

Chapter 11: Eukaryotic Cell Cycle & Cell Division

I. Eukaryotic Cell Cycle

A. Diagram:

1. Time is not shown here
2. Cell moves clockwise through cycle, starting at G_1

B. Interphase (G_1 , S, G_2)

1. G_1 usually longest phase – cells spend most of their life in G_1
 - a. If cell stays in G_1 forever, it has exited the cycle and is in " G_0 " ("G not")
 - i. Can be turned on again
 - b. Cells in G_1 or G_0 are normally functioning cells – doesn't mean they're dying
2. S: DNA Synthesis/Chromosome Replication (**Fig. 11.4**)
3. G_2 : synthesize proteins for M phase

C. M (Mitosis)

1. Mitosis: division of nuclear material (genetic material)
2. Cytokinesis: Division of all other cellular material

D. Cell progression is controlled by **cell signaling** via **Cyclin proteins**

1. Involved at three checkpoints (**Fig. 11.17**)

- a. End of G_1 checkpoint: is there DNA damage?
- b. End of G_2 checkpoint: is all the DNA replicated?
- c. Metaphase checkpoint: are chromosomes attached to the spindle?

2. Cyclins & how they work (**Fig. 11.14**)

- a. Amounts and types of cyclins vary as cell cycle progresses
- b. Cyclins bind to & turn on cyclin-dependent kinases (CDK's)
- c. CDK's phosphorylate (activate) proteins needed to continue in cycle
- d. Cyclins are degraded when cell moves to next stage
- e. Production of cyclin is the initial signal – must be turned off eventually (degraded)

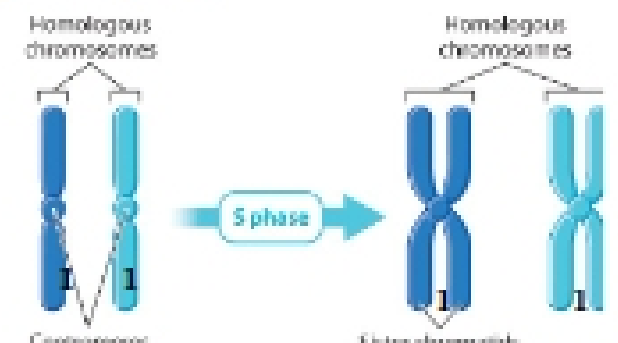
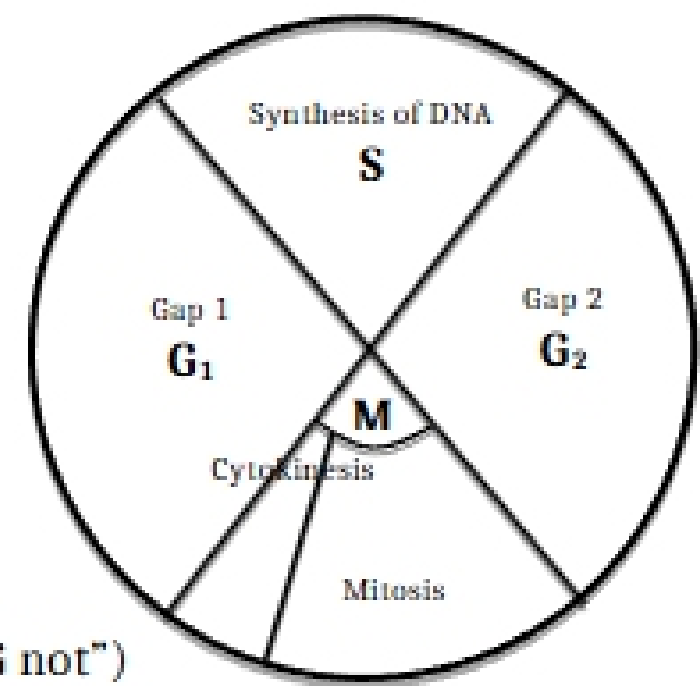


Fig. 11.4

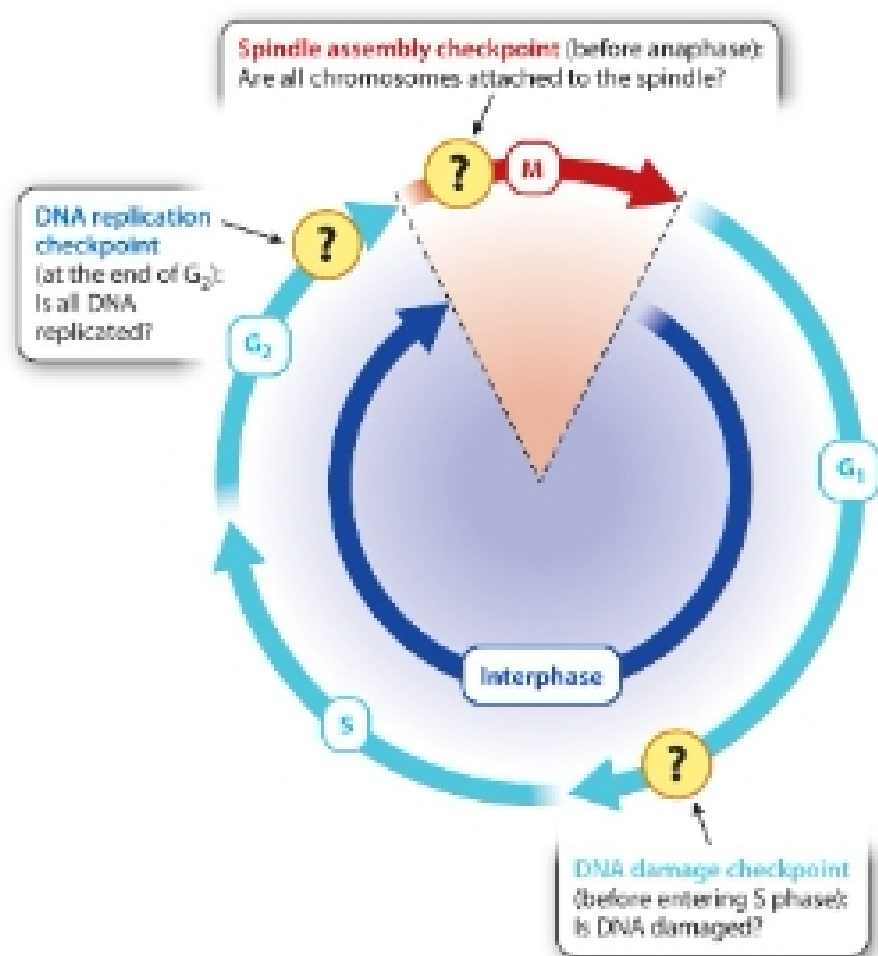


Fig. 11.17

II. Eukaryotic Chromosome Structure

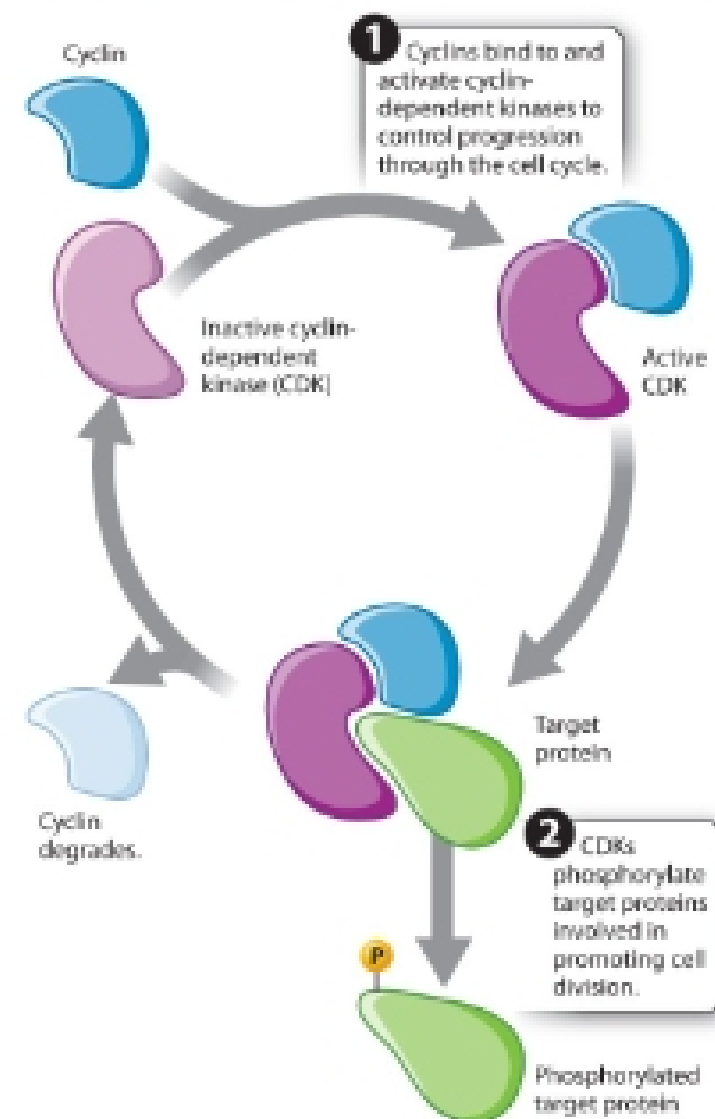


Fig. 11.14

A. Chromosomes ("colored bodies")

1. Units of genetic material; made of **chromatin** & contain **genes**

a. **Chromatin**: mixture of protein (histones) & DNA

i. Compacts DNA

b. **Genes**: sequences of DNA that code for a product & the DNA regions that control production (start/stop codons, promoter, etc.)

B. Structure (Fig. 11.4, pages 1 & 3)

1. Eukaryotic chromosomes are linear

a. Centromere: region of constriction

i. Doesn't have to be in the middle

2. After chromosome replication

a. Pair of sister chromatids = 1 chromosome (even though you now have double the DNA)

b. Kinetochore proteins lie over the centromere region - interact with microtubules & get pushed & pulled around

C. Chromosomes occur in sets

1. Haploid

a. 1 copy of each type of chromosome (n)

b. Gametes of diploid organisms are N (haploid)

c. Haploid organisms produce gametes by mitosis, & autosomal cells and gametes are both N

2. Diploid

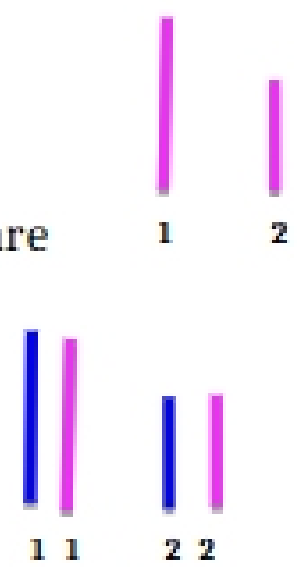
a. 2 copies of each chromosome (2N)

b. Autosomal (non-gametic) cells of diploid organisms are 2N

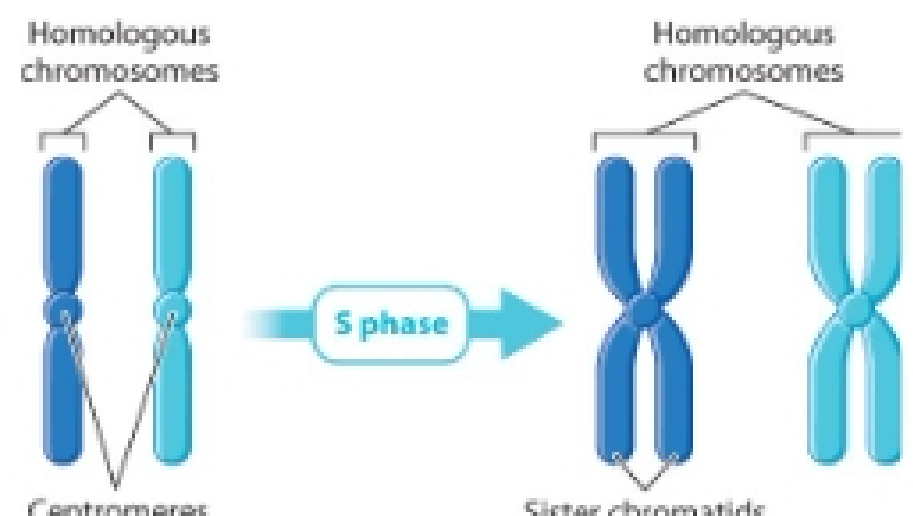
c. Gametes are N

3. Some eukaryotes are tetraploids (4N)

a. Ex. Durum wheat, green treefrog



III. Mitosis



- A. Forms 2 genetically identical daughter cells
- B. *S-Phase occurs before any of mitosis (**Fig. 11.4**)
- C. **5 phases of Mitosis: PPMAT-I** (**Fig. 11.5**)

1. Prophase
 - a. Chromosomes condense
 - b. Dark Blue = paternal copy
 - c. Light Blue = maternal copy
2. Prometaphase
 - a. Nuclear membrane breaks down
 - b. Spindle forms
 - c. Microtubules attach to kinetochore proteins of chromosomes (**Fig. 11.6**)
3. Metaphase
 - a. Sister chromatids align on metaphase plate
4. Anaphase
 - a. Sister chromatids separate & move to poles
5. Telophase & cytokinesis
 - a. Nuclear membrane reforms; daughter cells separate
6. Interphase
 - a. Chromosomes replicate (S). Required for mitosis to occur

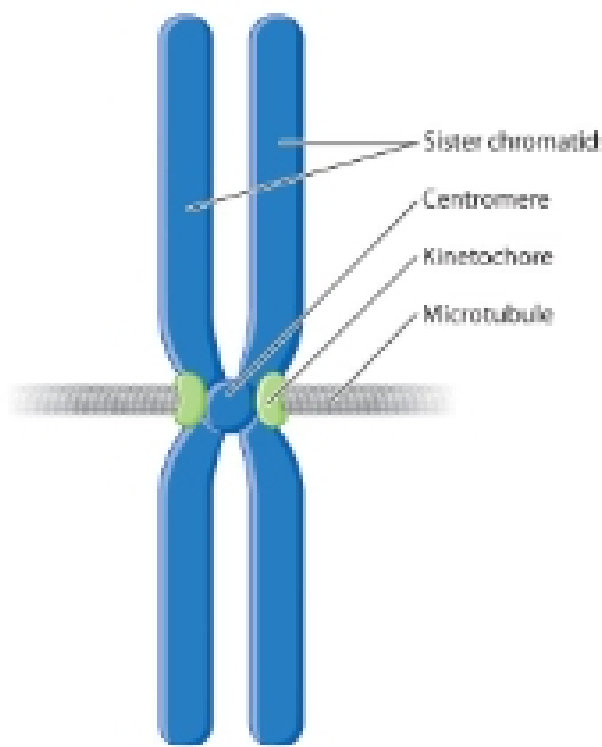


Fig. 11.6

Fig. 11.4

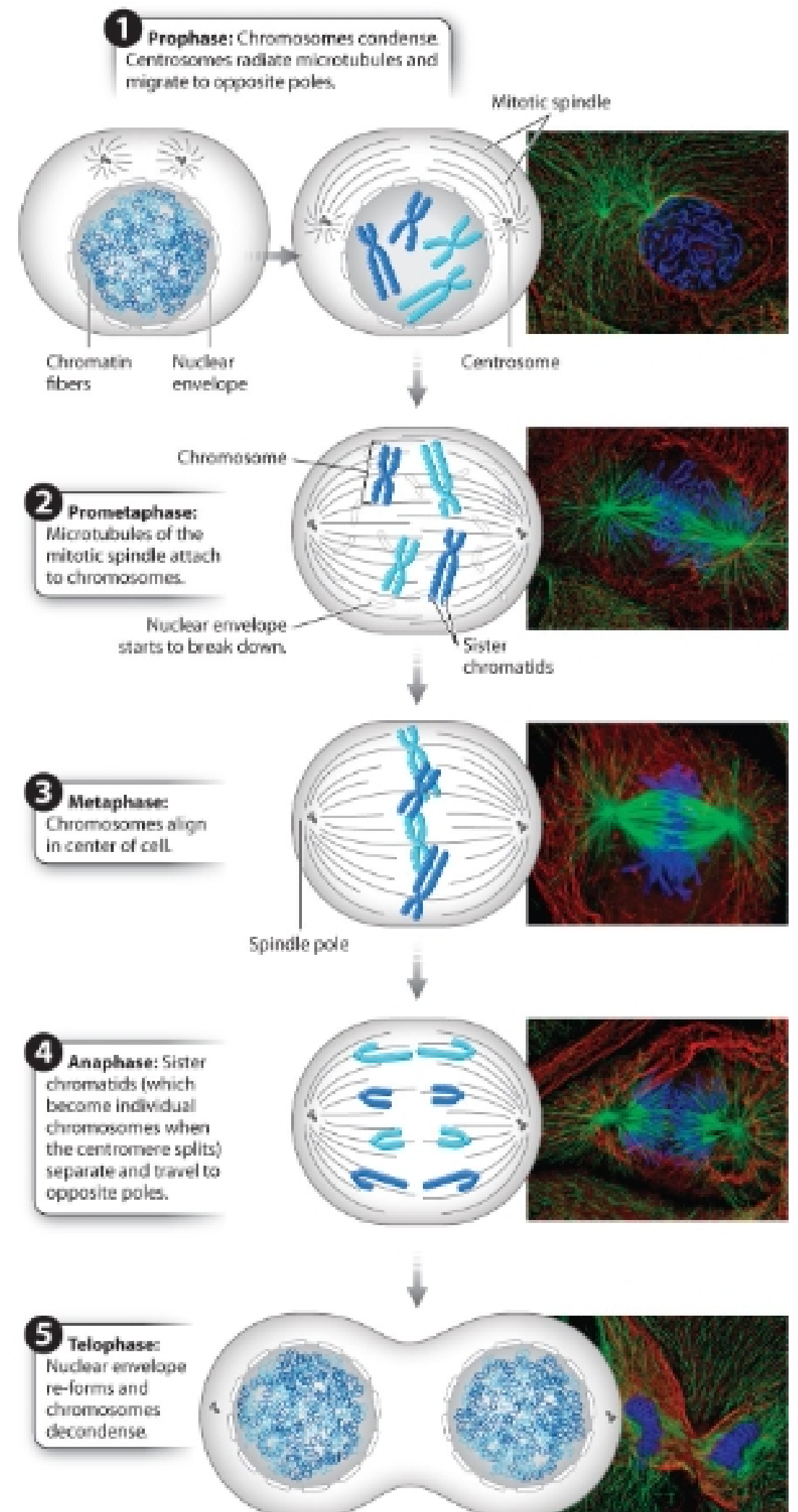


Fig. 11.5

IV. Meiosis