MITOSIS
Mitosis

- The form of **cell division** by which a eukaryotic **somatic cell** duplicates.

- **Mitosis** is **asexual reproduction**.

- **Cell division** is the continuation of life based on the **reproduction of cells**.
Mitosis

Liver Cell

2n=46

Liver Cell

2n=46

two identical daughter cells

Liver Cell

2n=46
Binary Fission

- Bacteria, cyanobacteria, and most single celled organisms reproduce by **binary fission**.
Somatic Reproduction

- Most eukaryotic cells reproduce asexually by **mitosis**.

- **Somatic cells** are all **body cells** (like nerve, liver, etc...) except sperm and ova (egg).

- All Somatic cells have the same number of **chromosomes**.
Cell Cycle

- The **dividing** and **non-dividing** stages in the life of a cell.

- **Phases:**
  1. **Interphase**: growth and DNA replication
  2. **Prophase**
  3. **Metaphase**
  4. **Anaphase**
  5. **Telophase**

Mitotic division
Cell Cycle

Mitosis
- prophase
- metaphase
- anaphase
- telophase

G1 G2

S phase

interphase
Interphase

• Comprises about 90% of the cell cycle.

• **Cellular growth:**
  a. *protein synthesis*
  b. *metabolic activities*
  c. *DNA synthesis*

• Made up of **three phases:**
  1. **G₁ phase**
  2. **S phase**
  3. **G₂ phase**
Interphase

1. **G₁ (gap) phase:**
   - a. protein synthesis and metabolic activities.
   - b. most cell are arrested in this phase.

2. **S phase:**
   - a. DNA replication takes place.

3. **G₂ (gap) phase:**
Interphase

- **Nucleus** and **nucleolus** visible.

![Cell Diagram]

- Chromatin
- Nuclear membrane
- Cell membrane
- Nucleolus
Question:

- What is a chromosome?
Answer:

- A chromosome is made up of a DNA-histone protein complex called chromatin.
- Chromatin is a long, thin fiber that is folded and coiled to form chromosomes.
Question:

• What is a replicated chromosome?
Answer:

- A replicated chromosome consist of two strands of identical chromosomal material called chromatids (sister chromatids).
Question:

• When is a chromatid a chromatid?
Answer:

- A **chromatid** is a **chromatid** as long as it is held in association with a **sister chromatid** at the **centromere**.
Mitotic Phase

• **Mitosis (karyokinesis)**
  a. **nuclear** division of **genetic material**.
  b. **prophase-metaphase-anaphase-telophase**

• **Cytokinesis**
  a. **cytoplasmic division**.
  b. Indicator of telophase.
Prophase

- **Longest phase**
- Nucleolus disappears
- Chromatin material condenses into chromosomes, consisting of two sister chromatids.
Prophase

- **Centrioles** move apart (not found in plants).

- **Spindle fibers** form and attach from **centrioles** to **centromeres by kinetochores**.

- Nuclear envelope fragments and disappears.
Prophase

early prophase  late prophase

- centrioles
- spindle fibers
- aster fibers
- nuclear envelope disappearing
- centromere
Question:

• What attaches the spindle fibers to the centromeres?
Answer: Kinetochore

Diagram showing:
- Centromere
- Spindle fibers
- Centriole
- Aster fibers
- Sister chromatids
Metaphase

- Shortest phase

- **Centrioles** are at opposite ends of the cell and attached with aster fibers.

- **Chromosomes** move to the metaphase plate (equatorial plate - center of cell).
Metaphase

Centrioles

Aster fibers

Spindle fibers

Metaphase plate
Anaphase

• **Centromeres** uncouple and **spindle fibers** shorten.

• **Sister chromatids** separate and move apart.

• After separation, **chromatids** are now considered **chromosomes**.
Anaphase

• During this phase, the cell contains twice the normal number of chromosomes.

• Cell begins to elongate.

• At the end, there are equal numbers of chromosomes at the poles.
Anaphase

No longer sister chromatids, now chromosomes

- aster fibers
- spindle fibers
- centrioles
Telophase

- Cleavage furrow develops in animal cells (Cytokinesis begins).
- Cell plate develops in plants (no cleavage furrows in plants).
- Nucleolus reappears.
Telophase

- Nuclear membrane reappears.

- **Chromosomes** uncoil.

- In the end, two genetically identical nuclei (karyokinesis completed) are present.
Telophase

cleavage furrow (cytokinesis)

nuclear membrane reforming

nucleolus reappears
Cytokinesis

- **Cytoplasmic division**
- **Cell plate** complete in **plants**
- In the end, two separate daughter cells produced with single nucleus.
Question:

• A cell containing 20 chromosomes at the beginning of mitosis would, at its completion, produce cells containing how many chromosomes each?
Answer:

• **20 chromosomes**
Question:

- A cell containing 40 chromatids at the beginning of mitosis would, at its completion, produce cells containing how many chromosomes each?
Answer:

- 20 chromosomes