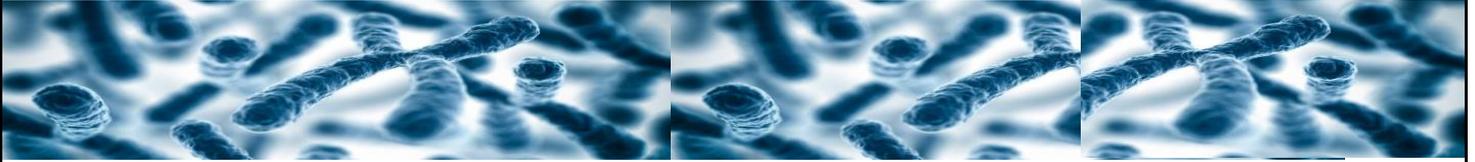


Chromosomes, cell division, and the cell cycle.



- When parents produce new individual this is called
- Cells reproduce when parent cell produces a new generation of cells.
- Reproduction is a part of individual life cycle.
 - **Asexual**: like binary fission in Amoeba
 - **Sexual**: depend on union of gametes
- Cell division is a part of cell life cycle
- DNA is organized in the chromosomes.

Depending on the chromosomal number, cell in the body are:

1. Somatic cell (body cells):

- All cells in the body except reproductive (germ) cells.
- Somatic cells have **diploid number of chromosomes**.

Diploid number of chromosomes:

- It is $(2n)$, n from mother and n from father.
- It is pairs; two each type.
- It is characteristic of each species.

2-germ (sex, reproductive) cells:

- They are found the **gonads (testes and ovaries)** and give rise to **gametes (sperm and ova)**.
- Gametes and some germ cell contain **the haploid number of chromosomes**.

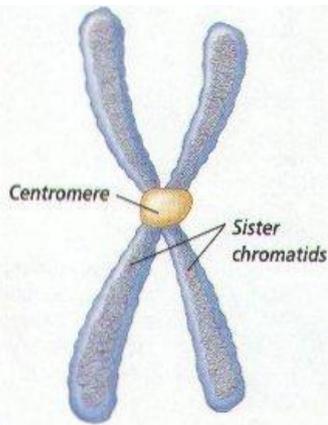
Haploid number of chromosomes:

- It is (n) ; one-half $(1/2)$ number
- One of each type of chromosomes.

- **Which one is even number (diploid or haploid)?** Diploid
- **Haploid number is always odd. True or false?** False

Chromosomes

(table 16-2)



- Thin thread-like structure containing genetic information (genes) & located inside the nucleus.

-It consist of DNA molecules and associated histone proteins.

-Before cell division, the chromosomes are **unduplicated** (one DAN molecules) and they must become **duplicated**_(two DNA molecules).

***duplicated chromosomes** :

-After the chromosomes are **duplicated**, each consists of **two** strands called **sister chromatids** attached at **centromere**.

Centromere:

- It constricted region of duplicated chromosomes where two sister chromatids are attached.

- It is the attachment site of microtubules that move the chromosomes during nuclear division.

- Chromosomes differ in size, position of centromere and banding patterns.

- Generally, in somatic cells the chromosomes occur in pairs called homologous chromosomes.

Homologous chromosomes:

-Two chromosomes (one from father and one from mother) having the same size, location of centromere , gene sequence and banding patterns.

Chromosomal Condensation:

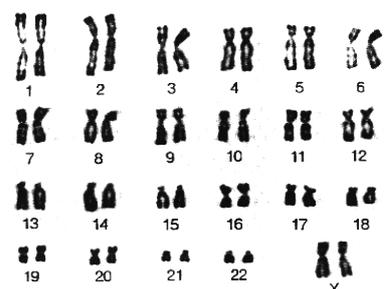
- After the chromosomes duplicated **during interphase**, it begins to condense and compact.

- Condensed chromosomes are metabolically inactive and each chromatid consist of a DNA molecule in a double helix and **histone** proteins.

- **Loop of double helix of DNA** encircle histone forming clusters → hollow tubules → coils & compact like phone cord → **condensed short chromosomes**.

Karyotype:

- Photograph of condensed homologous pairs of metaphase chromosomes.



Chromosomes number in human:

In somatic cell:

There are 46(23pairs) of chromosomes:

- 22 pairs (number 1-22): are somatic chromosomes (autosomes)
- One pair (number 23): is sex chromosomes

Sex Chromosomes: determine the sex and they are xx in female xy in males.

In each gamete:

There are 23 chromosomes (22 autosomes and 1 sex chromosomes):

- Ovum: (22+x)
- Sperm: (22+x) or (22+y)

Cell Division

- Cell division is part of the cell's life style.
- Cell division includes nuclear division (**mitosis or meiosis**) which is usually followed by cytoplasmic division (**cytokinesis**) to form two daughter cells.

Cell cycle: (Fig 16-2, Table 16-1)

- It is a series of event starting when a new cell is produce **by mitosis** and ends when the cell completes its own division.
- The length of the cell cycle varies depending on the type of the cell.
- Nerve cells remain in G1 of interphase and usually do not divide
- Mature RBCs have no cell cycle. **Why?**
- It proceeds through **inter-phase**, **mitosis** and **cytoplasmic division**.

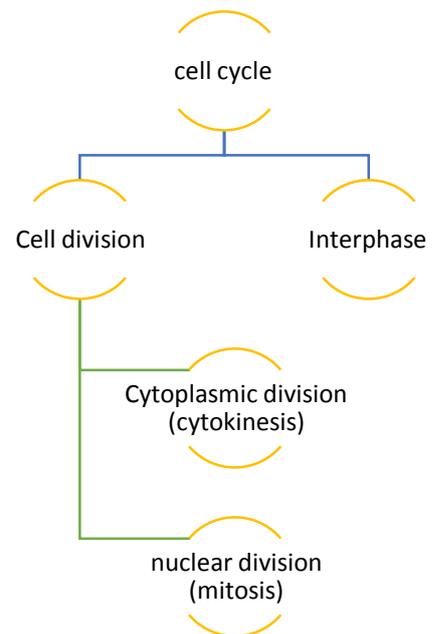
1. Inter-Phase:

- It is non-dividing period between cell divisions
- It is the longest phase of the cell cycle
- It is a time of intense metabolic activity
- It consist of three phase: G1, S, G2.

A.**G1 phase** (gap of cell growth) Organelles duplicated.

B.**S phases** (DNA synthesis; DNA replicate and chromosomes will become duplicated).

C.**G2 phases** (growth and final preparation for division).

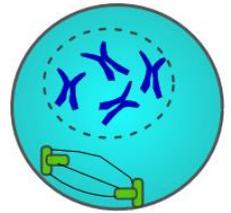


2. M-Phase (Mitosis):

- It is the division of the nucleus of a somatic cell into two nuclei, each with full diploid number of chromosomes.
- It maintains the chromosome number.
- The daughter cells produced after mitosis are genetically identical to each other and to the parental cell.
- Mitosis is the basis of : **growth, repair of damaged tissue, asexual reproduction in single and multicelled organisms** .
- Mitosis consists of four successive stages: **Prophase, Metaphase, anaphase and telophase**.

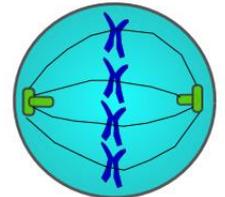
A. Prophase:

- Duplicated chromosomes (each with two sister chromatids) **condense** and become visible.
- Centrioles separate and move to the opposite poles of the nucleus.
- Spindle microtubules **assemble (formed)** and become attached to the centromere of the chromosomes.
- **Spindle**: an array of microtubules that moves chromosomes.
- The nuclear envelope **disappears**.



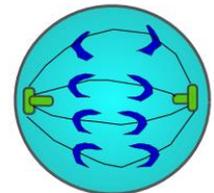
B. Metaphase:

- The duplicated chromosomes are in their most condensed form.
- All chromosomes have become **lined up in the center of the cell**.
(at the spindle equator midway between the spindle poles)



C. Anaphase:

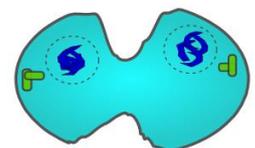
- Two sister chromatids separate.
- The spindle moves the chromosomes to opposite poles.
- Each chromatid now is an **independent chromosome**.



D. Telophase:

- The chromosomes reach the spindle poles and uncoil (**decondense**)
- The spindle disappears, nucleoli appear and nuclear envelopes form around each cluster of chromosomes, two daughter nuclei result, Mitosis is **completed**.

Followed by cytokinesis to form two diploid cells.



3. Cytokinesis (Cytoplasmic Division):

- It is the division of the parent cell cytoplasm between two daughter cells.
- It usually begins toward the end of anaphase and finishes after telophase.
- It occurs usually after each nuclear division.

- In animal cells, cleavage furrow is formed in the middle of cell.
- At cleavage furrow, ring of microfilaments (actin protein) attach to the plasma membrane, contract, pull the surface inward until the cell is pinched in two.

Sexual Reproduction:

- It involves:
 1. Meiosis.
 2. Gamete Formation.
 3. Fertilization.
- It introduces variation in the traits among offspring.