

Cell division Chapter 3

1. Mitosis → Division of nucleus 2. Cytokinesis → division of cytoplasm.

* Where does the cell division occur?

→ mitosis occur when a parent cell divide to produce two same daughter cell.

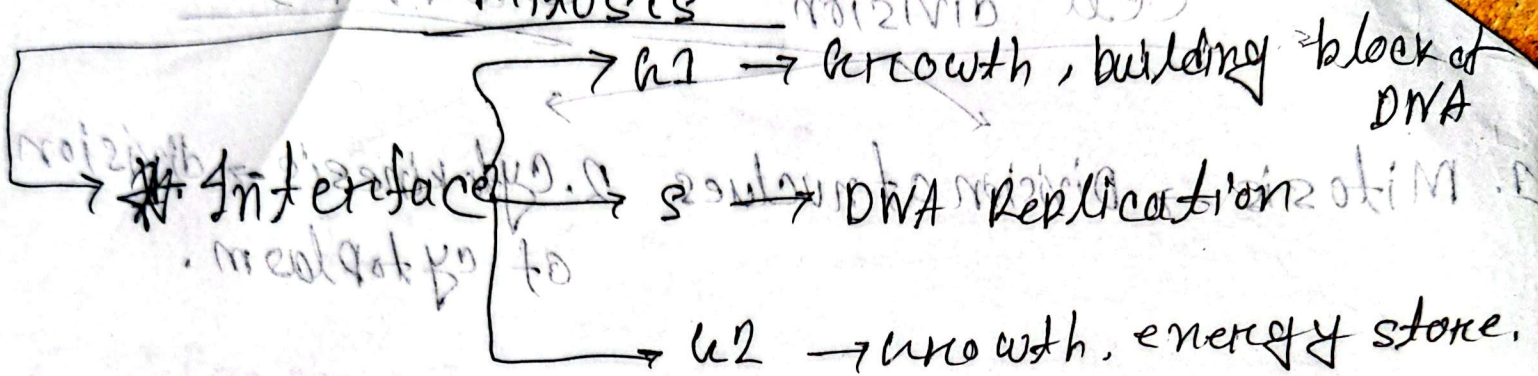
* Why cells divide

- 1. Growth → to help an organism grow by increasing number of cells.
2. Repair → To replace damage on dead cell.

B. Reproduction →

A. Main function → to maintain proper cell size and function

Mitosis



What are 4 phases of mitosis?

1. Prophase → Chromatin into chromosome
Chromosome attach with spindle fibers.

2. Metaphase → chromosome line up with centre of the cell.
metaphase plate.

3. Anaphase → sister chromatids are going to opposite poles of the cell.

4. Telophase: separation by nuclear envelope.

DNA

21/20/13M

most DNA is located in cell nucleus.

II 21/20/13M

I 21/20/13M

Haploid
(n)

→ 1 copy of each chromosome.

Diploid
(2n)

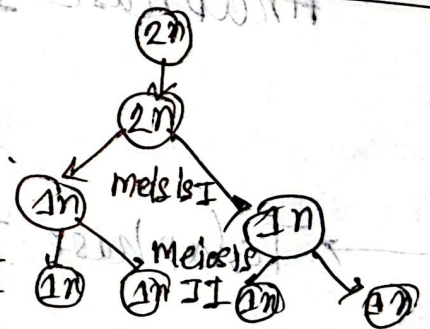
→ having 2

sets of chromosome ~~one~~ ¹ from mother and 1 from father. sexually reproduce. egg and sperm cells are haploid.

Meiosis → 4 new haploid daughter cells.

Meiosis I

Meiosis II

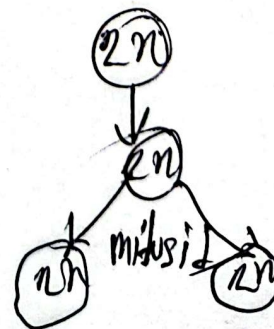


Start as diploid
end with haploid

Start as haploid

ends as ~~diploid~~ haploid

mitosis



Meiosis

DNA

2n → 2n → 2n

Meiosis I

Meiosis II

Pro phase I

Pro phase II

Metaphase I

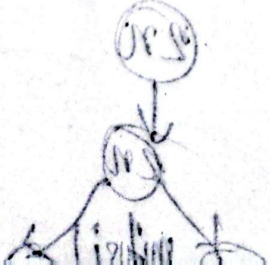
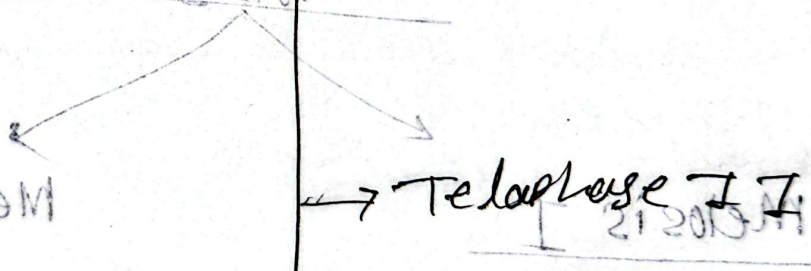
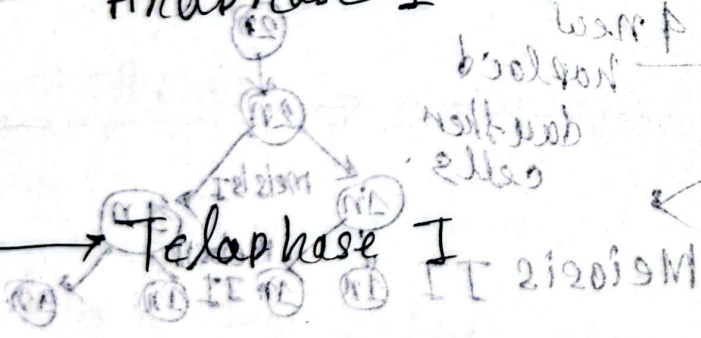
Metaphase II

Anaphase I

Anaphase II

Telophase I

Telophase II

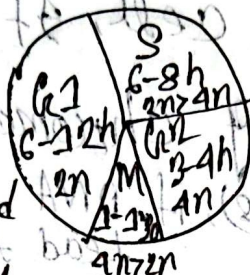


Control of the cell cycle

The length of the cell cycle is about 24 hours

The timing of events

in cell cycle controlled



by internal and external events to the cell

Regulation of the cell cycle by External events

- * Cell division can start or stop because of signals from outside the cell
- * it can be triggered by the death of nearby cell or by hormones like Human growth hormone (HGH)
- * lack of HGH can ^{stop} inhibit cell division, or too much HGH can lead to extra growth.
- * crowding of cells can stop cell division
- * the big size of cell can stop cell division

Then if the cell get signal for division, then it will continue cell cycle if everything needed is ready.

Regulation at internal checkpoint

* It is very important that new cells are exact copies of the original cell, if something wrong with copying or sharing chromosome, it can cause mutation (abnormal cells), if DNA get damage, it can lead to cancer.

* To avoid mutations, cells have internal checkpoints. It is a control point where the cell stops the ~~check~~ process if something wrong and the cell won't continue until the problem is fixed.

* There are 3 checkpoints

1. Restriction point (start, end of G₁), 2. G₂-M transition

Influenced by

* Growth factors

* Nutrients

* Cell size

* DNA Damage

Influenced by

* Cell size

* DNA Damage

* DNA replication

3. Metaphase-anaphase transition

Influenced by

* Chromosome attachments to spindle

3 type of genes

1. Proto-oncogenes

It's normally help cells to grow and divide to make new cells and help to cells stay alive. Like a gas pedal on car.

2. Oncogenes →

When a proto-oncogene mutates and too many copies of it then it's called oncogenes. For this the cell can start to grow abnormally out of control and lead to cancer. (KRAS, C-myc, APC)

3. Tumor suppressor genes →

This genes slow down uncontrolled cell division, they stop oncogenes, when they don't work properly cells can grow out of control which lead to cancer. It's like brake pedal on a car. (TP53, APC → guardian of genome/cell)

DNA Damage and Repair (DDR)

DDR genes produce protein that detect and fix mutations in other genes. DDR is important for maintaining genome stability and preventing cancer. DDR remove DNA lesions, tolerate DNA damage and protect DNA during replication. (ATM, WRN -)

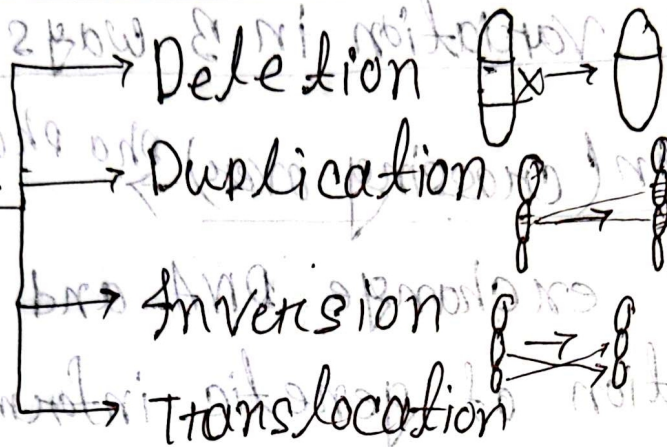
Common cause of DNA Damage and Repair pathway

- | | |
|---------------------------|-------------------------------|
| 1. Base mismatch | 1. base excision repair. |
| 2. Single strand break | 2. Nucleotide |
| 3. Double strand break | 3. non-homologous end joining |
| 4. Inter strand crosslink | 4. DNA mismatch repair. |

Chromosomal Aberrations

2 types

1. Structural



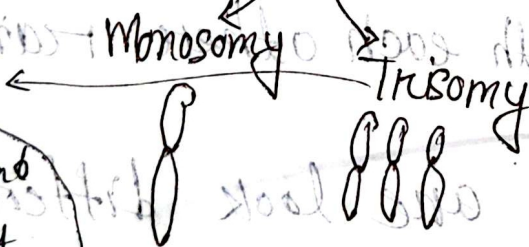
Cause of mental abnormality
Cri-du chat
example of abnormal people due to chromo some

2. Numerical

Poly ploidy → chromosome has more than 46 like, $2n, 4n, 5n$
↳ 96 ↳ 184

Aneuploidy → When human cells have 45 or 47 chromosomes instead of 46

As a this
short height
" fingers/hand
development delay
unique facial feature



Chromosomal karyotyping (male $(44XX)$ female $(44XX)$)

It's a picture of process where doctor can identify abnormal chromosome.

Karyotype → is the number and appearance of chromosomes, including their (length, banding pattern, shape and centromere position.) → if any change then abnormality
Karyogram → is the picture of all chromosomes.

Genetic Variation in Meiosis

meiosis creates variation in 3 ways

1. Recombination (crossing over) → pro phase I
Chromosomes exchange DNA and making new gene combination of genetic information.

2. Independent assortment →
chromosome are randomly distributed to gametes.

3. Random orientation → during meiosis I
Chromosome pair up with each other randomly.
That's why siblings are look different than each other.

Chromosomal diseases

1. <u>Down syndrome (Trisomy 21)</u> → extra copy of chromosome 21. * short height, fingers, delay growth	3. <u>Turner Syndrome (XO)</u> → female have only one X. * short height, infertility
2. <u>Klinefelter syndrome (XXY)</u> → male have extra X, tall height, learning problem	4. <u>Edwards syndrome (Trisomy 18)</u> → extra copy of chromosome 18. * small head, organ serious, baby not long live