

Al- Mustaqbal University College

First stage.  
Department of Optometry(Optics)



جامعة المستقبل الاهلي  
مرحلة الاولى  
قسم التقنيات البصرية

- Cell Reproduction
  - Cell Cycle and Mitosis
- Lecture :5

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## CELL REPRODUCTION

- Cell Division: process by which a cell divides to form two new cells (daughter cells)
- Three types of cell division, or cell reproduction
  - Prokaryotes (bacteria)
    - Binary fission → divides forming two new identical cells
  - Eukaryotes
    - Mitosis
      - Cell or organism growth
      - Replacement or repair of damaged cells
    - Meiosis
      - formation of sex cells, or gametes

## Why do cells divide?

### 1: DNA Overload

- If cells grow without limit, an “information crisis” would develop
- DNA cannot serve the needs of the increasing size of cell

### 2: Exchange of materials

- Food and oxygen have to cross membrane very quickly
- Waste must get out
- If cell is too large, this occurs too slowly and cell will die

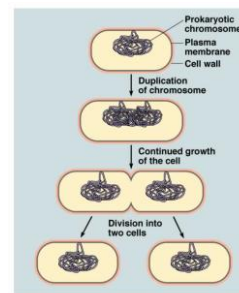
## PROKARYOTIC CELL DIVISION

### • Binary fission

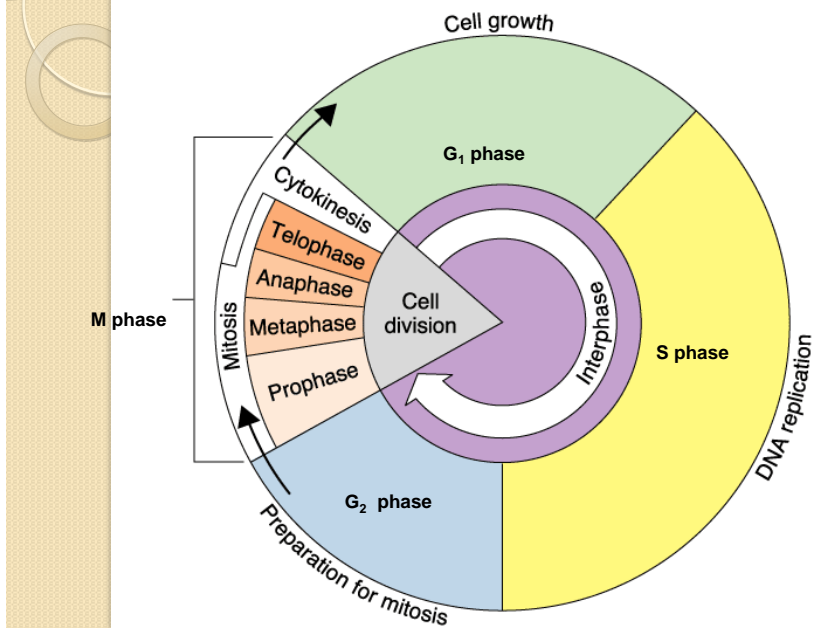
#### ◦ 3 main steps:

- 1: DNA Replication—DNA is copied, resulting in 2 identical chromosomes
- 2: Chromosome Segregation—2 chromosomes separate, move towards ends (poles) of cell
- 3: Cytokinesis—cytoplasm divides, forming 2 cells

- Each new daughter cell is genetically identical to parent cell

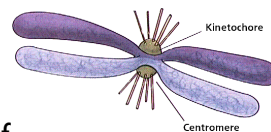
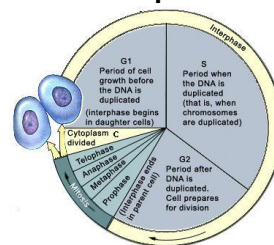


# THE CELL CYCLE



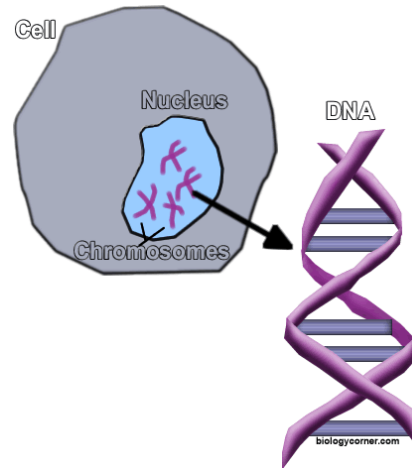
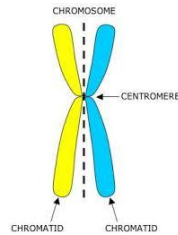
## CELL CYCLE-INTERPHASE

- Interphase: period of growth and DNA replication between cell divisions
- Three phases:
  - G<sub>1</sub> Phase
    - cell increases in size
  - S Phase
    - Replication of chromosomes
      - **Now two strands called sister chromatids joined by a centromere**
  - G<sub>2</sub> Phase
    - organelles double
    - new cytoplasm forms
    - All other structures needed for mitosis form



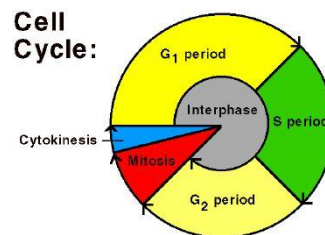
## What are Chromosomes?

- DNA containing cell's genetic code
- Each chromosome has a matching pair
  - Homologous Pair
- During interphase, each chromosome copies itself



## EUKARYOTIC CELL DIVISION

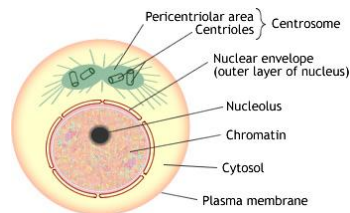
- DNA found on chromosomes located in nucleus of cell
- Cell cycle continuous process
  - Cells grow
  - DNA replicated
  - Organelles duplicated
  - Divide to form daughter cells
- 2 Main steps:
  - 1: Mitosis (4 steps—Prophase, Metaphase, Anaphase, Telophase)  
*Nucleus divides*
  - 2: Cytokinesis—Cytoplasm divide, forming 2 cells



Each new daughter cell is *genetically identical* to parent cell

## Life Cycle of the Cell

- Mitosis = nuclear division
- Mitosis is followed by cytokinesis (cell division)
- The steps of mitosis ensure that each new cell has the exact same number of chromosomes as the original



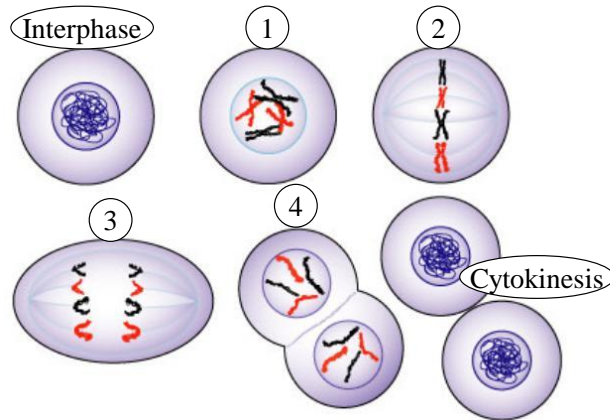
## MITOSIS

- Process that divides cell nucleus to produce two new nuclei each with a complete set of chromosomes
- Continuous process
- Four phases (PMAT)
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase

## Mitosis

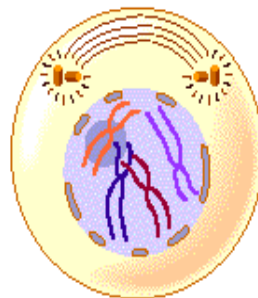
- (1) Prophase
- (2) Metaphase
- (3) Anaphase
- (4) Telophase

## • PMAT



## PROPHASE

1. chromosomes visible (sister chromatids)
2. centrioles migrate to the poles (only in animals)
3. nuclear membrane disappears
4. spindle forms

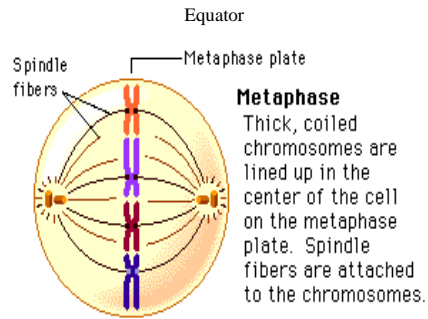


### Prophase

The chromosomes appear condensed, and the nuclear envelope is not apparent.

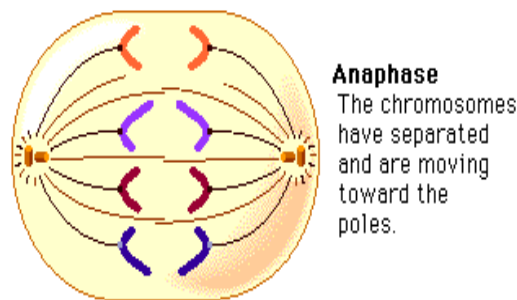
## METAPHASE

1. chromosomes line up on the equator of the cell
2. spindles attach to centromeres



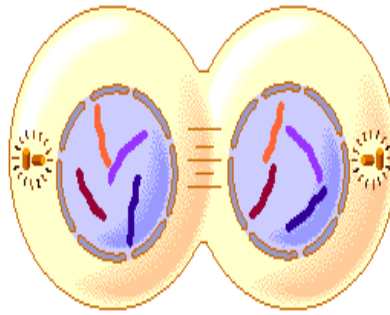
## ANAPHASE

1. sister chromatids separate
2. centromeres divide
3. sister chromatids move to opposite poles



## Telophase

1. chromosomes uncoil • now chromatin
2. nuclear membranes reform
3. spindle disappears

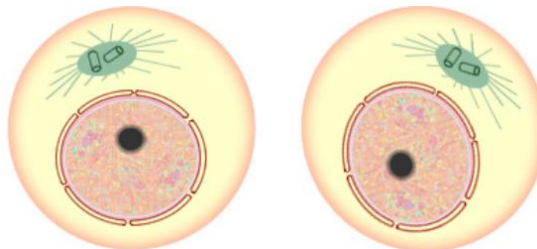


### Telophase

The chromosomes are at the poles, and are becoming more diffuse. The nuclear envelope is reforming. The cytoplasm may be dividing.

## CYTOKINESIS

- Occurs at end of Mitosis
  - division of the cytoplasm to form 2 new daughter cells
  - organelles are divided
- Daughter cells are genetically identical



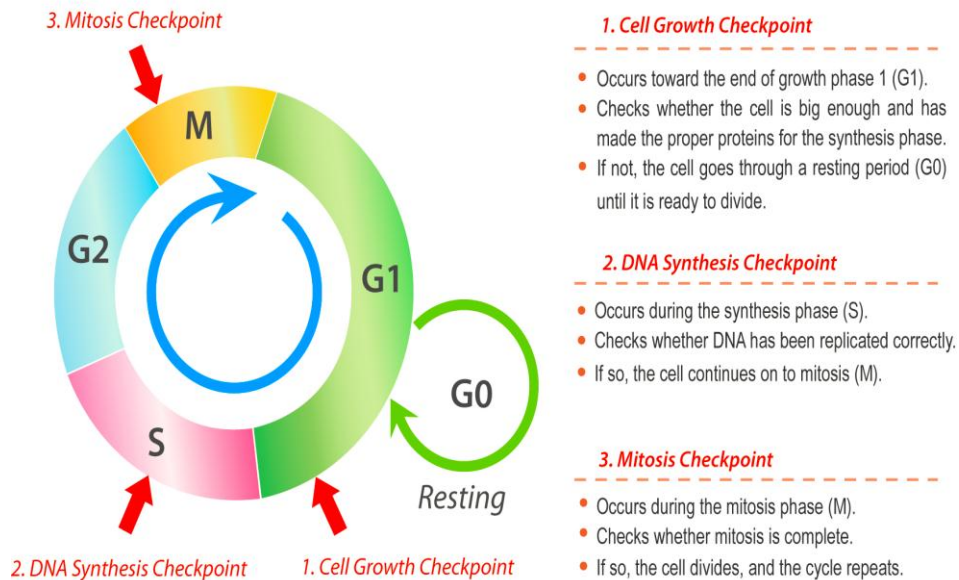
Cells return to interphase



## Control of the Cell Cycle

- Regulatory proteins called cyclins control the cell cycle at checkpoints:
- G1 Checkpoint—decides whether or not cell will divide
- S Checkpoint—determines if DNA has been properly replicated
- Mitotic Spindle Checkpoint—ensures chromosomes are aligned at mitotic plate

## The Cell Cycle and the Checkpoints



# CANCER CELLS

- Result of uncontrolled cell division of cells that have lost ability to regulate cell cycle
- Reproduce more rapidly than normal cells
- Masses formed called 'tumors'

