Mitosis

Learning Objectives:

- Define the terms: “Aster”, “Spindle formation”, “Mitotic centers/Spindle Poles”, “Polar fiber”, “kinetochores”, “ Metaphase plate”, and “Daughter chromosomes”.

- Describe briefly the prophase, metaphase, anaphase, telophase and cytokinesis.

Mitosis:

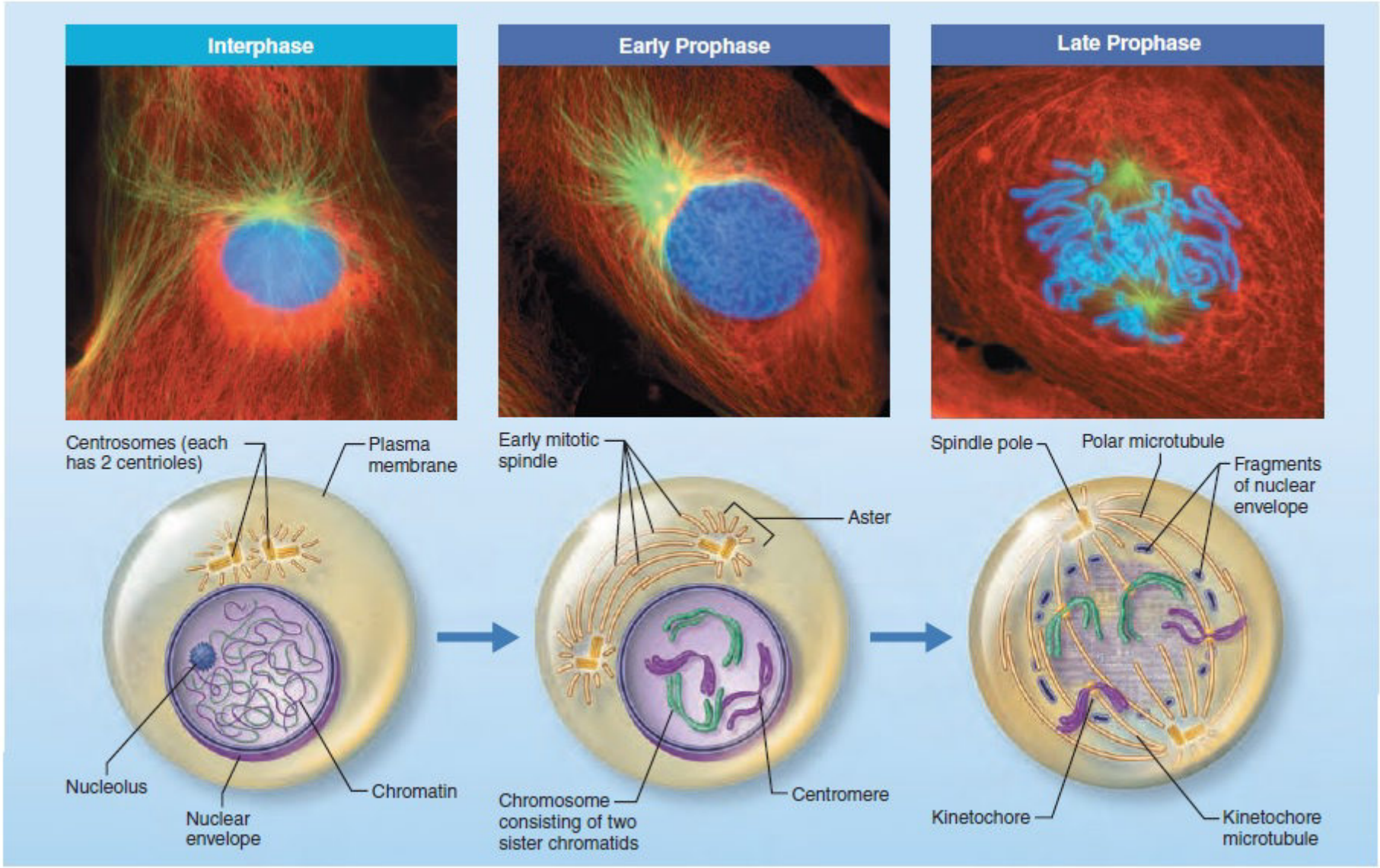
- Mitosis is the series of events that parcels out the replicated DNA of the mother cell to two daughter cells. Described as four phases:
  - **Prophase.**
  - **Metaphase.**
  - **Anaphase.**
  - **Telophase.**
- Mitosis is actually a continuous process, with one phase merging smoothly into the next. Its duration varies according to cell type, but ***in human cells it typically lasts about an hour or less.***
- *The purpose of mitosis is to ensure that one copy of each duplicated chromosome partitioned into each of the two daughter nuclei.*

Mitosis- *Prophase:*

❖ Preparation of chromosomes for division, and formation of spindle:

- ***Migration of centrioles to opposite ends of the cell*** to initiate spindle formation.
- ***Chromosome condensation*** - get fatter (600nm) until visible with light microscope.
- ***Fragmentation of the nuclear envelope and nucleoli***.
- ***Spindle formation:*** Migrating centrioles initiate a radial array of ***microtubules***, called an ***aster***. ***Centrioles can also be referred to as the mitotic centers or the spindle poles.*** Some of the microtubules elongate, forming a ***"football shaped" mitotic spindle.*** There are two types of microtubules in the spindle:
  - ✓ **Polar fibers** extending from the spindle pole toward the equator of the spindle.
  - ✓ **Chromosomal fibers** extending from individual chromosomes outward toward the spindle poles. Chromosomal fibers are attached to specialized structures on either side of the centromere, called ***kinetochores.***

Mitosis- *Prophase:*



Mitosis- *Metaphase , Anaphase, and Telophase:*

- **Metaphase:** alignment of chromosomes. Chromosomes become aligned along the equator of the cell, called the ***metaphase plate***. This central migration of chromosomes is the result of the spindle activity of the chromosomal fibers of the spindle microtubules.

- **Anaphase:** separation of sister chromatids towards spindle poles:

  - ***Anaphase is usually the shortest phase in mitosis, lasting only a few minutes.***
  - Movement of sister chromatids toward opposite spindle poles. All chromatids separate at the same time, pulled on their spindle fibers toward the spindle poles at about one micron per minute. Spindle poles also move further away from each other. ***(Kinetocores chromosomal fibers pull the chromosomes and the polar microtubules lengthen pushing the two poles of the cell apart).***
  - Once the sister chromatids are completely separated, they are now referred to as ***daughter chromosomes***.

- **Telophase (last phase of mitosis):** completion of daughter nuclei:

  - Chromosomes disappear into their less visible 200 nm wide form.
  - Nucleoli develop at nucleolar organizing sites on some chromosomes.
  - Nuclear envelopes form around the two daughter nuclei.

Cytokinesis:

❖ **Cytokinesis:** (cytoplasmic cell division) usually begins before mitosis is complete:

- A cleavage furrow encircles the cell. The plane of the cleavage furrow is always perpendicular to the long axis of the mitotic spindle, and this ensures that the two sets of daughter chromosomes are segregated into the two daughter cells.

- Cleavage is carried out by a the ***contractile ring***, ***a bundle of actin microfilaments***. Actin filaments can be seen, while myosin filaments have not been seen, but have been deduced by antibody studies, to be involved in cell cleavage.

Mitosis- *Metaphase , Anaphase, and Telophase:*