



جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

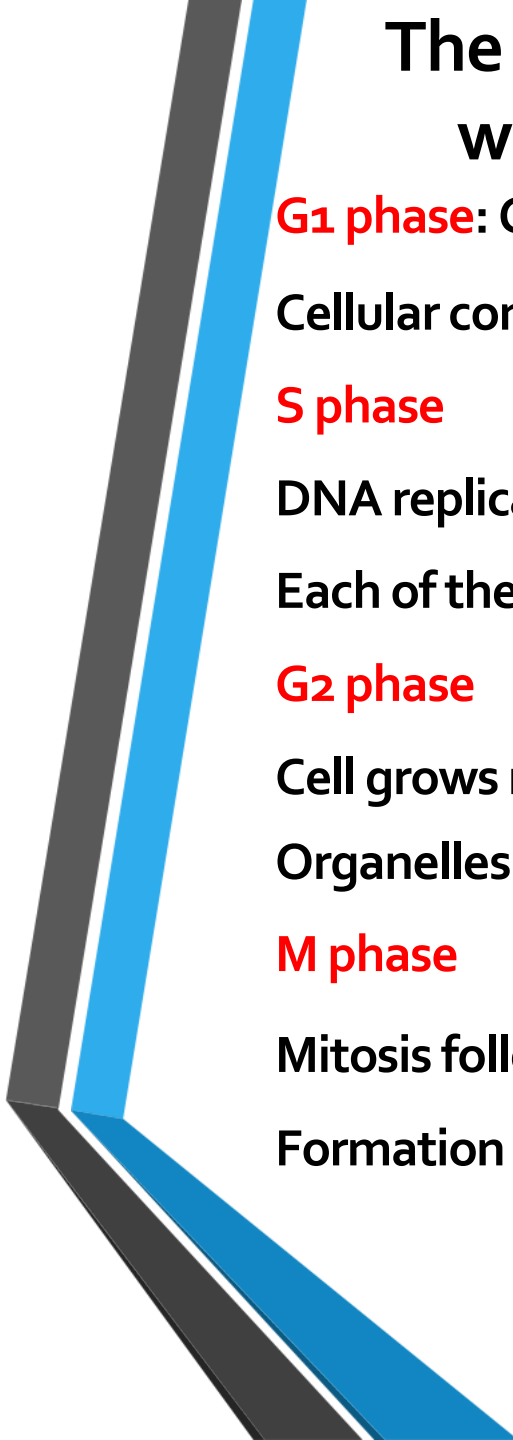
كلية العلوم
قسم الأدلة الجنائية
المحاضرة الخامسة

Cellular level: cell cycle and cell division

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The cell cycle

- **Cell**: the smallest unit that can live on its own and that makes up all living organisms and the tissues of the body. A cell has three main parts: **the cell membrane, the nucleus,** and the **cytoplasm.**
- A cell cycle is a series of events that takes place in a cell as it **grows** and **divides**
- A cell spends most of its time in what is called **interphase,** and during this time it grows, **replicates its chromosomes,** and prepares for cell division. The cell then leaves interphase, undergoes mitosis, and completes its division.
- The resulting cells, known as **daughter cells,** each enter their own interphase and begin a new round of the cell cycle.



The stages in the cell cycle between one mitosis and the next, which include G₁, S and G₂, are known collectively as the interphase.

G₁ phase: Cell increases in size

Cellular contents are duplicated

S phase

DNA replication

Each of the 46 chromosomes (23 pairs) is replicated by the cell

G₂ phase

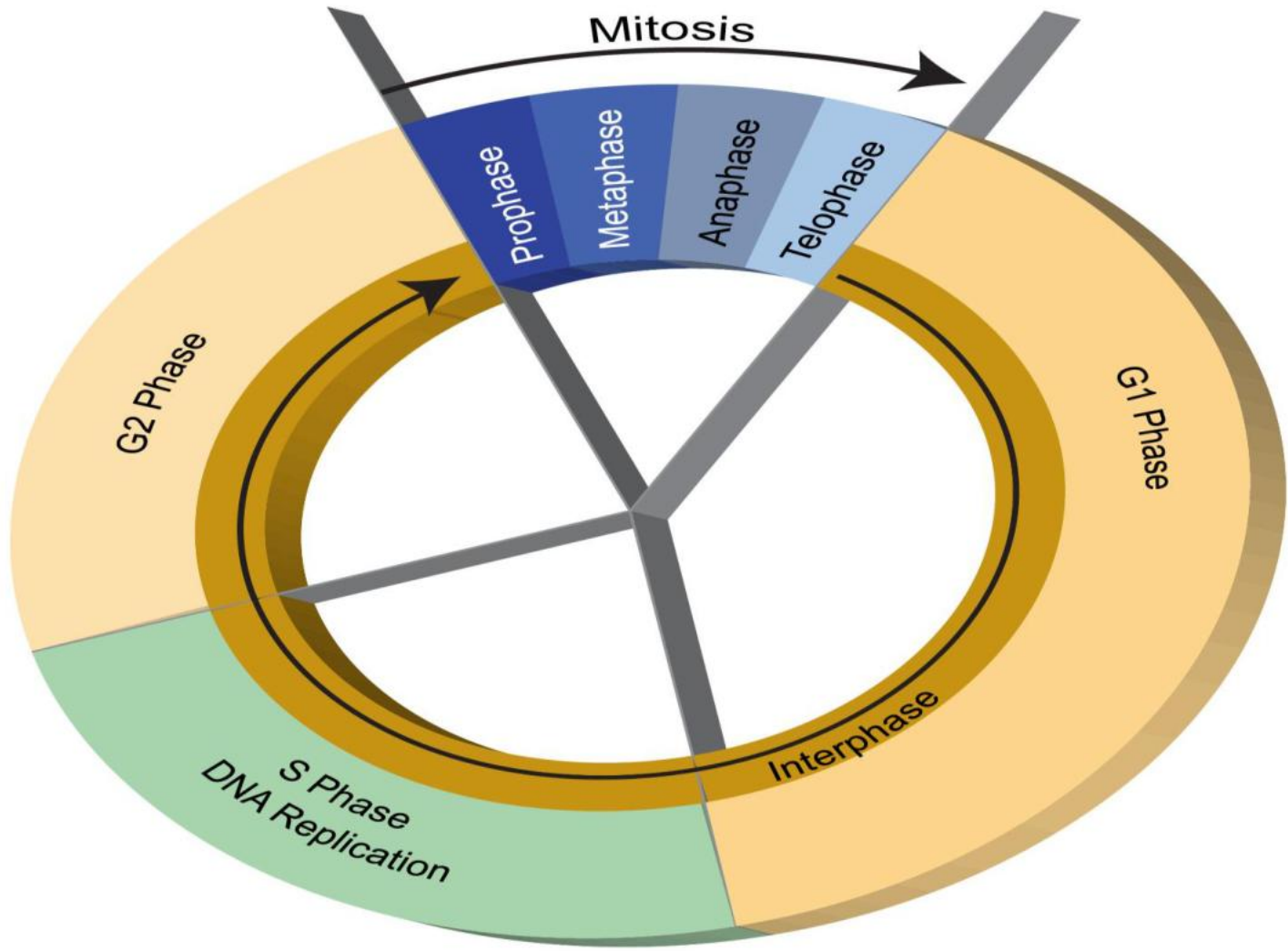
Cell grows more

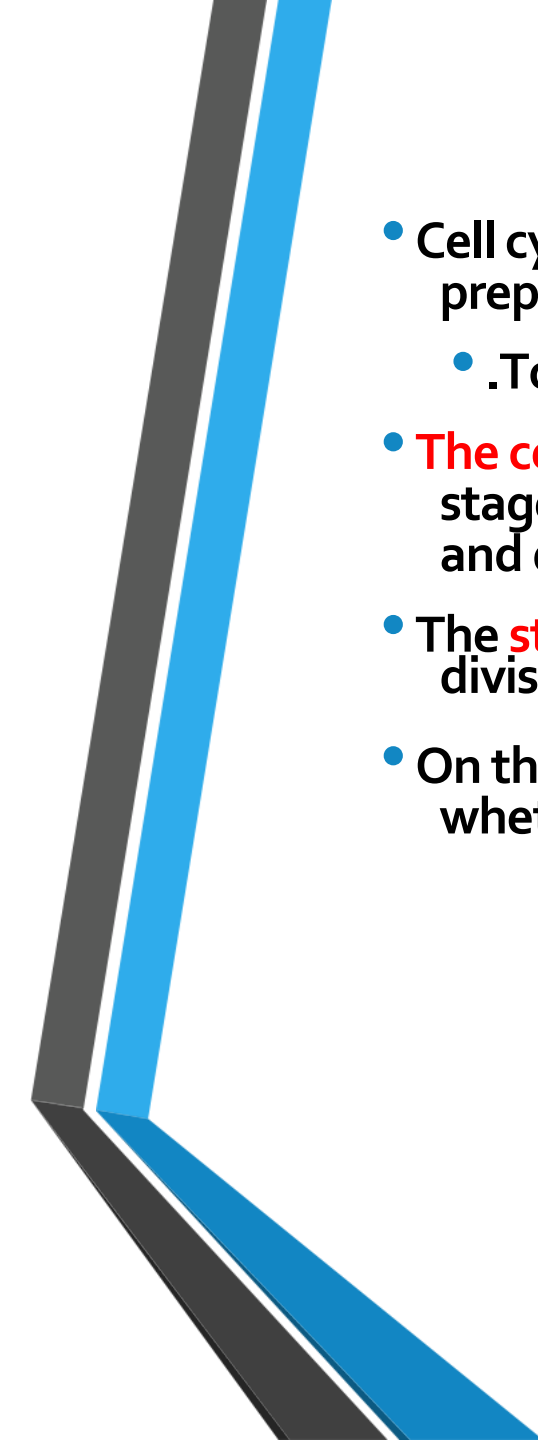
Organelles and proteins develop in preparation for cell division

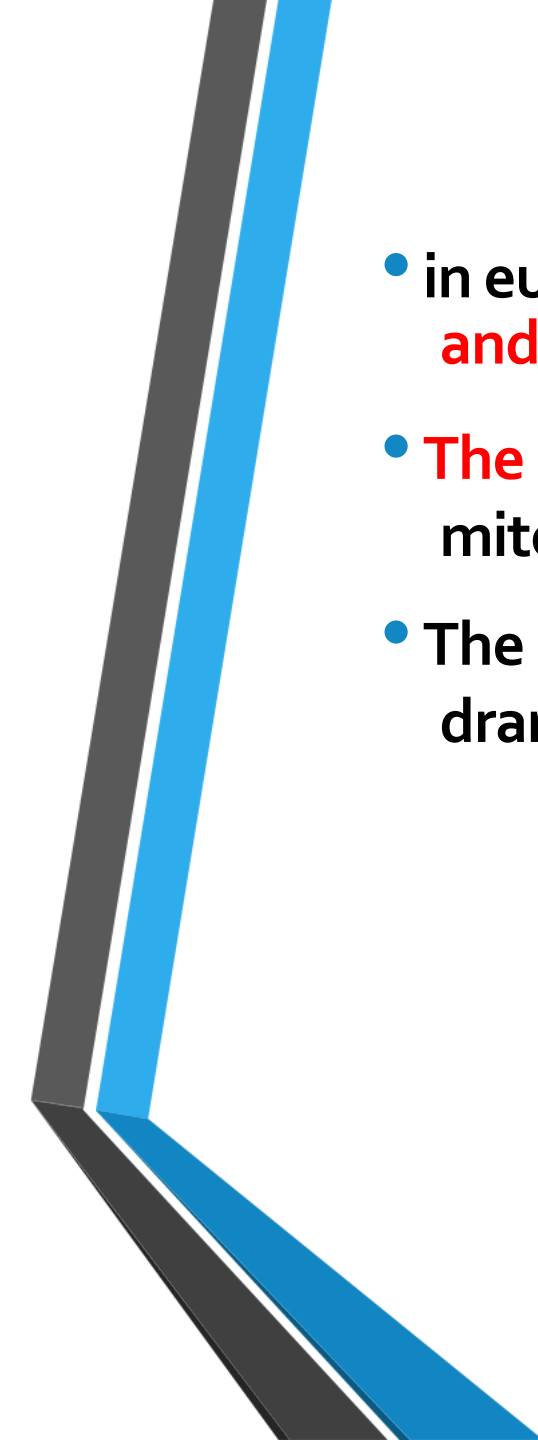
M phase

Mitosis followed by cytokinesis (cell separation)

Formation of two identical daughter cells



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- Cell cycle has different stages called **G₁**, **S**, **G₂**, and **M**. **G₁** is the stage where the cell is preparing to divide
 - .To do this, it then moves into **the S phase** where **the cell copies all the DNA**
 - **The cell cycle is a four-stage process** in which the cell increases in size (gap 1, or **G₁**, stage), copies its DNA (synthesis, or **S**, stage), prepares to divide (gap 2, or **G₂**, stage), and divides (mitosis, or **M**, stage).
 - The **stages G₁**, **S**, and **G₂** make up interphase, which accounts for the span between cell divisions.
 - On the basis of the stimulatory and inhibitory messages a cell receives, it “decides” whether it should enter the cell cycle and divide

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- in eukaryotes, the cell cycle consists of four discrete phases: **G₁, S, G₂, and M.**
 - **The S or synthesis** phase is when DNA replication occurs, and the M or mitosis phase is when the cell **actually divides.**
 - The other two phases — G₁ and G₂, the so-called gap phases — are less dramatic but equally important.

Cell division

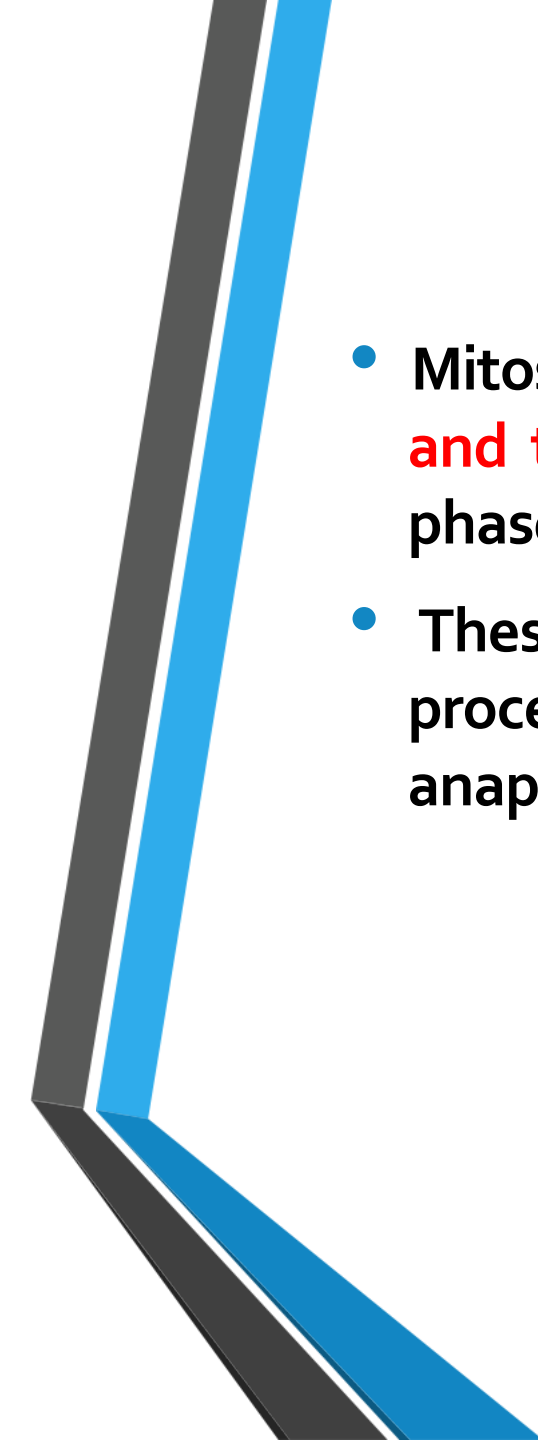
- Cell division is the process by which a parent cell divides into two or more daughter cells.
- Cell division usually occurs as part of a larger cell cycle
- **In eukaryotes**, there are two distinct types of cell division; a vegetative division, whereby each daughter cell is genetically identical to the parent cell (mitosis), and a reproductive cell division, whereby the number of chromosomes in the daughter cells is reduced by half to produce **haploid gametes (meiosis)** **Cell division gives rise to genetically identical cells in which the total number of chromosomes is maintained.**

WhatThe mitosis

- **Mitosis** is a type of cell division in which one cell (the mother) divides to produce two new cells (the daughters) that are genetically identical to itself
- In the context of the cell cycle, mitosis is the part of the division process in which the DNA of the cell's nucleus is split into two equal sets of chromosomes. The great majority of the cell divisions that happen in your body involve mitosis.
- **During development and growth**, mitosis populates an organism's body with cells, and throughout an organism's life, it replaces old, worn-out cells with new ones. For single-celled eukaryotes like yeast, mitotic divisions are actually a form of reproduction, adding new individuals to the population.

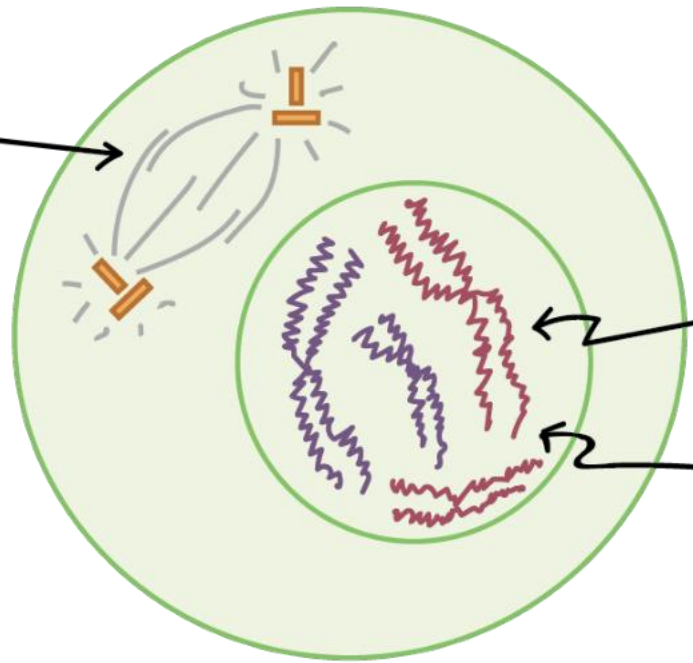
Mitosis

- In all of these cases, **the “goal”** of mitosis is to make sure that each daughter cell gets a perfect, full set of chromosomes
- Cells with too few or too many chromosomes usually don't function **well: they may not survive, or they may even cause cancer.**
- So, when cells undergo mitosis, they don't just divide their DNA at random and toss it into piles for the two daughter cells.
- Instead, they split up **their duplicated chromosomes** in a carefully organized series of steps.

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- Mitosis consists of four basic phases: **prophase, metaphase, anaphase, and telophase**. Some textbooks list five, breaking prophase into an early phase (called prophase) and a late phase (called prometaphase) .
 - These phases occur in strict sequential order, and cytokinesis - the process of dividing the cell contents to make two new cells - starts in anaphase or telophase.

EARLY PROPHASE

mitotic spindle starts to form



chromosomes start to condense

nucleolus is gone!

What miosis

- Meiosis results in four haploid daughter cells by undergoing one round of DNA replication followed by two divisions
- . **Homologous chromosomes** are separated in the first division, and sister chromatids are separated in the second division
- Both of these cell division cycles are used in the process of **sexual reproduction** at some point in their life cycle.

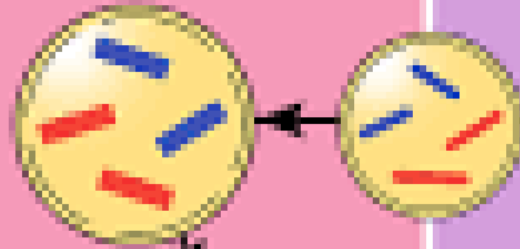
Cell Division in Eukaryote

- Cell division in **eukaryote** is much more complicated than **prokaryote**. Depending upon **chromosomal number** reduced or not; Eukaryotic cell divisions can be classified as mitosis (**sequational division**) and meiosis (**reductional division**).
- A primitive form of cell division is also found which is **called amitosis**. The **amitotic** or **mitotic cell division** is more atypical and diverse in the various groups of organisms such as protists (**namely diatoms, dinoflagellates** etc.) and fungi.

MITOSIS

MEIOSIS

Prophase



Prophase I



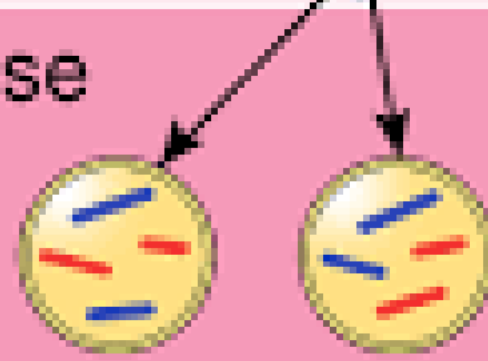
Meta Phase



Meta Phase I



Anaphase



Anaphase I



Meiosis II



What is the structure and function of chromosomes?

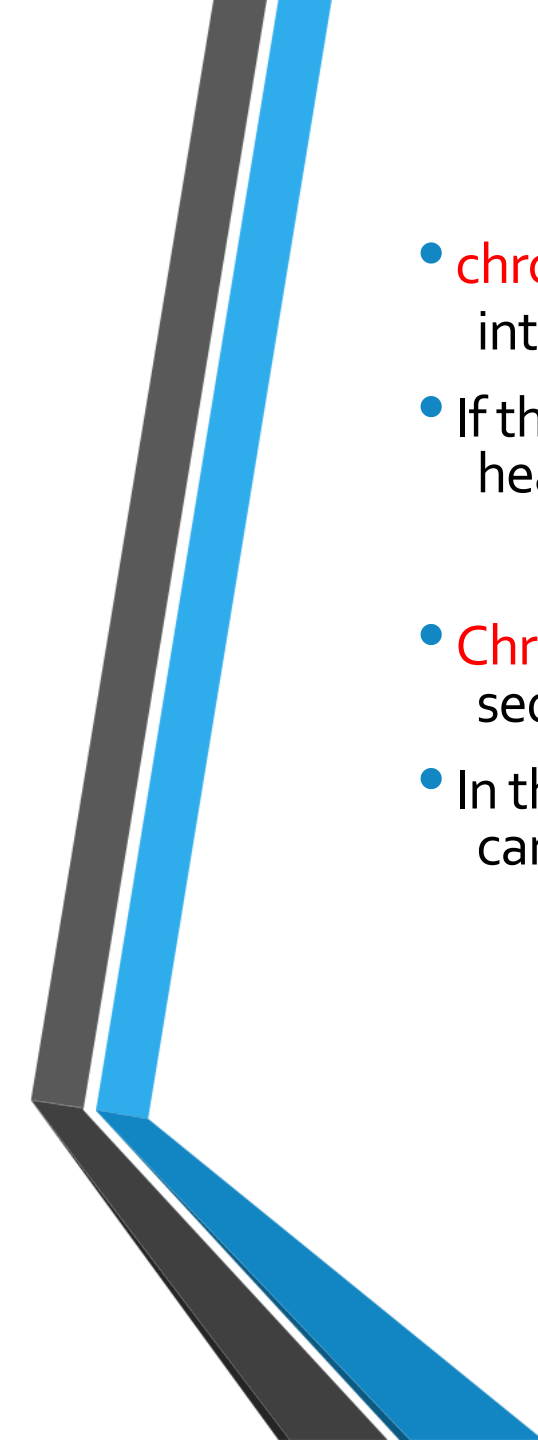
- **Chromosomes are:** thread-like structures located inside the nucleus of animal and plant cells.
- **Each chromosome** is made of **protein** and **a single molecule of deoxyribonucleic acid (DNA)**.
- Passed **from** parents to offspring, DNA contains the specific instructions that make each type of living **creature unique**

Chromosome changes

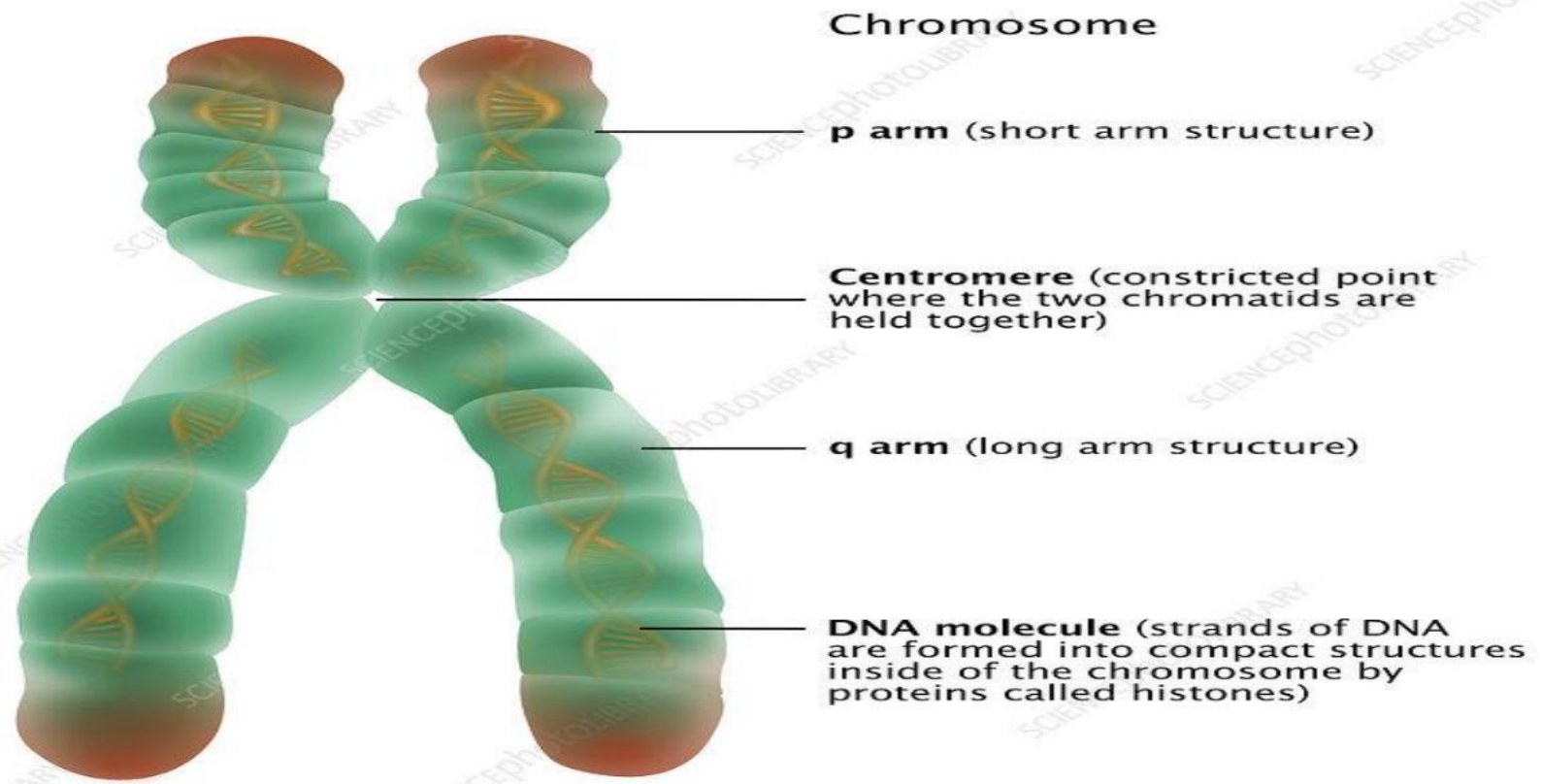
- **Chromosome changes**: can include variations in the number, size and structure of one or more chromosomes.
- **There are also two sex chromosomes**: called X and Y. In females, cells in the body typically have 46 chromosomes (44 autosomes plus two copies of the X chromosome), **They are said to have a 46,XX karyotype**.
- Chromosome **abnormalities** often happen due to one or more of these:
 1. **Errors** during dividing of sex cells (meiosis)
 2. Errors during dividing of other cells (mitosis)
 3. Exposure to substances that cause birth defects (teratogens)

There are 4 types of chromosome structural changes

- The four main types of structural chromosomal aberrations are **deletion, duplication, inversion, and translocation**
- 1-**chromosom Deletions** occur when a portion of the chromosome is deleted, or taken out, which can make that chromosome **less functional**.
- **2-chromosom Duplication**: it is means that the chromosome has duplicated part of itself, so that there is too much chromosome material present
- This additional chromosome material may mean there are too many instructions for the body to process, and this may result in learning disability, developmental delay and health problems in a child.
- .

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- **chromosome insertion**: means that material from a chromosome has been inserted into an unusual position in the same or another chromosome.
 - If there is no additional or missing chromosome material, that person is usually healthy.
 - **Chromosome inversion** means that part of a chromosome has turned so that the sequence of genes in the chromosome is partly reversed.
 - In the majority of cases this does not cause any health problems to the person carrying the inversion

Chromosome structure





Thank
You