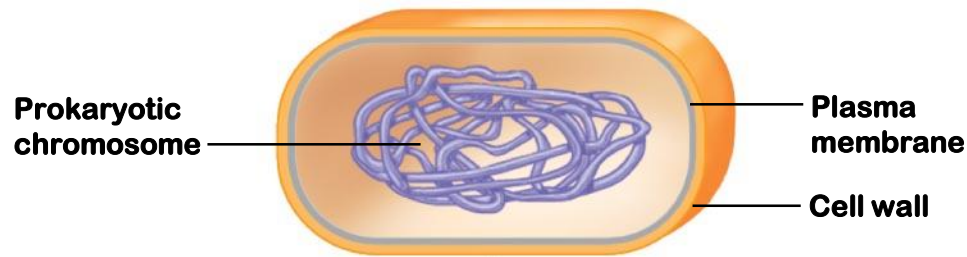


Cell Division

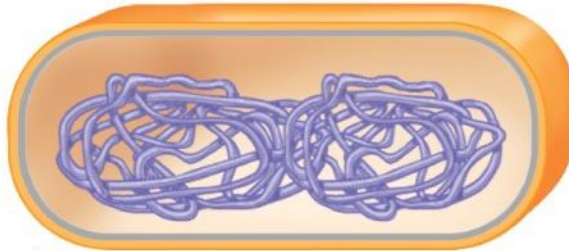
Binary Fission, Mitosis & Meiosis



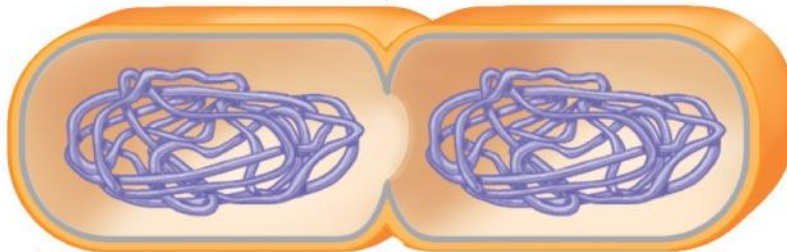
**Prokaryotic cells reproduce asexually
by a type of cell division called binary
fission**



1
Duplication of chromosome and separation of copies



2
Continued elongation of the cell and movement of copies



3
Division into two daughter cells



binary fission

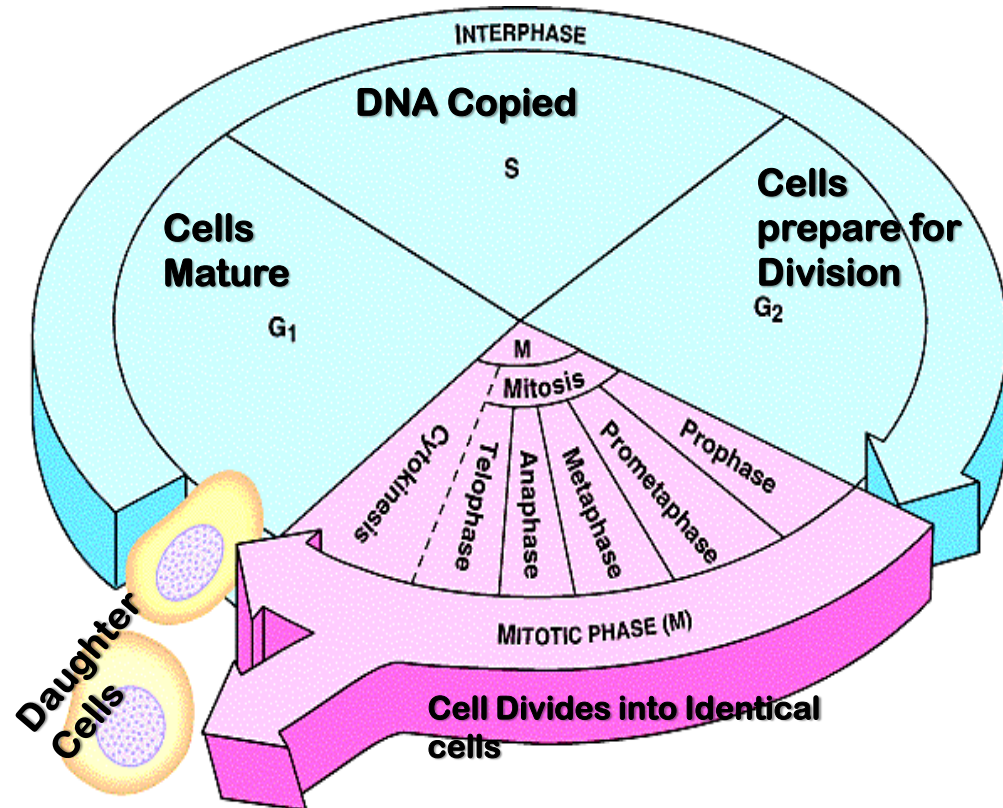
- The circular DNA molecule replicates to form 2 chromosomes
- The chromosome copies move apart
- The cell elongates
- The plasma membrane grows inward, dividing the parent into two daughter cells

Mitosis

- Eukaryotes divide by a more complicated system called **Mitosis**
- This is because:
 1. They have a nucleus which must be broken up and then reformed
 2. They have their DNA “packaged” in the form of **Chromosomes**
 3. Chromosomes are composed of **Chromatin**
 4. Also contain **Nucleosomes** containing **Histones** - Proteins the DNA is wrapped around Name for the DNA/Protein complex is **Chromatin**
 5. They usually have more than 1 chromosome (Humans have 23 pairs)
 6. They have numerous organelles to equally share

The Cell Cycle

- Most of the cell's life is spent doing its regular function.
- Cells divide along a rough time frame called its Cell Cycle.
- The Cell cycle consists of the following steps:
 - **G₁ (Gap 1) Phase** - Cell performs its **normal function** (cells which do not divide stay in this stage for their entire life span)
 - **S (Synthesis) Phase** - Here the cell actively **duplicates its DNA** in preparation for division
 - **G₂ (Gap 2) Phase** - Amount of cytoplasm (including organelles) increases in **preparation for division**.
 - **Mitosis** - Actual division occurs



Cell Cycle

- Cell cycle describes the “life cycle” of a cell-
Cell cycle is tightly controlled
 - G1
 - S
 - G2
- Interphase

Mitotic Phase

- Mitosis
 - Prophase, metaphase, anaphase, telophase
- Cytokinesis

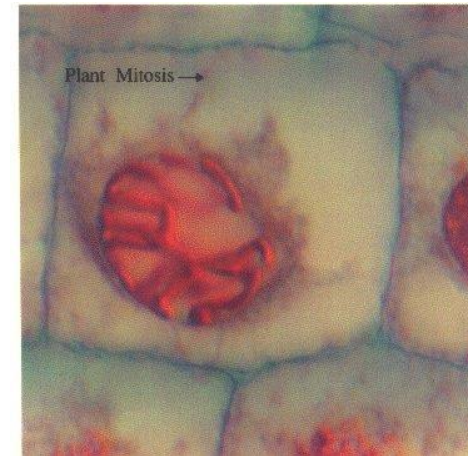
Interphase

- **Cell Replicates its DNA/Chromosomes in preparation of upcoming division**



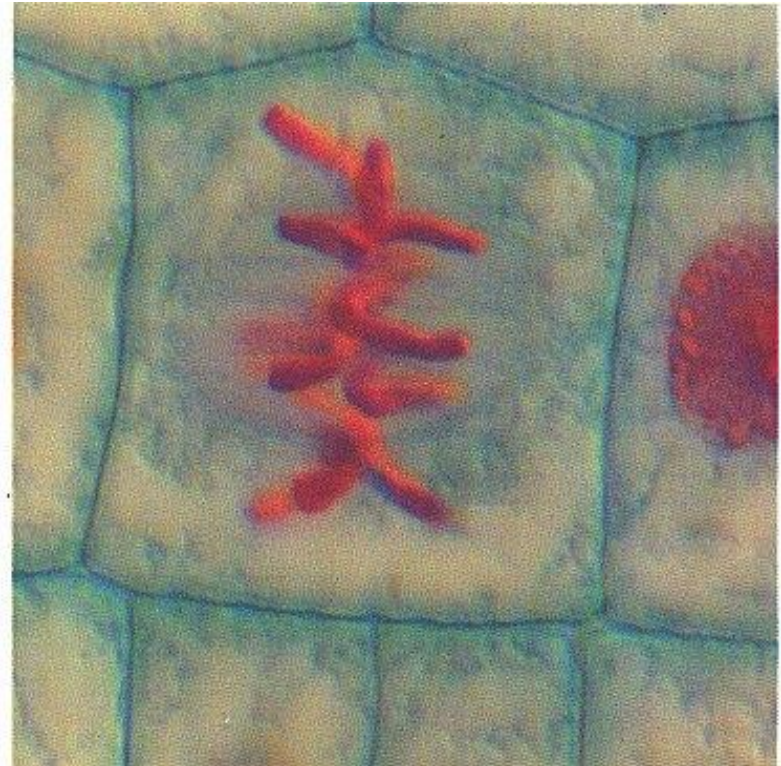
Prophase

1. Chromosomes Shorten and become visible.
2. Centrosome move to opposite sides of the cell
3. Nuclear envelope disappears
4. Spindle Fibers & Astral Fibers both together are known as the Spindle Apparatus begin to form



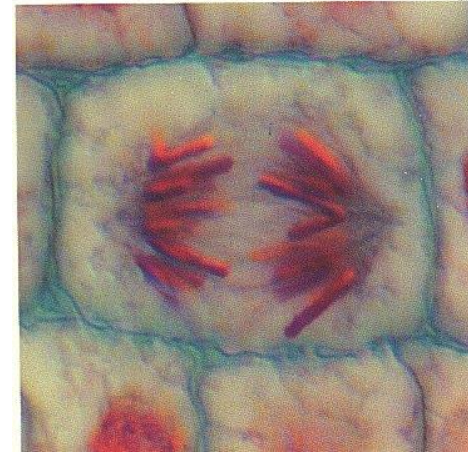
Metaphase

- Chromosomes line up along center of cell called the Metaphase Plate
- Chromosomes attach to spindle fibers
- Spindle & Astral fibers are now clearly visible



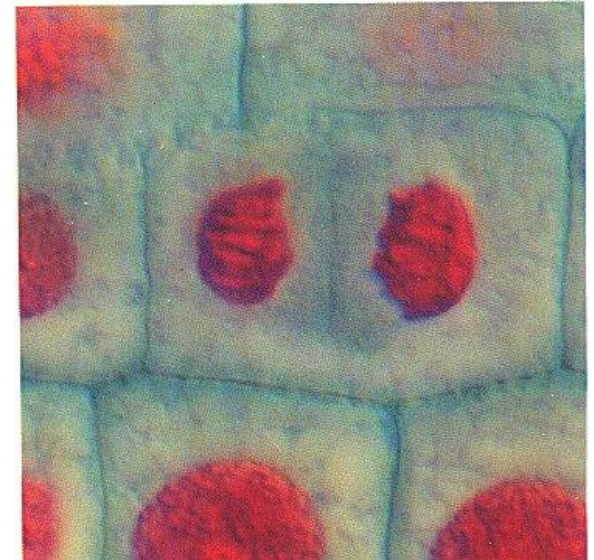
Anaphase

- Centromeres break up separating chromosome copies
- Chromosomes are pulled apart to opposite sides of cell
- Spindle & Astral fibers begin to break down



Telophase (cytokinesis)

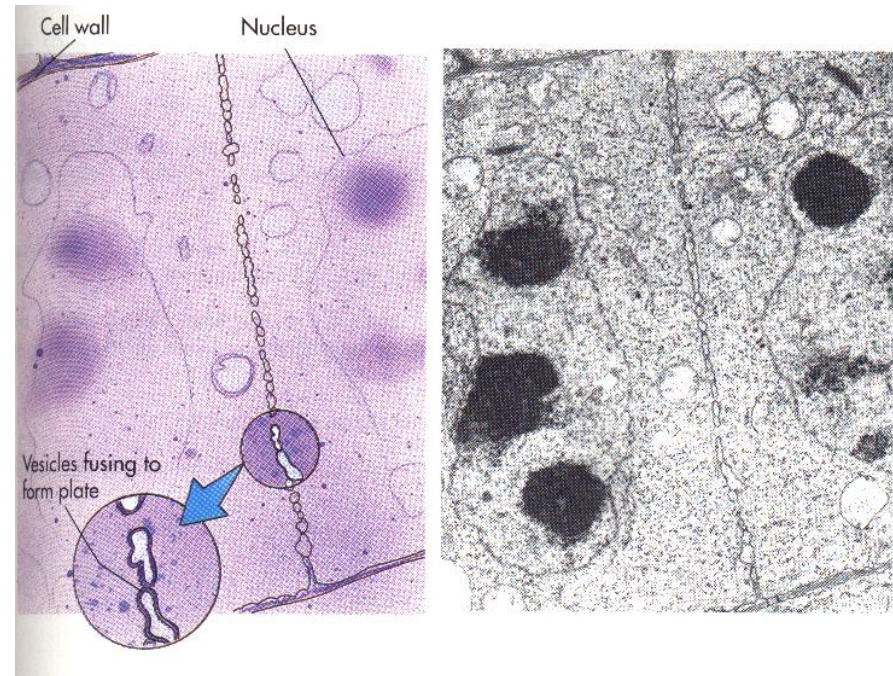
- Nuclear envelope forms around both sets of chromosomes
- DNA uncoils
- Spindle & Astral fibers completely disappear
 - **Cytokinesis** happens with most (but not all) cells
 - Cytoplasm & organelles move (mostly equally) to either side of the cell. Cell Membrane “pinches” to form 2 separate cells



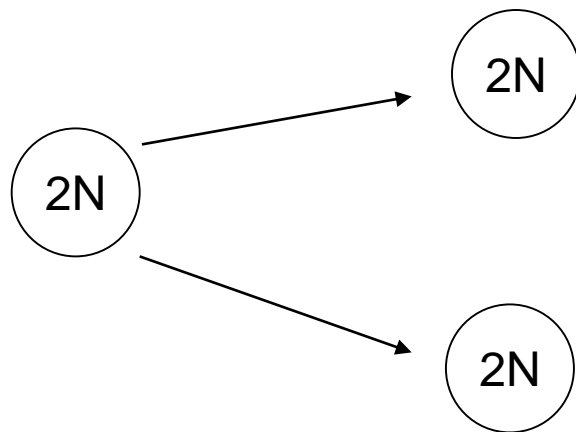
Plant Cytokinesis- division of the cytoplasm

- With Plants, a cell wall must be formed between the 2 daughter cells.
- **Vesicles** containing Cellulose form and fuse between the two daughter cells, eventually forming a complete cell wall.

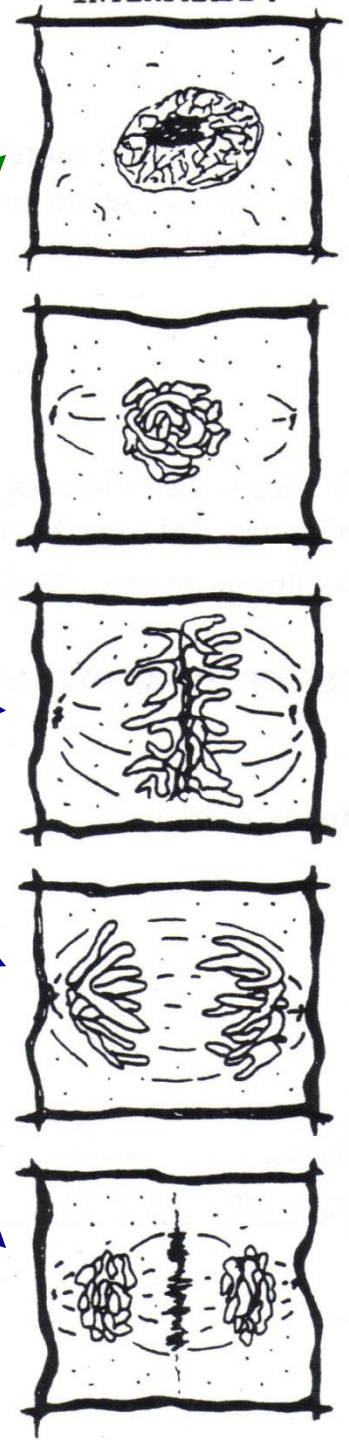
- Vesicles containing cell wall material line up across middle of cell
- Vesicles merge and form cell plate
- Cell plate grows until it divides the cell in 2



Overview of Mitosis



1. *Interphase*
2. Prophase
3. Metaphase
4. Anaphase
5. Telophase
6. *Cytokinesis*



Overview of Mitosis

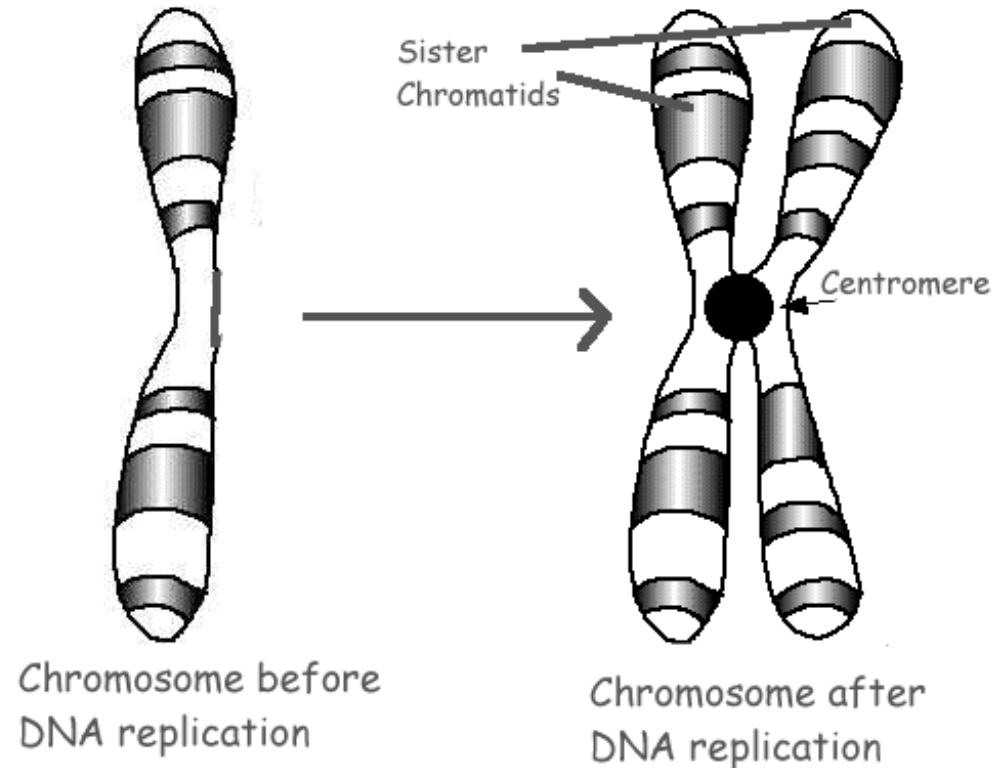
- ❑ Occurs in somatic cells
- ❑ Longitudinal division of replicated chromosomes in one nucleus to form two genetically identical daughter nuclei.
- ❑ Each “daughter” nucleus has the same number of chromosomes (and sets) that the “parent” nucleus had.
- ❑ Mitosis requires One division.
 - 1 cell → 2 cells (*called daughter cells*)
 - Daughter cells are genetically identical
 - Chromosome number does not change.

Meiosis

- Meiosis is needed for sexual reproduction
 - Purpose of meiosis is to create gametes
 - Egg and pollen in flowering plants
 - Needed for sexual reproduction
 - Gametes have only one copy of each type of chromosome
 - Occurs in germ cells
 - Ovaries and anther of flowering plants
- Similar in many ways to mitosis with several differences
- Involves 2 cell divisions
- Results in 4 cells with $\frac{1}{2}$ the normal genetic information

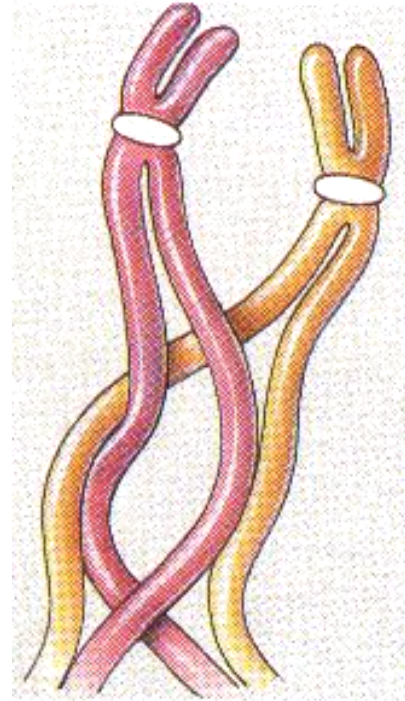
Meiosis Phases

- Meiosis occurs in 2 phases; **Meiosis I**, & **Meiosis II**.
- **Meiosis I** to separate homologous chromosomes
- **Meiosis II** Second division to separate duplicated chromosomes



Crossing Over

- During metaphase 1 homologous chromosomes line-up along the metaphase plate
- Areas of homologous chromosomes connect at areas called chiasmata

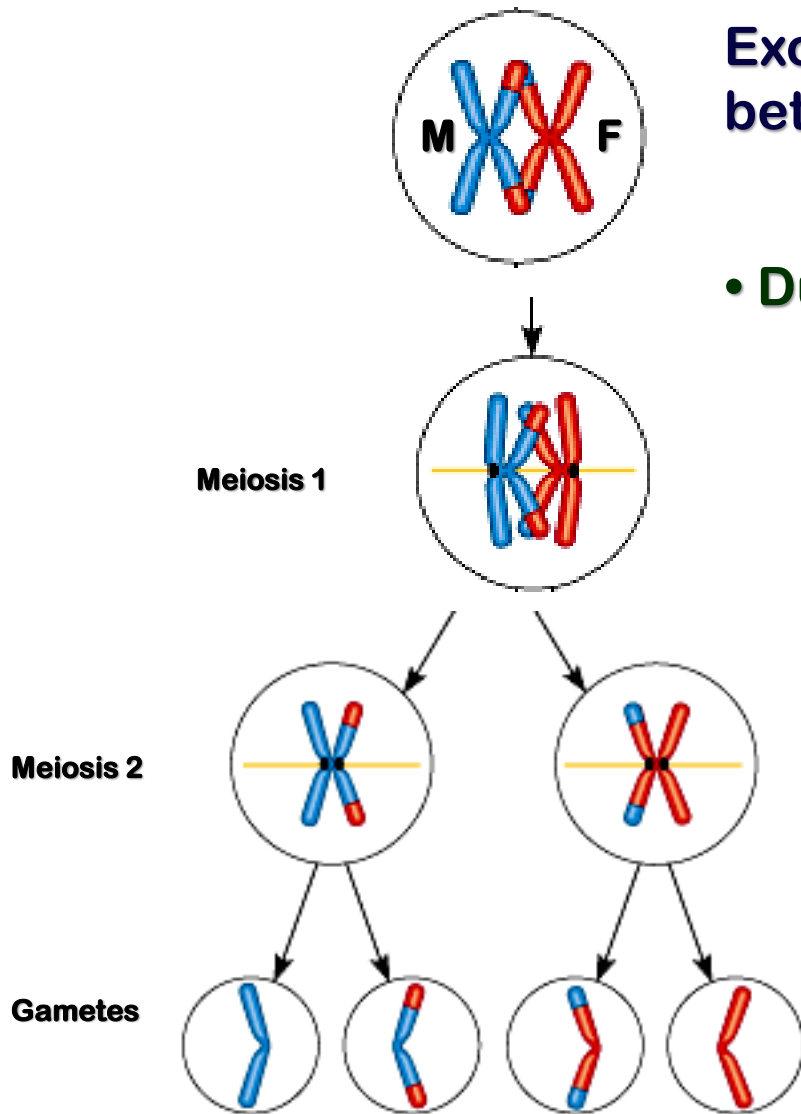
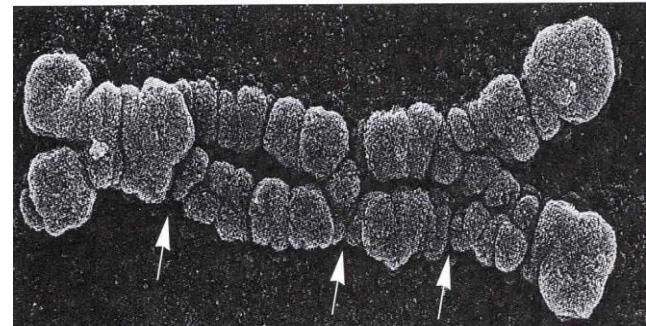


Crossing over (contd.)

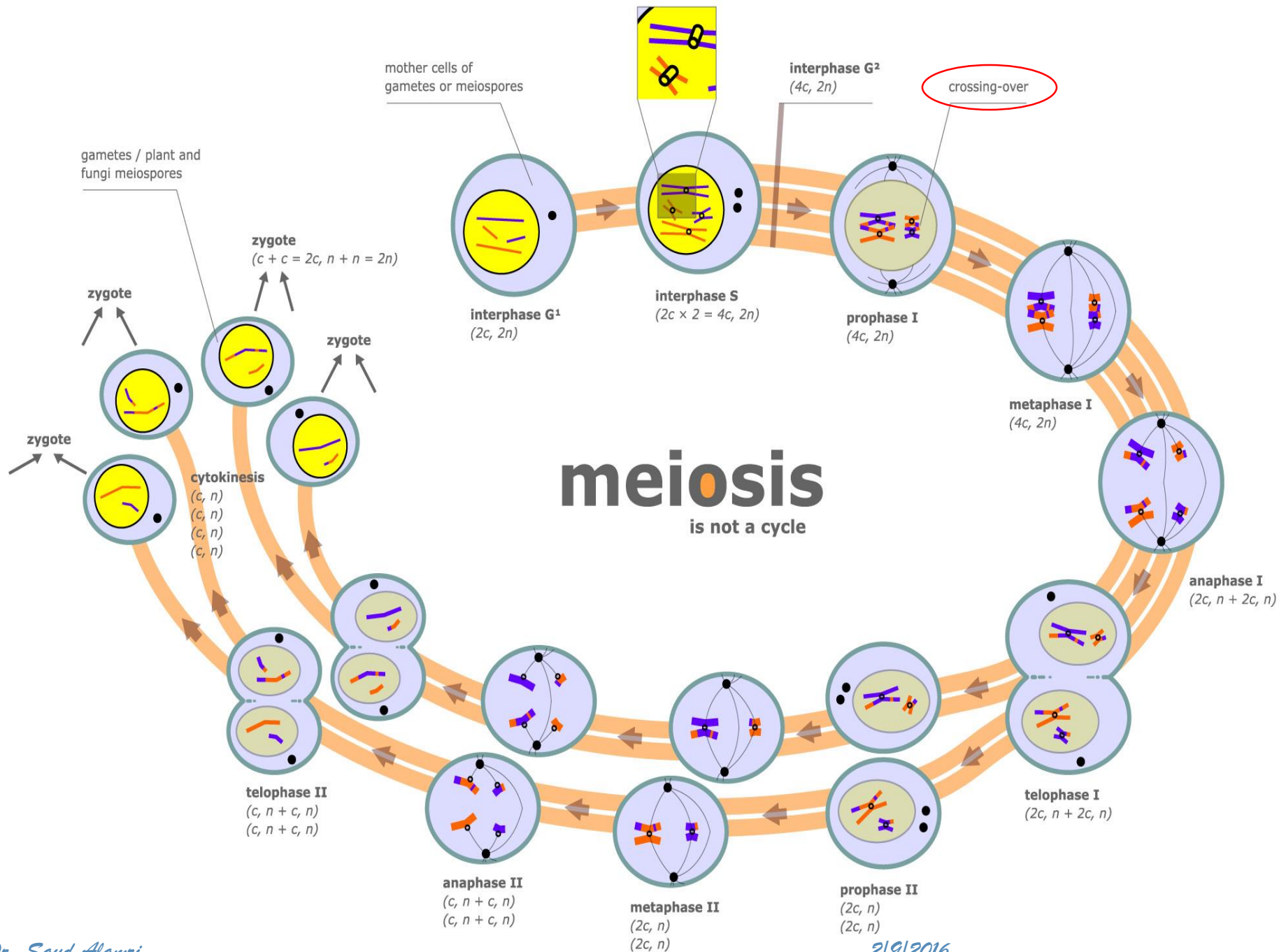
Exchange of genetic material
between Homologous Chromosomes

- During Prophase I

occurs at CHIASMA

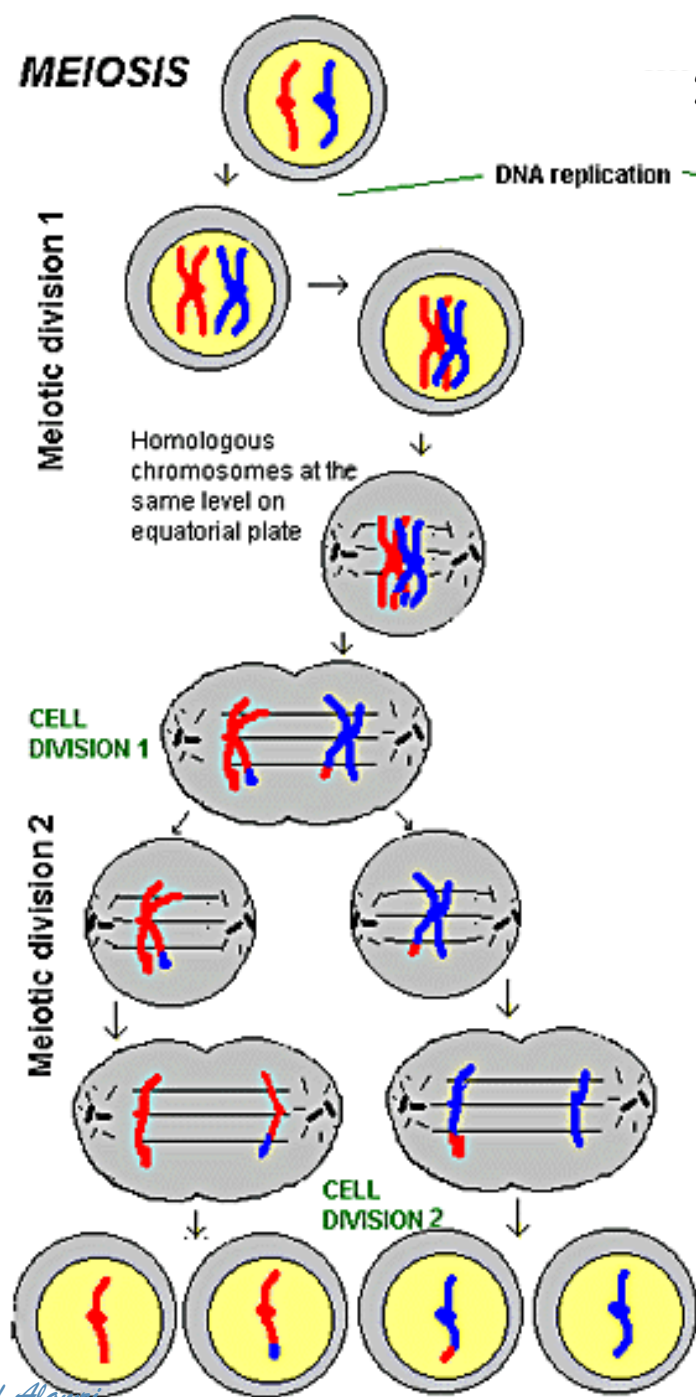


Produces new genetic combinations
--Chromosomes with both
Maternal & Paternal components



MEIOSIS

$$2N = 2$$



Crossing over occurs in meiosis I.

Homologous chromosomes separate in meiosis I

2 cells, $N = 1$ for each Sister chromatids separate in meiosis II 4 cells, $N = 1$ for each.

Chromosomes are different due to crossing over

