CHAPTER 03 and Lab

Overview of the CELL CYCLE

BIO 211:
ANATOMY & PHYSIOLOGY I

Dr. Lawrence G. Altman
www.lawrencegaltman.com

Some illustrations are courtesy of McGraw-Hill.

The Cell Cycle

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

Stages:
interphase
mitosis
cytoplasmic division
differentiation

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A. The Cell Cycle

1. During the **first growth phase, G₁**, (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. **G₂, the second growth phase**, is a **brief period** in which the cell makes the enzymes needed for cell division. G₁, S, and G₂ are collectively known as **interphase**.

4. During the **M, or mitotic, phase**, the nucleus replicates its contents (**karyokinesis**).

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**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

• produces two daughter cells from an original cell
• nucleus divides – karyokinesis
• cytoplasm divides – cytokinesis

Stages:
- prophase – chromosomes form; nuclear envelope disappears
- metaphase – chromosomes align midway between centrioles
- anaphase – chromosomes separate and move to centrioles
- telophase – chromatids form; nuclear envelope forms

LAB ATLAS
REFERENCE:
pp. 6 - 7
Morton & Perry, 1998
Cytoplasmic Division

(CYTOKINESIS)

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

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

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

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

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

ANAPHASE
2 - 10 minutes

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

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

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.