



الوراثة الطبية 1 / الكورس الاول

Cell Cycle and Cell Division

Sawa University

جامعة ساوة الاهلية

College of health and medical techniques

كلية التقنيات الصحية والطبية

Department of Medical Laboratories

قسم تقنيات المختبرات الطبية

Third Stage

المرحلة الثالثة

محاضرة رقم 2

الجانب النظري : الوراثة الطبية

Lecture No. 2

Theoretical : Medical Genetics

تدريسي المادة : م. د عباس علي

Learning Objectives

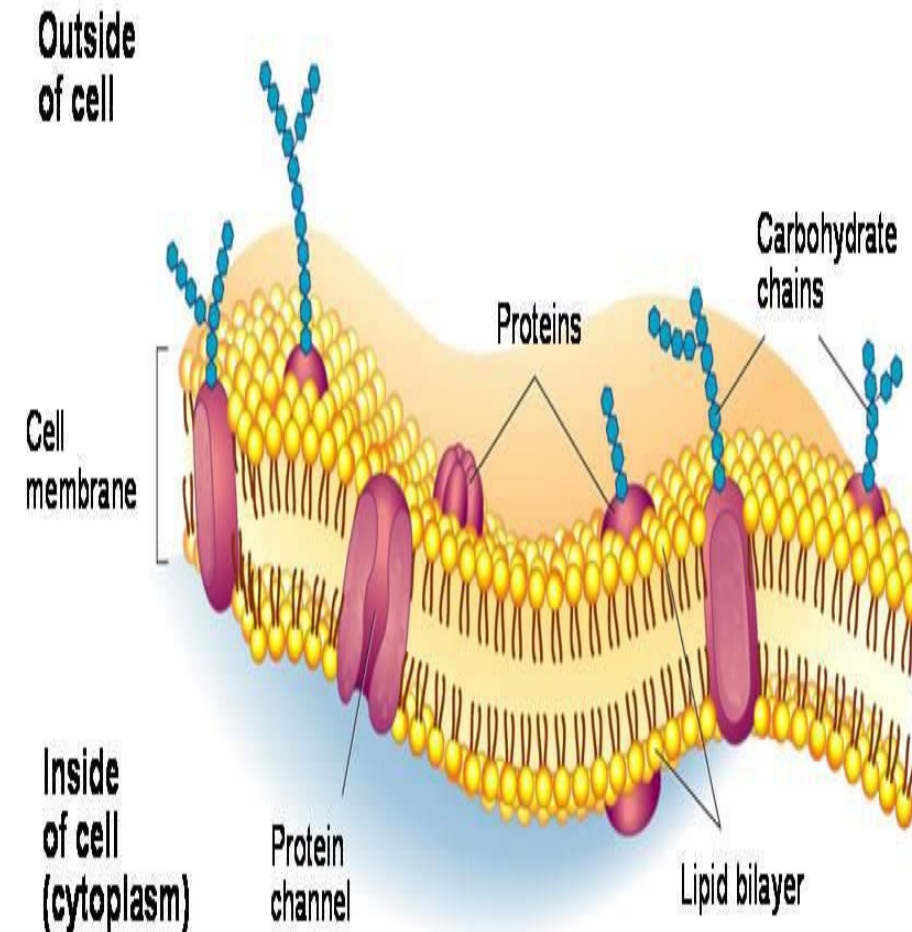
By the end of this lecture, you will be able to:

1. List the cell-cycle phases in correct order.
2. State one main function for each named organelle.
3. Explain why DNA duplication occurs only in S phase.
4. Distinguish G0 (non-dividing) from cycling cells, giving one example of each.

Cell contents

1- **The cell membrane**, also known as the plasma membrane, is a thin, flexible barrier that surrounds the cell. It separates the internal contents of the cell from its external environment.

- The cell membrane is primarily composed of a lipid bilayer, which includes: **Phospholipids** , **Proteins**, **Cholesterol** **Carbohydrates**.
- The cell membrane is selectively permeable, meaning it regulates the passage of substances, allowing essential molecules like oxygen and nutrients to enter while keeping harmful substances out.



Cell contents

2-Nucleus

- Nucleus” refers to the **central part** of most cells, containing **genetic material (DNA)** and acting as the control center for cell activity.
- It is surrounded by a double membrane called the **nuclear envelope**, which protects the DNA and regulates the flow of materials in and out of the nucleus.
- The nucleus plays a key role in processes like **gene expression**, It is the process of transcription, which is the process of converting DNA into RNA.

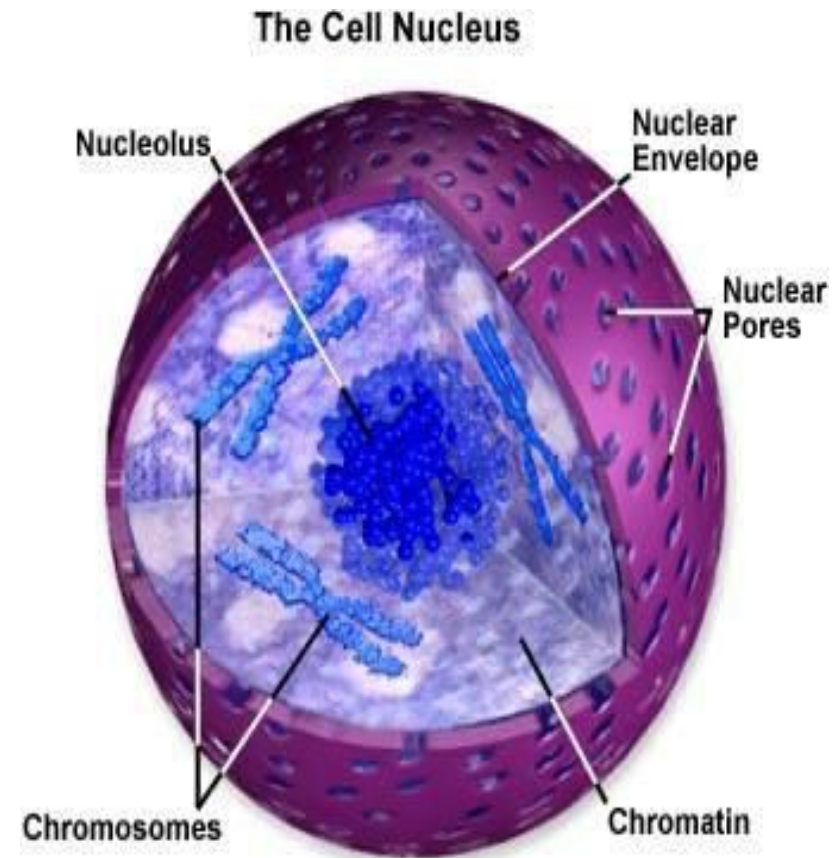


Figure 1

Cell contents

3-Mitochondria are membrane-bound organelles found in the cytoplasm of most eukaryotic cells.

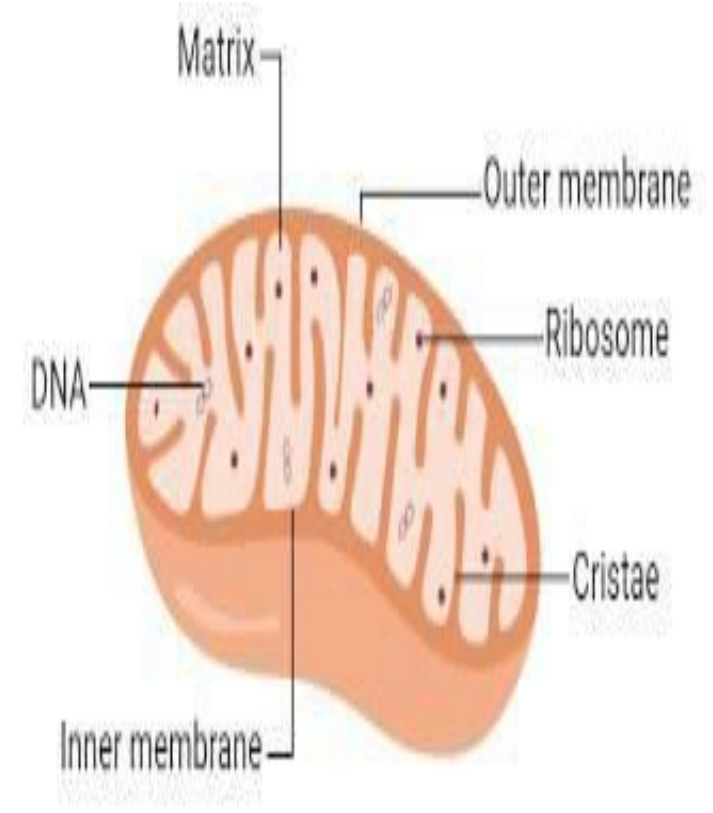
- They are often referred to as the “powerhouses” of the cell because they generate most of the cell’s supply of adenosine triphosphate (ATP).

- **The main function of mitochondria:**

1- The main function of mitochondria is to perform cellular respiration, converting nutrients like glucose and oxygen into ATP.

2- Mitochondria also play roles in apoptosis (programmed cell death).

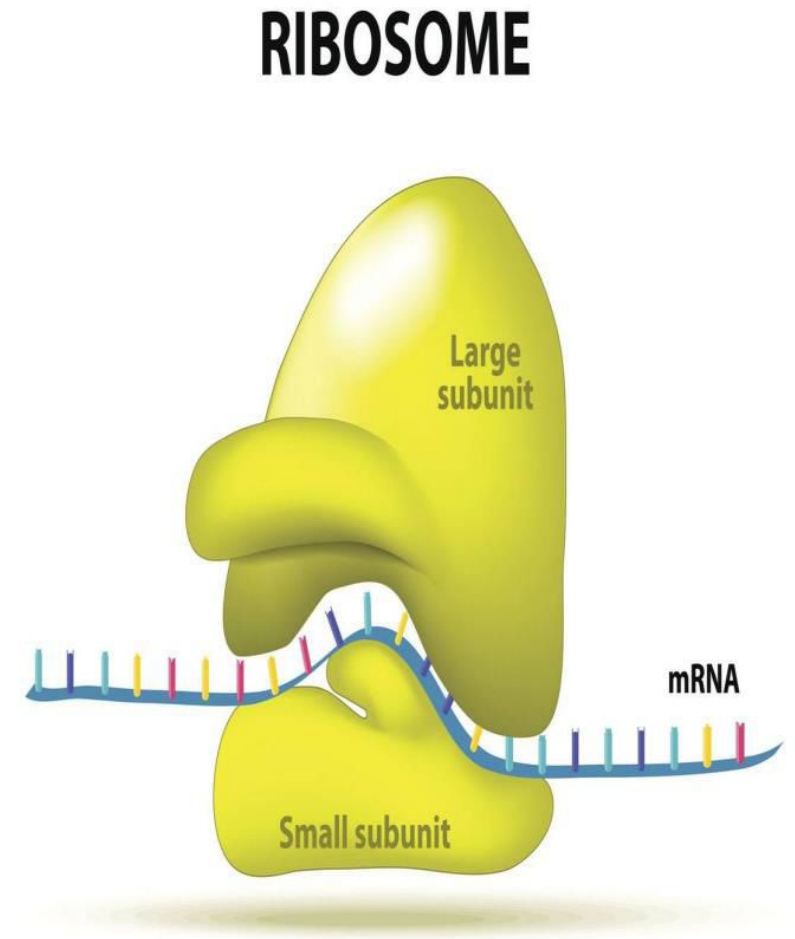
3- Mitochondrial DNA: Mitochondria have their own circular DNA, which is **inherited from the mother**. This mitochondrial DNA (mtDNA) encodes some of the proteins needed for mitochondrial function.



Cell contents

4-Ribosomes

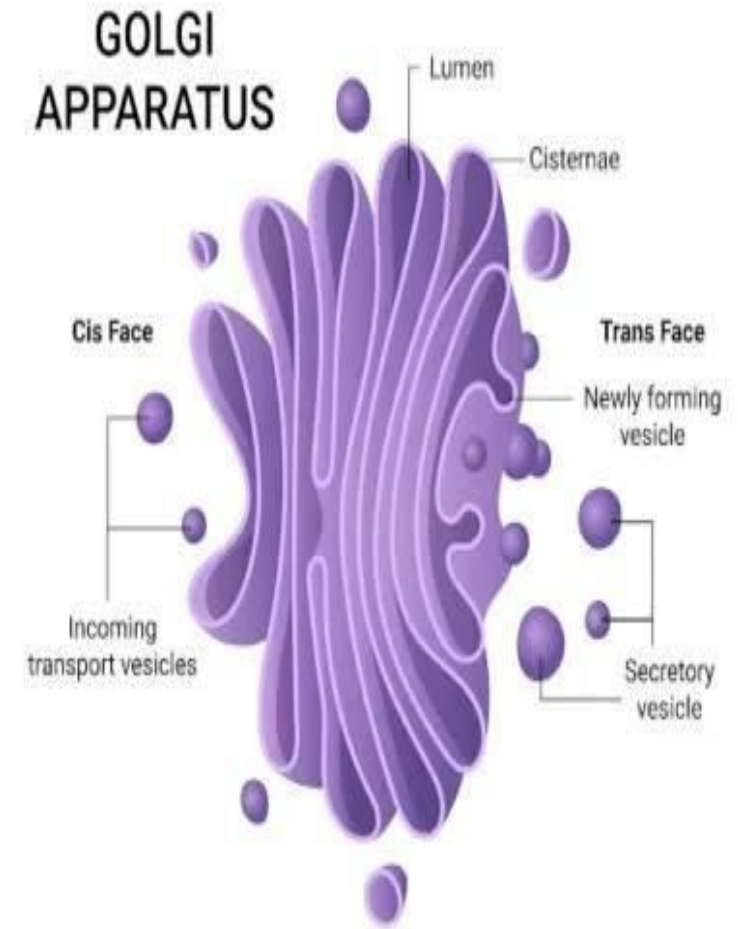
- Ribosomes are cellular organelles **responsible for protein synthesis** in both prokaryotic and eukaryotic cells.
- They are composed of two subunits: a large subunit and a small subunit, each **made of ribosomal RNA (rRNA) and proteins**.
- Ribosomes translate messenger RNA (mRNA) into amino acid sequences, which fold into functional proteins.



Cell contents

5-Golgi apparatus

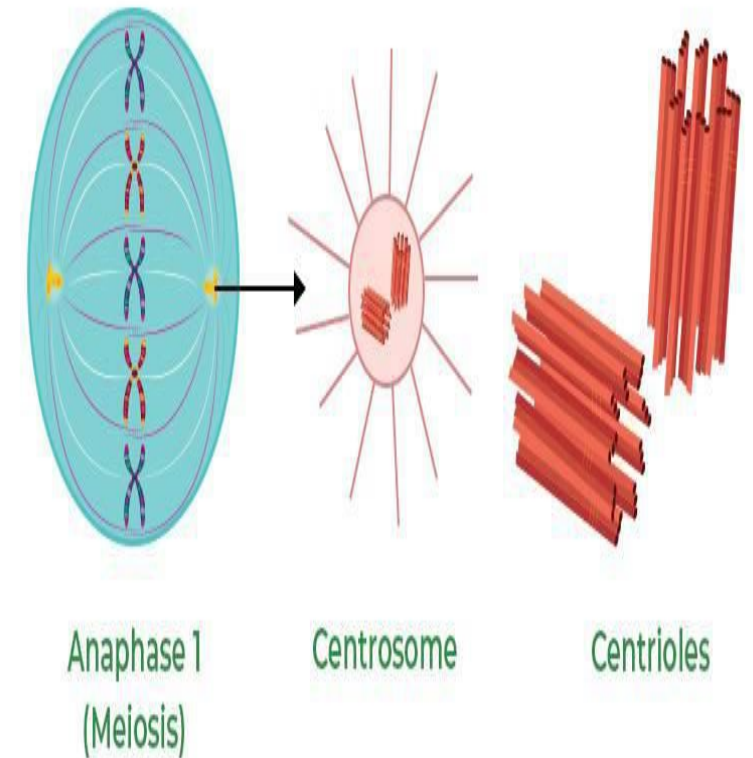
- The Golgi apparatus, also **known as the Golgi complex or Golgi body**, is an essential organelle found in most eukaryotic cells..
- **Key functions of the Golgi apparatus include:**
 1. **Protein modification**: It processes proteins by adding carbohydrates (glycosylation) or lipids (lipidation).
 2. **Sorting and packaging**: It packages proteins into vesicles to be sent to their final destination.
 3. **Lipid transport**: The Golgi also plays a role in distributing lipids within the cell
 4. **Formation of lysosomes**: It is involved in creating lysosomes, which are organelles containing digestive enzymes.



Cell contents

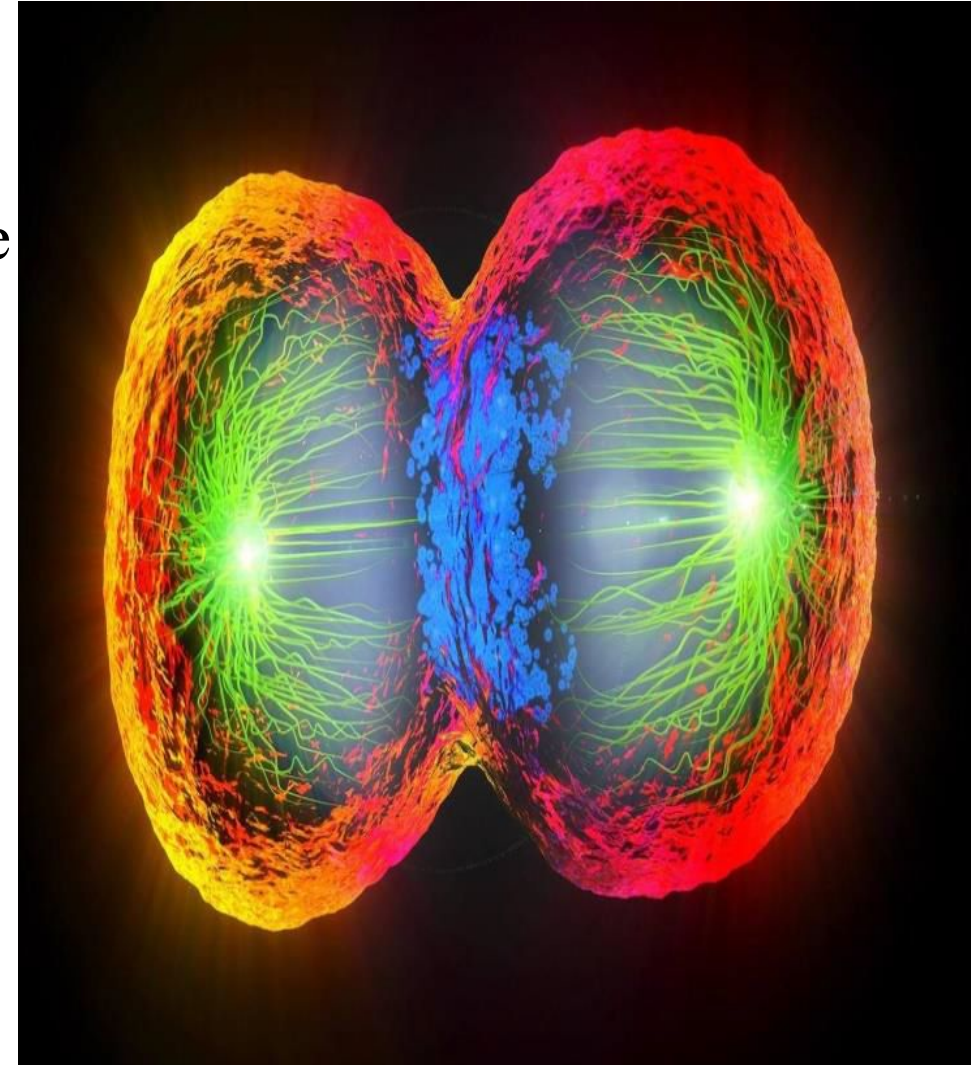
6- Centrosome

- The centrosome: It is composed of **two centrioles**
- The centrosome **is important for organizing the microtubules that make up the cell's cytoskeleton,**
- during mitosis or meiosis, it helps in the formation of the **mitotic spindle**, which ensures that chromosomes are properly distributed between daughter cells.



Cell division

- Cell division is the process by which a parent cell divides into two or more daughter cells.
- In cell division, the cell that is dividing is called the "parent" cell.
- The parent cell divides into two "daughter" cells.
- **Why Do Cells Divide?**
- Cells divide basically for three reasons. They are:
 - 1- For the growth & development of our body
 - 2- To repair the dead and damaged tissues
 - 3- For reproduction



Cell Cycle

Cell Cycle : Cellular reproduction is a cyclic process in which daughter cells are produced through nuclear division (**Mitosis**) and cellular division (**cytokinesis**). Mitosis and cytokinesis are part of the growth-division cycle called the **cell cycle**.

❖ **Cyclic process:** $G_1 \rightarrow S \rightarrow G_2$ (Interphase) $\rightarrow$ **Mitosis** $\rightarrow$ **cytokinesis**

Cell Cycle

Interphase = growth + DNA replication + protein synthesis (NOT resting)

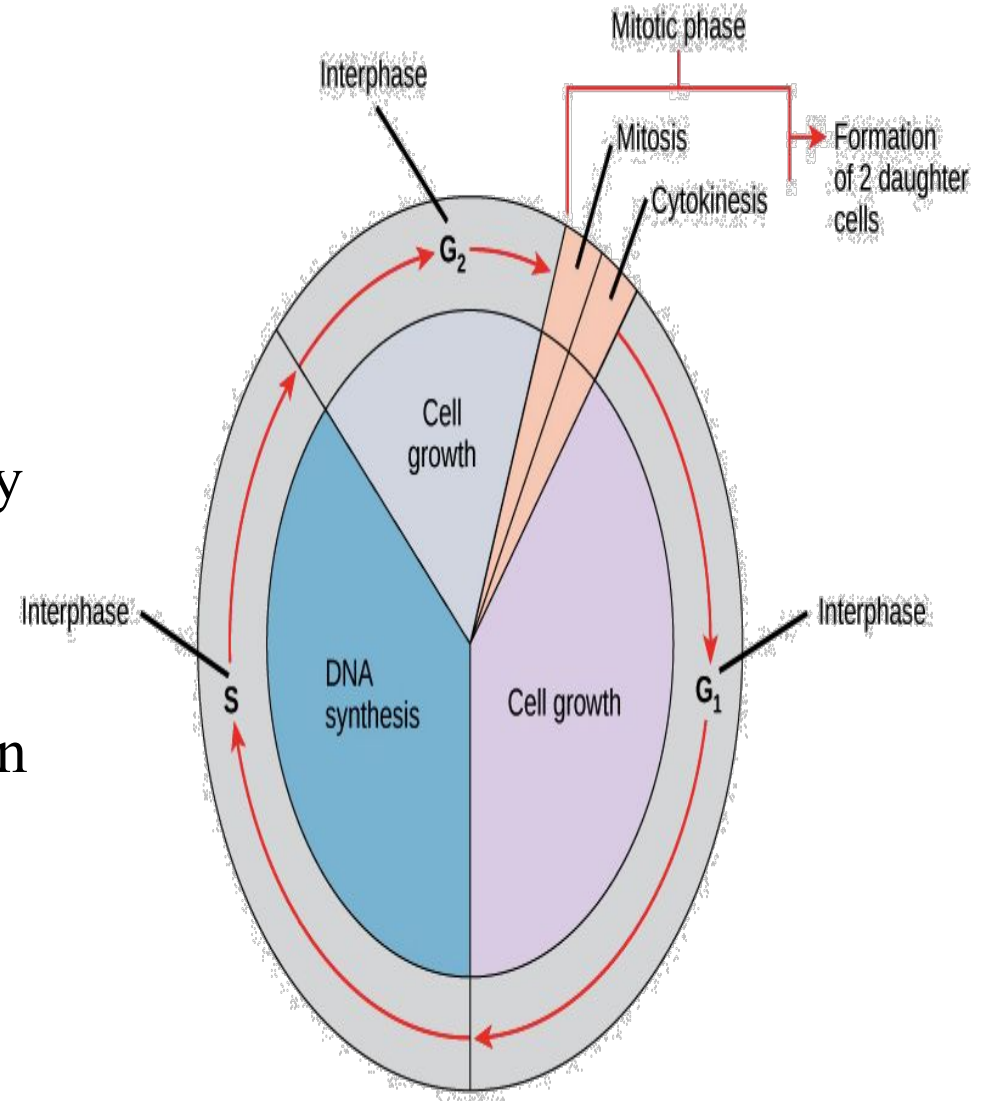
The interphase consists of three phases:

1- G₀ Phase (Resting Phase): The cell neither divides nor prepares itself for division.

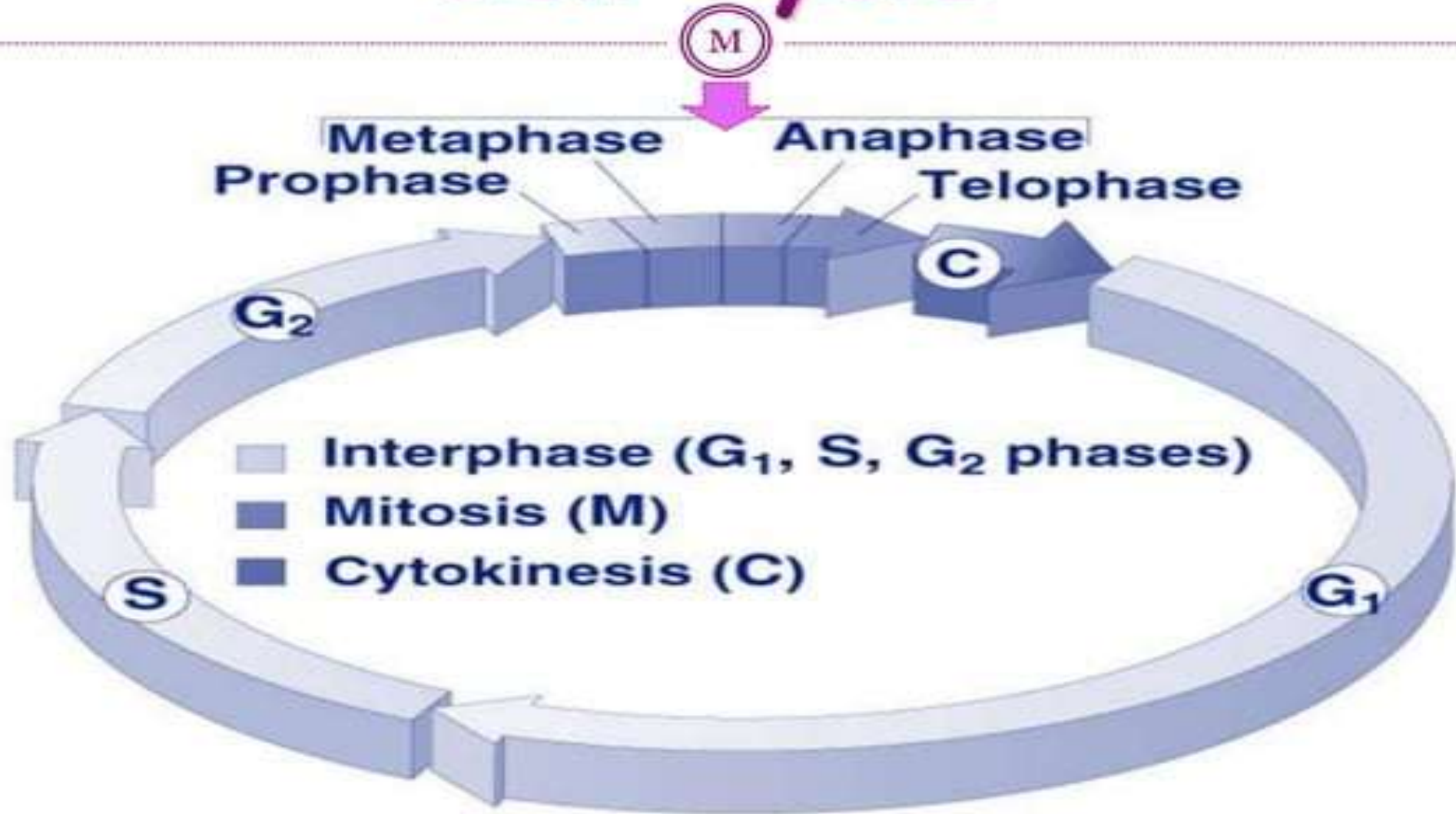
2- G₁ Phase (Gap 1): The cell is metabolically active and grows continuously during this phase, produces RNA, and synthesizes proteins needed for DNA replication.

3- S phase (Synthesis): The DNA replication or synthesis occurs during this stage so the cell has two copies of its genetic material..

4- G₂ phase (Gap 2): Protein synthesis happens in this phase.



Cell Cycle



Interphase: G₁



- **Events during G₁**

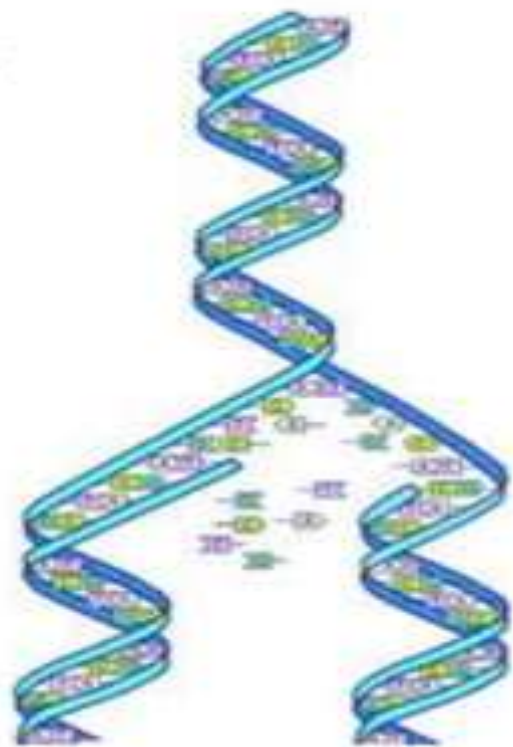
- 1st stage of Cell growth after cell division
- Preparation of chromosomes for replication
- Duplication of cellular components (cytoplasm and organelle)
- Cell carries on its normal metabolic activities
- G₁ checkpoint (or restriction point); cell commits to division or exits from cell cycle

S- phase



- ✓ The instructions for making cell parts are encoded in the DNA, so each new cell must get a complete set of the DNA molecules
- ✓ DNA must be copied or replicated before cell division
- ✓ Each new cell will then have an identical copy of the DNA

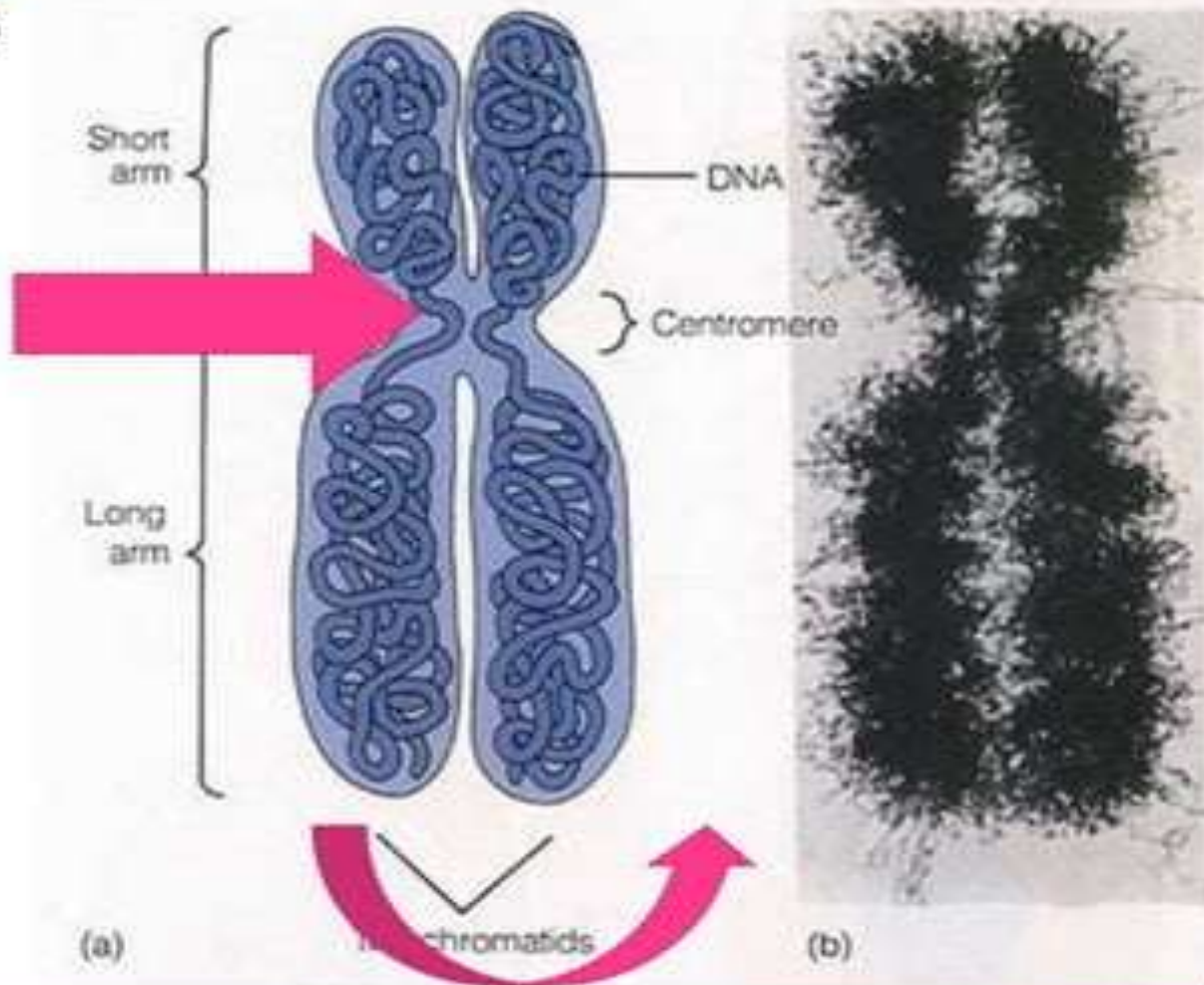
Original DNA strand



Two new, identical DNA strands

S- phase

- ✓ Duplicated chromosomes are called **chromatids**
- ✓ & are held together by the **centromere**



Called Sister Chromatids

Interphase: G2



- 2nd Cell growth stage
- Occurs after DNA has been copied
- All cell structures needed for division are made (e.g. centrioles)
- Both organelles & proteins are synthesized
- Checkpoint (restriction point) for entry into M phase

Reference:

Jorde, L.B.; Carey, J.C & Bamshad, M.J. (2019). Medical genetics. Sixth Edition, June 1.

Any questions?

*Thank
You*