

11.1 CELL GROWTH, DIVISION AND REPRODUCTION

Limits to Cell Size There are two main reasons why cells divide:

- **Information "overload":** The larger a cell gets, the more demands it places on its DNA. Eventually, the cell's DNA cannot meet the cell's needs.
- **Exchange of materials:** Cells take in nutrients and eliminate wastes through the cell membrane.
 - The larger a cell's volume, the more materials it needs to function and the more waste it creates.
 - A cell's volume increases at a faster rate than its surface area. As a cell grows, its surface-area-to-volume ratio becomes too small.
 - The larger a cell gets, the harder it is for enough materials to move across its cell membrane.
- **Cell division** solves the information overload and materials exchange problems.

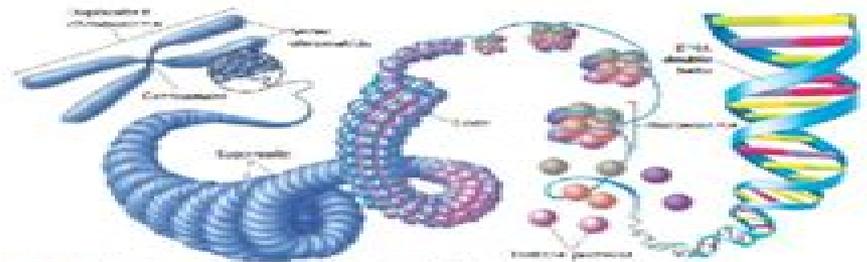
Cell Division and Reproduction Cell division is part of both types of reproduction:

- **Asexual reproduction:**
 - produces genetically identical organisms.
 - occurs in many single-celled organisms and in some multicellular organisms.
 - allows rapid reproduction of organisms in favorable environments.
- **Sexual Reproduction:**
 - produces organisms with genetic information from both parents.
 - occurs in most animals and plants and in many single-celled organisms.
 - increases genetic diversity, which aids species survival in changing environments.

11.2 THE PROCESS OF CELL DIVISION

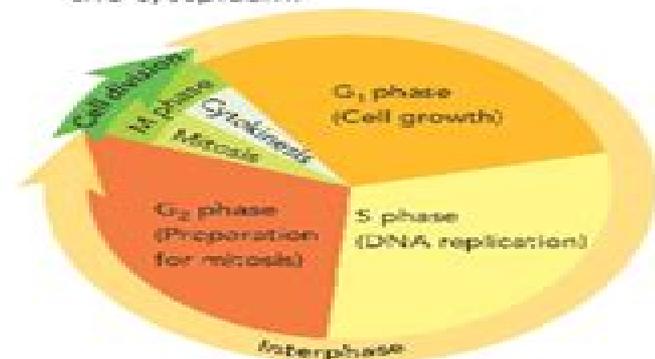
Chromosomes Packages of DNA called **chromosomes** hold a cell's genetic information.

- Prokaryotic chromosomes consist of a single, circular strand of DNA.
- Eukaryotic chromosomes are highly organized structures.
 - The DNA winds around histone proteins, forming **chromatin**.
 - Chromosomes make the precise separation of DNA possible during cell division.



The Cell Cycle The **cell cycle** is the series of events in the growth and division of a cell.

- In the prokaryotic cell cycle, the cell grows, duplicates its DNA, and divides by pinching in the cell membrane. The eukaryotic cell cycle has four stages (the first three of which are referred to as **interphase**):
 - In the G₁ phase, the cell grows.
 - In the S phase, the cell replicates its DNA.
 - In the G₂ phase, the cell produces organelles and materials for division.
 - In the M phase, the cell divides in two stages—**mitosis**, the division of the nucleus, and **cytokinesis**, the division of the cytoplasm.



Mitosis The division of the nucleus, mitosis, occurs in four stages:

- **Prophase:** a cell's genetic material condenses, a spindle starts to form, and the nuclear envelope breaks down.
- **Metaphase:** the duplicated chromosomes line up and spindle fibers connect to the centromeres. Spindle fibers extend from a region called the **centrosome**, where tiny paired structures called **centrioles** are located.

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