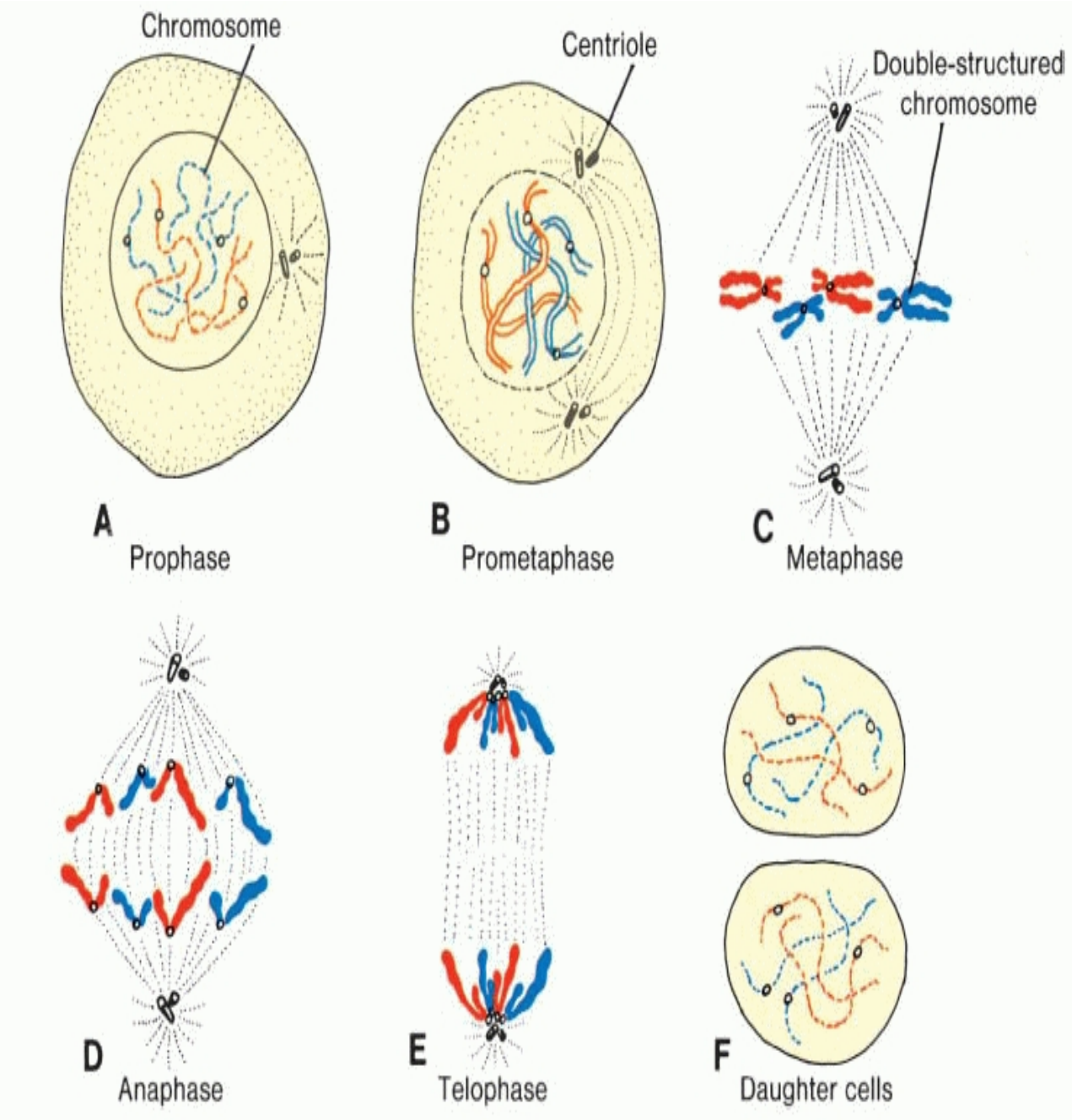

بسم الله الرحمن الرحيم


لا إله إلا الله محمد رسول الله

MITOSIS

- **Mitosis is the process whereby one cell divides, giving rise to two daughter cells that are genetically identical to the parent cell.**
- **Each daughter cell receives the complete complement of 46 chromosomes.**
- **Before a cell enters mitosis, each chromosome replicates its deoxyribonucleic acid (DNA).**

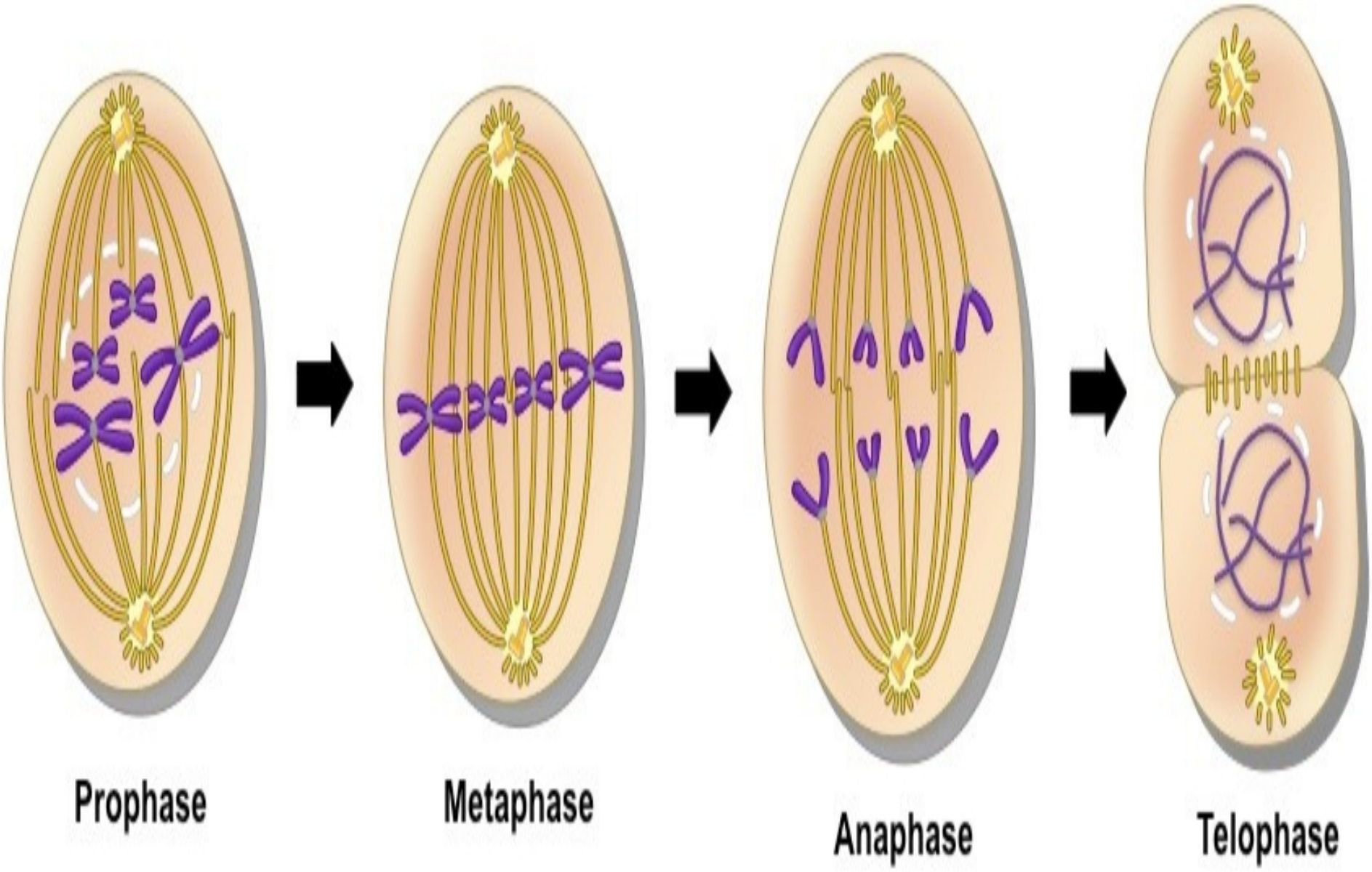
Figure 2.3 Various stages of mitosis. In prophase, chromosomes are visible as slender threads. Doubled chromatids become clearly visible as individual units during metaphase. At no time during division do members of a chromosome pair unite. Blue, paternal chromosomes; red, maternal chromosomes.

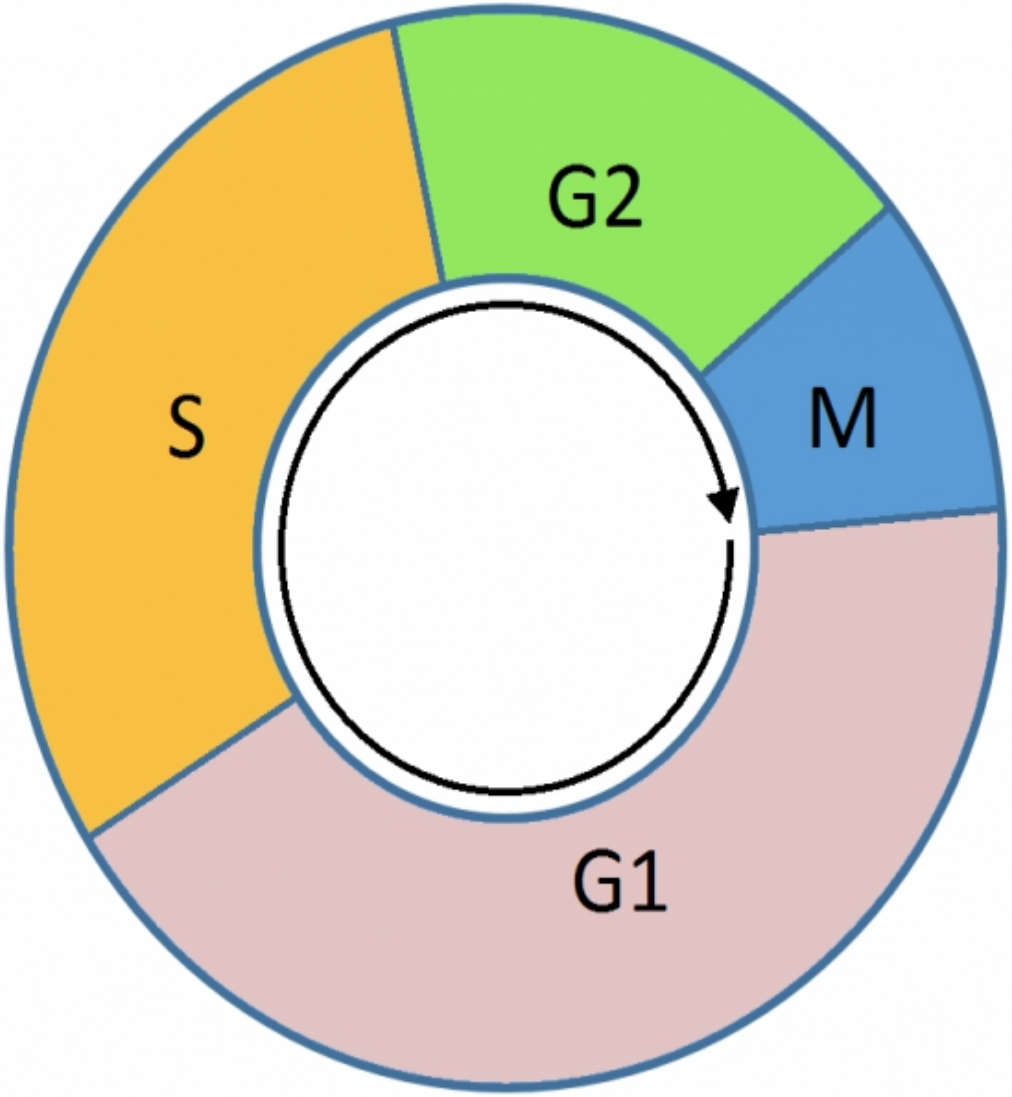


- During this replication phase, chromosomes are extremely long, they are spread diffusely through the nucleus, and they cannot be recognized with the light microscope.
- With the onset of mitosis, the chromosomes begin to coil, contract, and condense; these events mark the beginning of prophase.
- Each chromosome now consists of two parallel subunits, chromatids, that are joined at a narrow region common to both called the **centromere**.

- Throughout prophase, the chromosomes continue to condense, shorten, and thicken,
- Only at prometaphase do the chromatids become distinguishable.
- During metaphase, the chromosomes line up in the equatorial plane, and their doubled structure is clearly visible.
- Each is attached by microtubules extending from the centromere to the centriole, forming the mitotic spindle.

- Soon, the centromere of each chromosome divides, marking the beginning of anaphase,
- Followed by migration of chromatids to opposite poles of the spindle. Finally, during telophase, chromosomes uncoil and lengthen, the nuclear envelope reforms, and the cytoplasm divides.
- Each daughter cell receives half of all doubled chromosome material and thus maintains the same number of chromosomes as the mother cell.


Prophase
Metaphase
Anaphase
Telophase

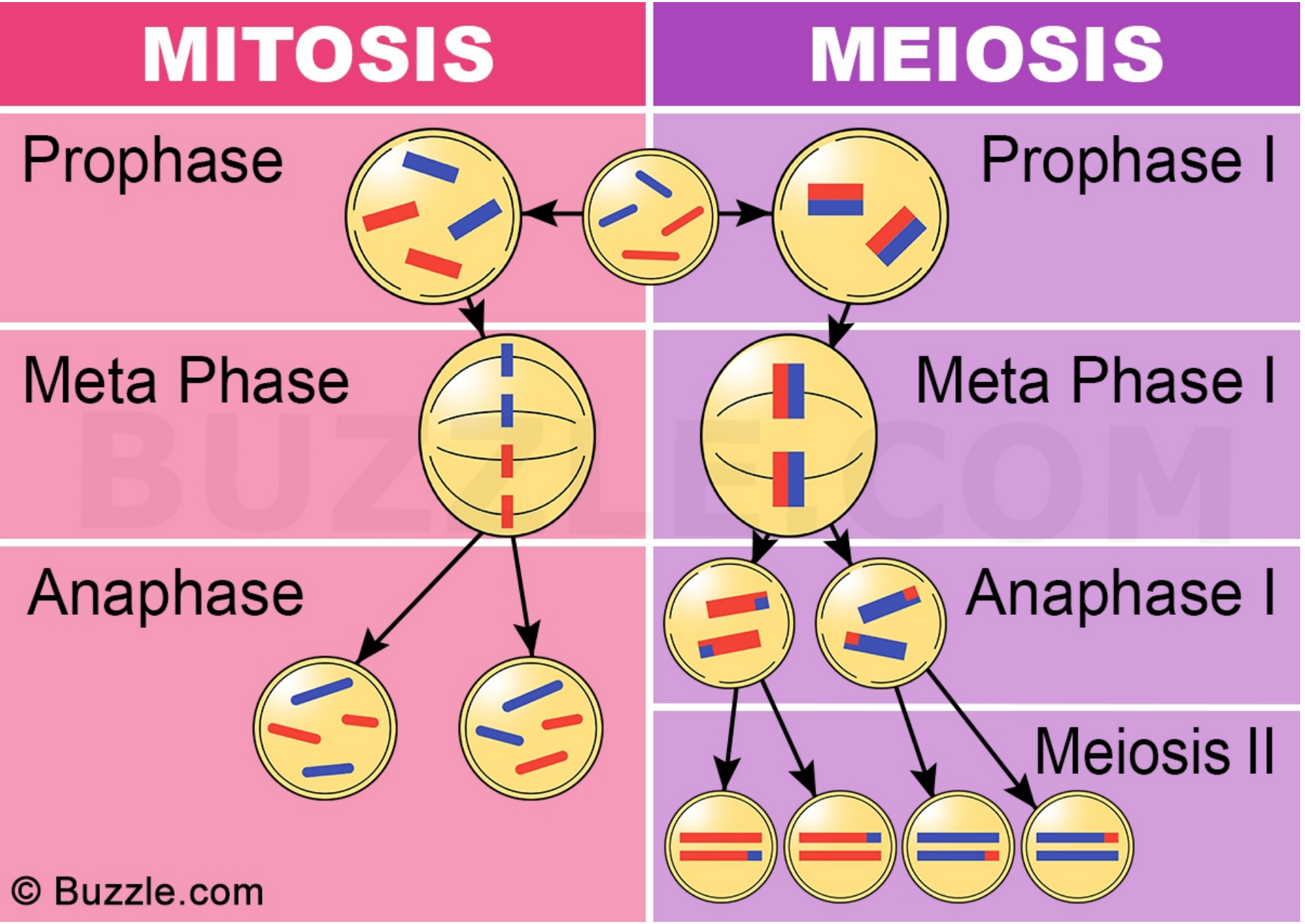


G1 - Growth

S - DNA synthesis

G2 - Growth and preparation for mitosis

M - Mitosis (cell division)


MITOSIS
MEIOSIS
Prophase
Meta Phase
Anaphase
Prophase I
Meta Phase I
Anaphase I
Meiosis II
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Meiosis

Meiosis is the cell division that takes place in the germ cells to generate male and female gametes. Meiosis requires two cell divisions, meiosis I and meiosis II, to reduce the number of chromosomes to the haploid number of 23.

As in mitosis, male and female germ cells (spermatocytes and primary oocytes) at the beginning of meiosis I replicate their DNA so that each of the 46 chromosomes is duplicated into sister chromatids.

- In contrast to mitosis, however, homologous chromosomes then align themselves in pairs, a process called synapsis.
- The pairing is exact and point for point except for the XY combination. Homologous pairs then separate into two daughter cells, thereby reducing the chromosome number from diploid to haploid. Shortly thereafter, meiosis II separates sister chromatids. Each gamete then contains 23 chromosomes.

1. LEPTOTENE

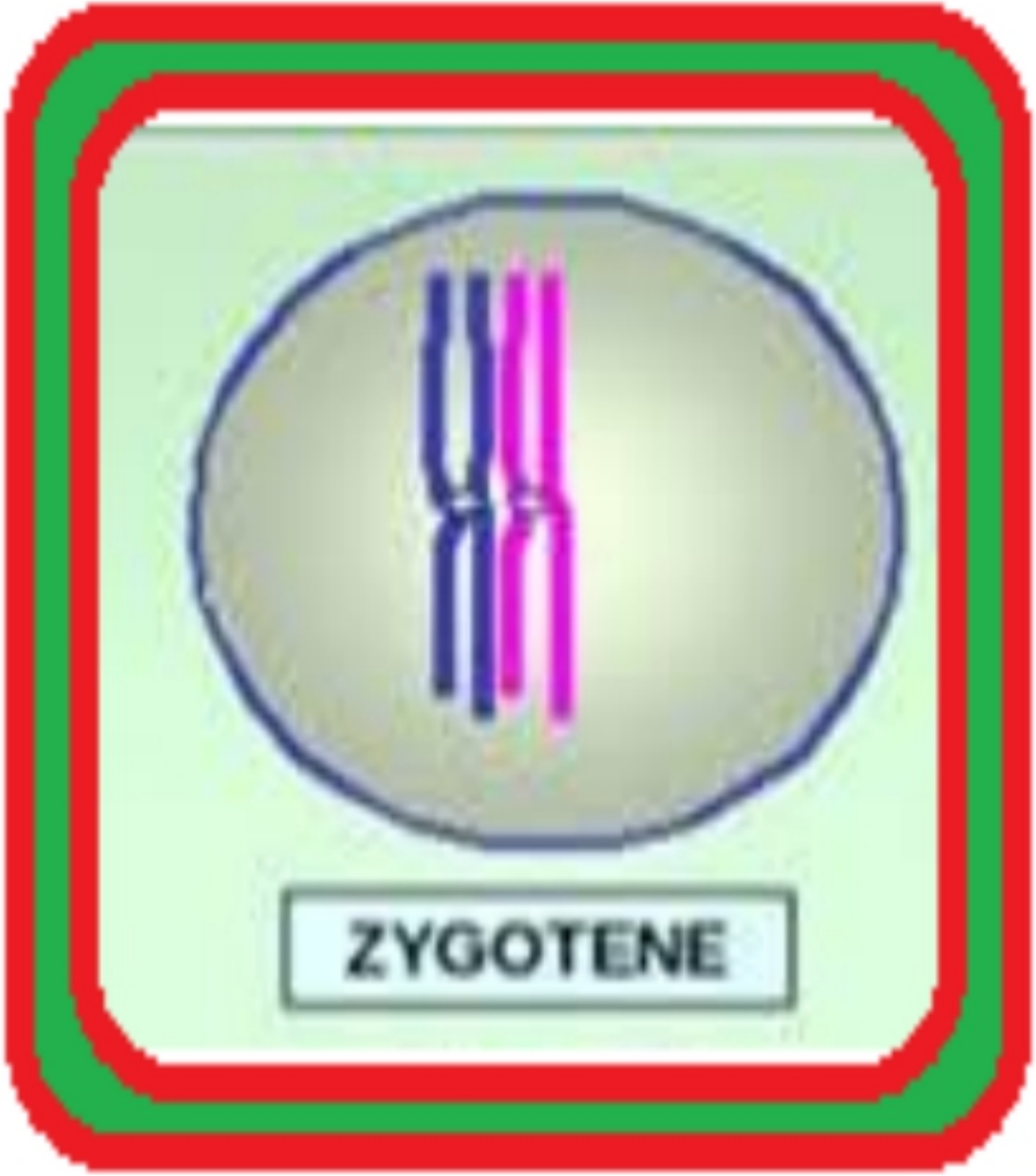
The first stage of prophase I is the Leptotene stage ("thin threads“)

In this stage chromosomes form thin strands

2. Zygotene

("Paired threads.)

The homologous chromosome pairs.



3. Pachytene

- **The Pachytene sta ge ("thick threads)**

- At the sites where exchange happens,
- **CHIASMATA** form.

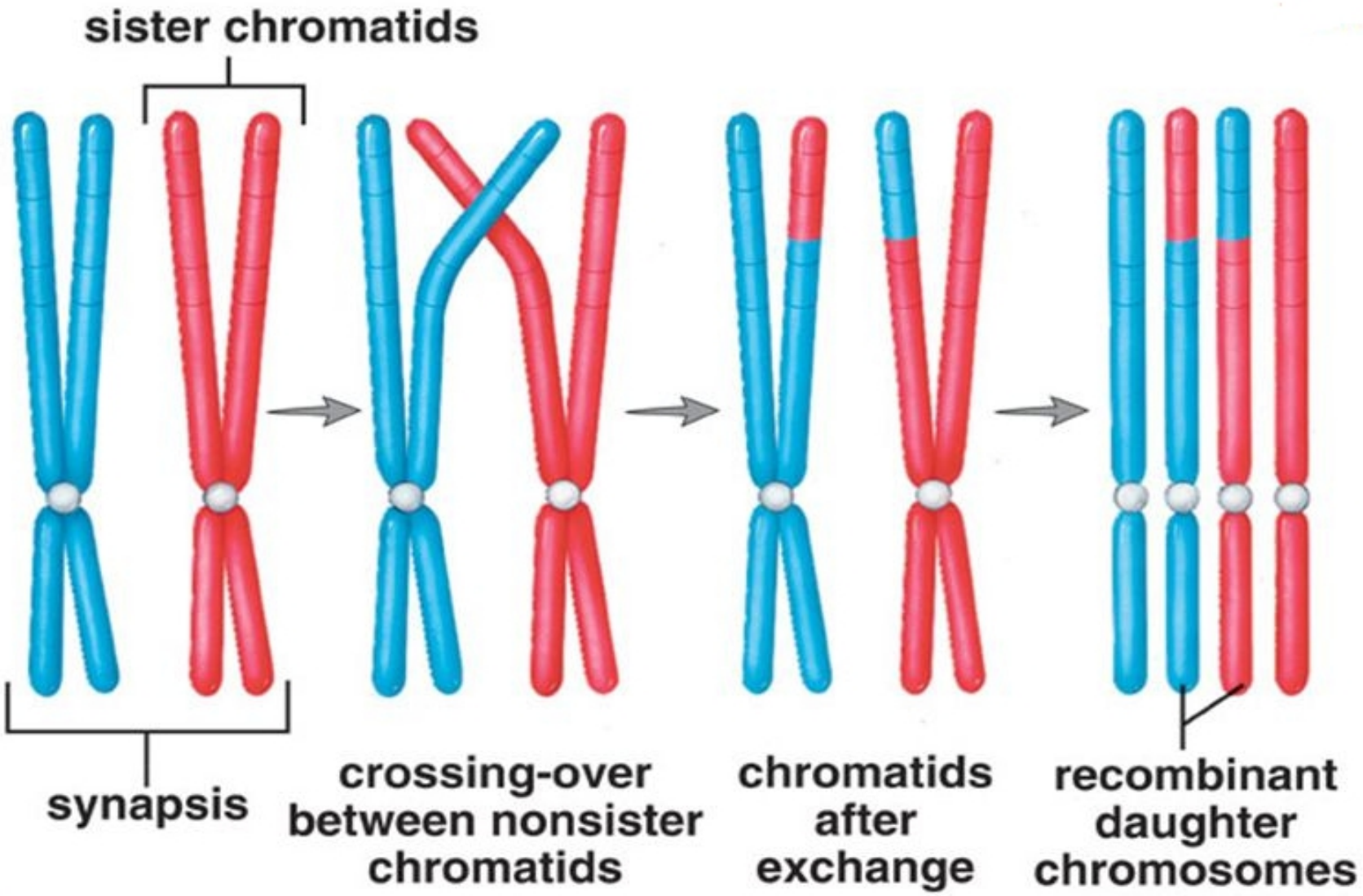
4. DIPLOTENE

The homologous chromosomes separate from one another a little.

But tightly bound at chiasmata, the regions where crossing-over occurred.

5. Diakinesis ("moving through)

This is the first point in meiosis where the four parts of the tetrads are more separated and actually visible.


sister chromatids
synapsis
crossing-over between nonsister chromatids
chromatids after exchange
recombinant daughter chromosomes

First and second meiotic divisions.

A. Homologous chromosomes approach each other.

B. Homologous chromosomes pair, and each member of the pair consists of two chromatids.

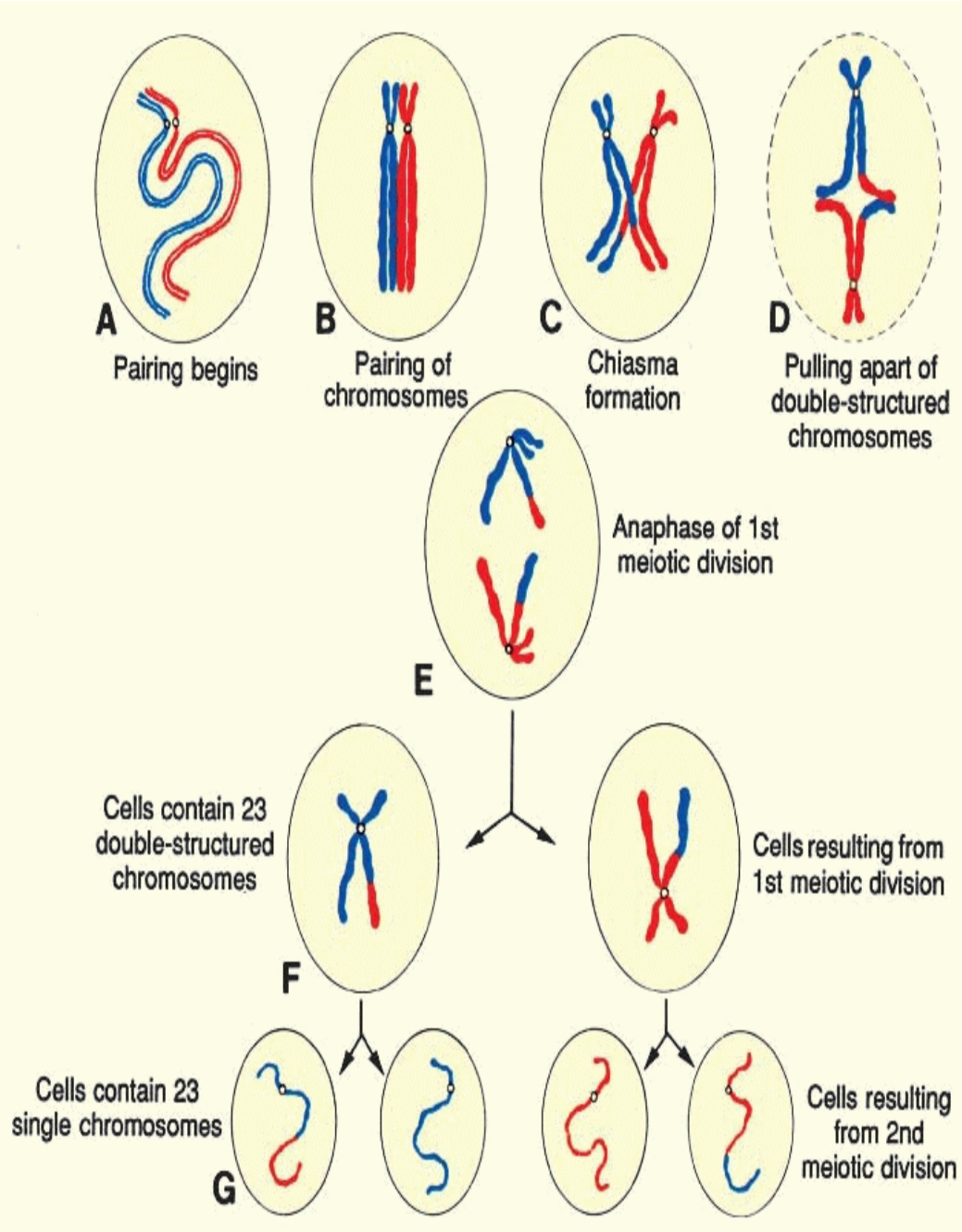
C. Intimately paired homologous chromosomes interchange chromatid fragments (crossover). Note the chiasma.

D. Double-structured chromosomes pull apart.

E. Anaphase of the first meiotic division.

F,G.

During the second meiotic division, the double-structured chromosomes split at the centromere. At completion of division, chromosomes in each of the four daughter cells are different from each other.



CLINICAL APPLICATIONS

Birth defects may arise through abnormalities in chromosome number or structure and from single gene mutations.

THANKS