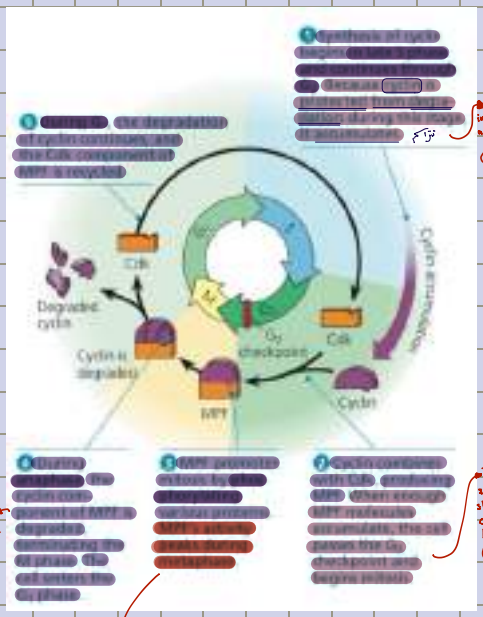
1- Cyclins → Activity fluctuates during the cell cycle → begin synthesis in later S phase & continues through G_2.

2- cyclin-dependent kinases (Cdks) → Activity fluctuates during the cell cycle because it is controlled by cyclins, so named because their concentrations vary with the cell cycle.

3- Maturation-promoting factor (MPF) → is a cyclin-Cdk complex.
or a
Mphase-promoting factor.



(a) Fluctuation of MPF activity and cyclin concentration during the cell cycle



• There are 2 type of signals
- internal signals → all of signals in cell cycle
- external signals
  - growth factors
  - density-dependent inhibition
  - anchorage dependence

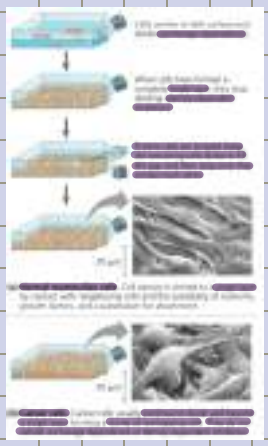
→ The external signals :-

1) growth factors → Proteins released by certain cells that stimulate other cell to divide.
for example : platelet-derived growth factor (PDGF) → stimulates the division of human fibroblast cells in culture.

نوع الخلايا المسؤولة عن إنتاج الـ Connective tissue

2) density-dependent inhibition → Crowded cells stop dividing

3) anchorage dependence → must be attached to a substratum in order to divide.



They do not exhibit anchorage dependence or density-dependent inhibition.

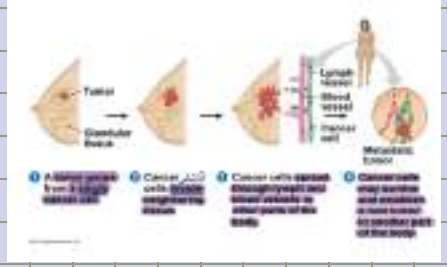
* Cancer cells do not respond normally to the body's control mechanisms.
* Cancer cells may not need growth factors to grow & divide
* Cancer cells are :-
  1- They make their own growth factors.
  2- They convey a growth factor's signal without the presence of the growth factor.
  3- They have an abnormal cell cycle control system.

* Cancer cells that aren't eliminated by the immune system form tumors.

→ transformation :- is a process of converting a normal cell to Cancerous cell.

→ Tumors :- masses of abnormal cells within otherwise normal tissue.

- benign tumor (if abnormal cells remain only at the original site)
- Malignant tumors (invade surrounding tissues & can metastasize, exporting cancer cells to other part of the body, where they may form additional tumors).



{وَمَا تَوْفِيقِي إِلَّا بِاللَّهِ ۚ عَلَيْهِ تَوَكَّلْتُ وَإِلَيْهِ أُنِيبُ}