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CHAPTER 03 and Lab

Overview of the CELL CYCLE

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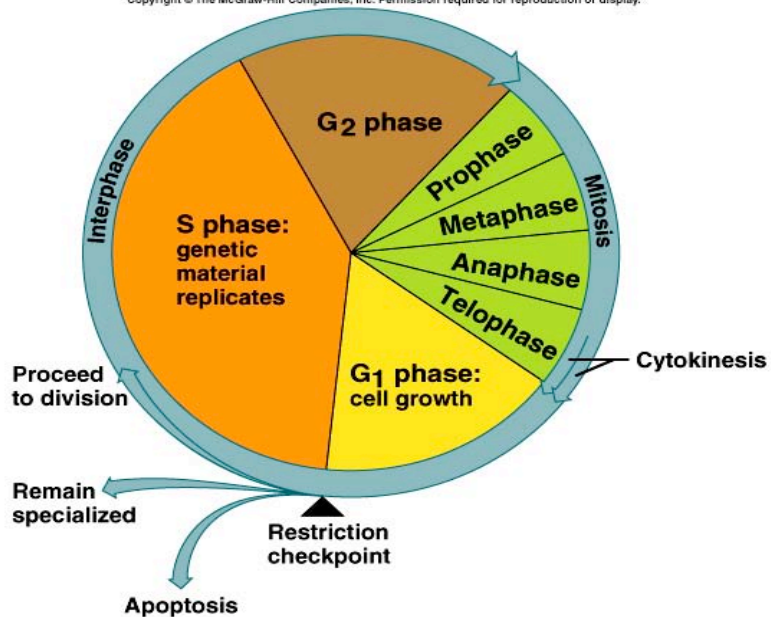
The Cell Cycle

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Series of changes
a cell undergoes
from the time it
forms until the
time it divides-

Stages:

interphase
mitosis
cytoplasmic division
differentiation



The Cell Cycle

A. The Cell Cycle

1. During the **first growth phase, G_1** , (your text refers to G as "gap") the cell synthesizes new proteins and grows in size. At the end of this phase, **centrioles replicate**.
2. During the **S, or synthesis phase**, the cell undergoes **semiconservative replication of DNA**.
3. **G_2 , the second growth phase**, is a **brief period** in which the **cell makes the enzymes needed for cell division**.
 G_1 , S, and G_2 are collectively known as **interphase**.
4. During the **M, or mitotic, phase**, the nucleus replicates its contents (**karyokinesis**).

Interphase

- very active period
- cell grows
- cell maintains routine functions
- cell replicates genetic material to prepare for nuclear division
- cell synthesizes new organelles to prepare for cytoplasmic division
- Phases:
 - **G phases** – cell grows and synthesizes structures other than DNA
 - **S phase** – cell replicates DNA

Mitosis

5

**LAB ATLAS
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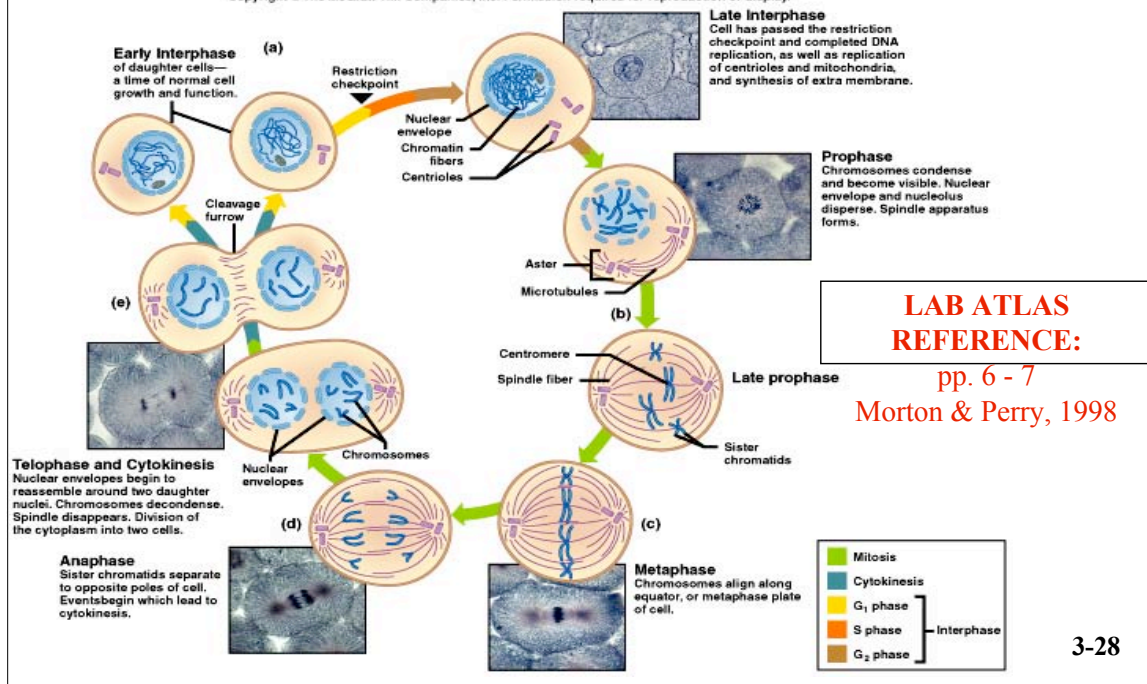
pp. 6 - 7
Morton & Perry, 1998

- produces two daughter cells from an original cell
- nucleus divides – **karyonkinesis**
- cytoplasm divides – **cytokinesis**
- Stages:
 - **prophase** – chromosomes form; nuclear envelope disappears
 - **metaphase** – chromosomes align midway between centrioles
 - **anaphase** – chromosomes separate and move to centrioles
 - **telophase** – chromatin forms; nuclear envelope forms

Mitosis

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**LAB ATLAS
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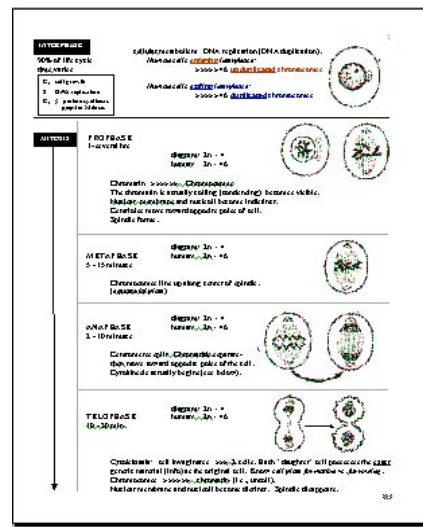
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Cytoplasmic Division

(CYTOKINESIS)

- begins during anaphase
- continues through telophase
- contractile ring pinches cytoplasm in half (furling)

Be sure to get the separate, one-page MITOSIS SKETCH at the end.



Control of Cell Division

- cell division capacities vary greatly among cell types
 - skin and blood cells divide often
 - liver cells divide a specific number of times then cease
- chromosome tips (**telomeres**) that shorten with each mitosis provide a mitotic clock
- cells divide to provide a more favorable **surface area to volume relationship**
- **growth factors and hormones** stimulate cell division
 - hormones stimulate mitosis of smooth muscle cells in uterus
 - epidermal growth factor stimulates growth of new skin
- **contact inhibition**
- tumors are the consequence of a **loss of cell cycle control**

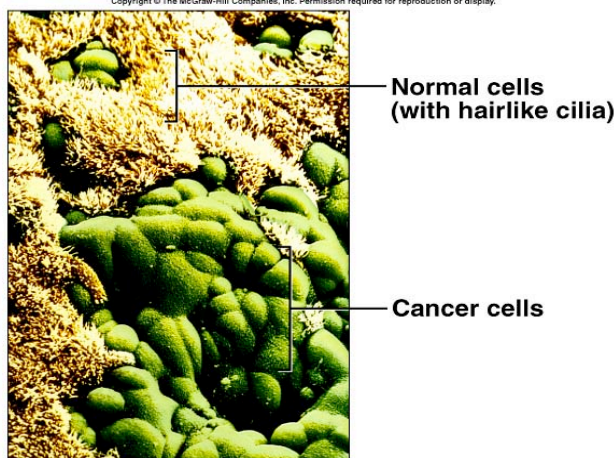
Tumors

Two types of tumors

- **benign** –
 - usually remains localized
- **malignant** –
 - invasive and can metastasize; cancerous

Genes that cause cancer

- **oncogenes** –
 - activate other genes that increase cell division
- **tumor suppressor gene** –
 - normally regulate mitosis; if inactivated they will not regulate mitosis



MITOSIS SKETCH

INTERPHASE

90% of life cycle
time varies

- G₁ cell growth
- S DNA replication
- G₂ ↑ protein synthesis
prep for Mitosis

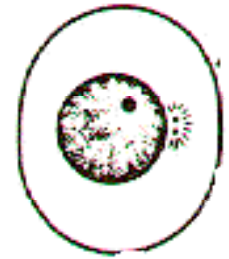
cellular metabolism; DNA replication (DNA duplication).

Human cells **entering** interphase:

>>>>> 46 **unduplicated** chromosomes

Human cells **exiting** interphase:

>>>>> 46 **duplicated** chromosomes

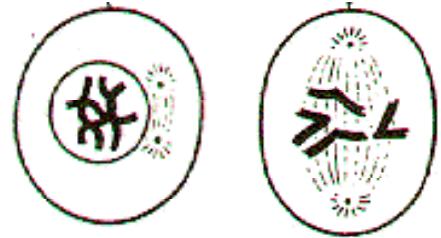


MITOSIS

PROPHASE

1 - several hrs

diagram: 2n = 4
human: 2n = 46



Chromatin >>>>> Chromosomes

The chromatin is actually coiling (condensing); becomes visible.

Nuclear membrane and nucleoli become indistinct.

Centrioles move toward opposite poles of cell.

Spindle forms.

METAPHASE

5 - 15 minutes

diagram: 2n = 4
human: 2n = 46

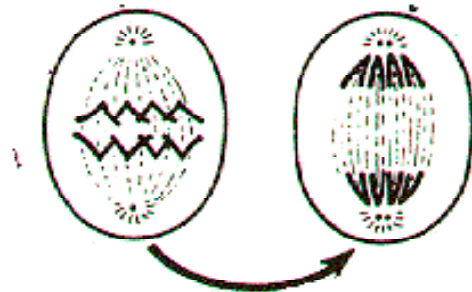


Chromosomes line up along center of spindle.
(*equatorial plate*)

ANAPHASE

2 - 10 minutes

diagram: 2n = 4
human: 2n = 46

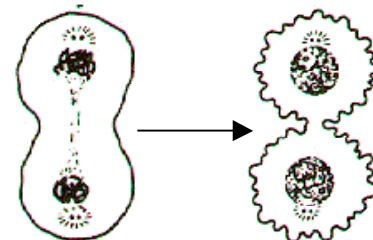


Centromeres split; Chromatids separate-
then move toward opposite poles of the cell.
Cytokinesis actually begins (see below).

TELOPHASE

10 - 30 min.

diagram: 2n = 4
human: 2n = 46



Cytokinesis: cell invaginates >>> 2 cells. Each “daughter” cell possesses the exact genetic material (info) as the original cell. Know *cell plate formation vs. furrowing*.

Chromosomes >>>>> chromatin (i.e., uncoil).

Nuclear membrane and nucleoli become distinct. Spindle disappears.