Laboratory Exercise 7

Cell Cycle

Materials Needed

Textbook
Models of animal mitosis
Microscope slides of whitefish mitosis (blastula)
Compound light microscope

For Demonstration:

Microscope slide of human chromosomes from leukocytes in mitosis
Oil immersion objective

The cell cycle consists of the series of changes a cell undergoes from the time it is formed until it divides. Typically, a newly formed cell grows to a certain size and then divides to form two new cells (*daughter cells*). This cell division process involves two major steps: (1) division of the cell's nuclear parts, *mitosis* and (2) division of the cell's cytoplasm, *cytokinesis*. Before the cell divides, it must synthesize biochemicals and other contents. This period of preparation is called *interphase*. The extensive period of interphase is divided into three phases. The S phase, when DNA synthesis occurs, is between two gap phases (G_1 and G_2), when cell growth occurs and cytoplasmic organelles duplicate. Eventually, some specialized cells, such as skeletal muscle cells and most nerve cells, cease further cell division, but remain alive.

A special type of cell division, called *meiosis*, occurs in the reproductive system to produce gametes and is not included in this laboratory exercise.

Purpose of the Exercise

To review the stages in the cell cycle and to observe cells in various stages of their life cycles.

LEARNING OUTCOMES

After completing this exercise, you should be able to

1. Describe the cell cycle, and locate structures involved with the process.
2. Identify and sketch the stages in the life cycle of a particular cell.
3. Arrange into a correct sequence a set of models or drawings of cells in various stages of their life cycles.

EXPLORE

Procedure—Cell Cycle

1. Review the section entitled "The Cell Cycle" in chapter 3 of the textbook.
2. As a review activity, study the various stages of the cell's life cycle represented in figure 7.1 and label the structures indicated in figure 7.2.
3. Observe the animal mitosis models, and review the major events in a cell's life cycle represented by each of them. Be sure you can arrange these models in correct sequence if their positions are changed. The acronym IPMAT can help you arrange the correct order of phases in the cell cycle. This includes interphase followed by the four phases of mitosis. Cytokinesis overlaps anaphase and telophase.
4. Complete Part A of Laboratory Report 7.
5. Obtain a slide of the whitefish mitosis (blastula).
   a. Examine the slide using the high-power objective of a microscope. The tissue on this slide was obtained from a developing embryo (blastula) of a fish, and many of the embryonic cells are undergoing mitosis. The chromosomes of these dividing cells are darkly stained (fig. 7.3).
   b. Search the tissue for cells in various stages of cell division. There are several sections on the slide. If you cannot locate different stages in one section, examine the cells of another section because the stages occur randomly on the slide.
   c. Each time you locate a cell in a different stage, sketch it in an appropriate circle in Part B of the laboratory report.

Critical Thinking Application

Which stage (phase) of the cell cycle was the most numerous in the blastula? _____

Explain your answer. _____

_____

_____

6. Complete Parts C, D, and E of the laboratory report.

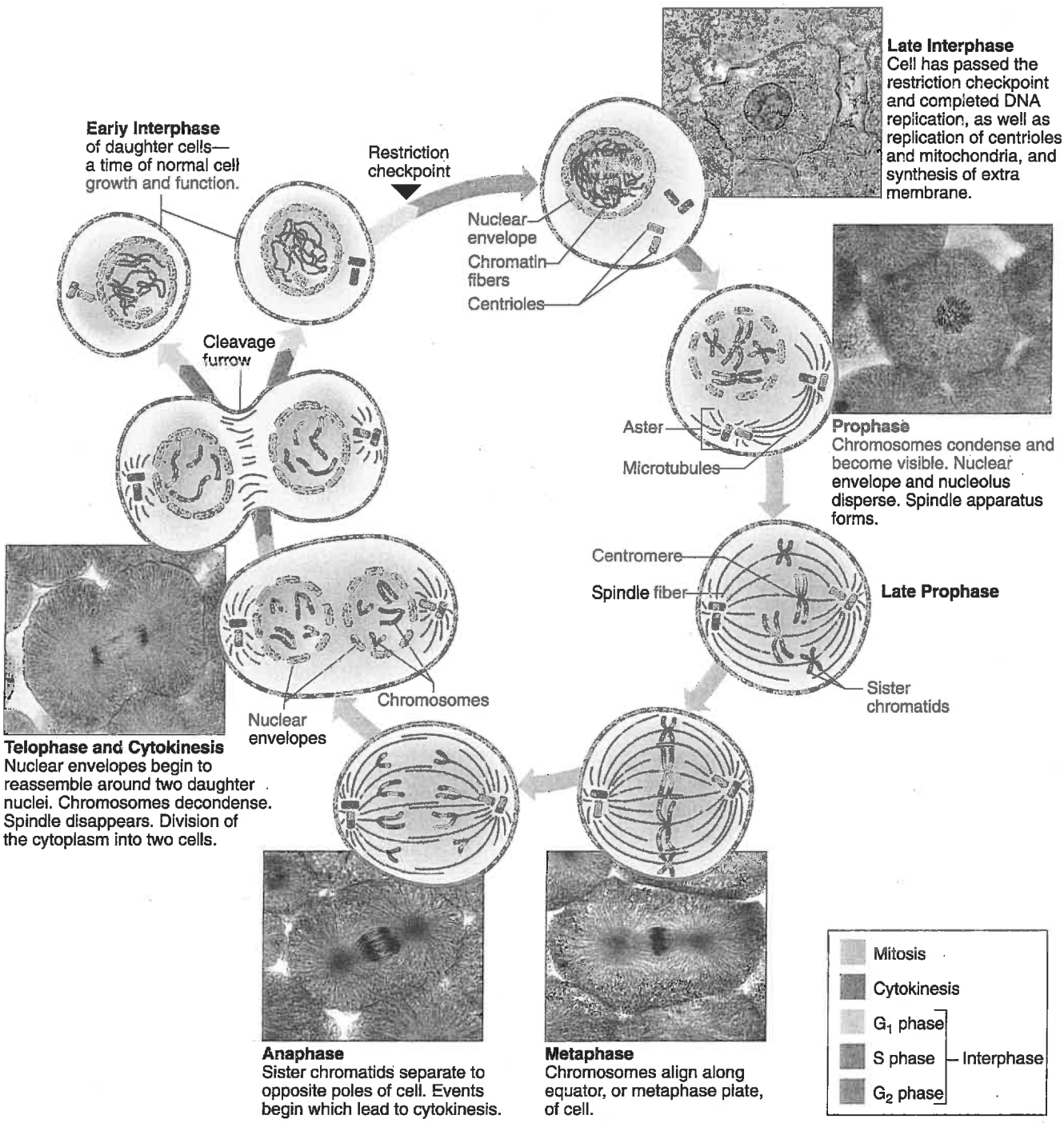


Figure 7.1 The cell cycle: interphase, mitosis, and cytokinesis.

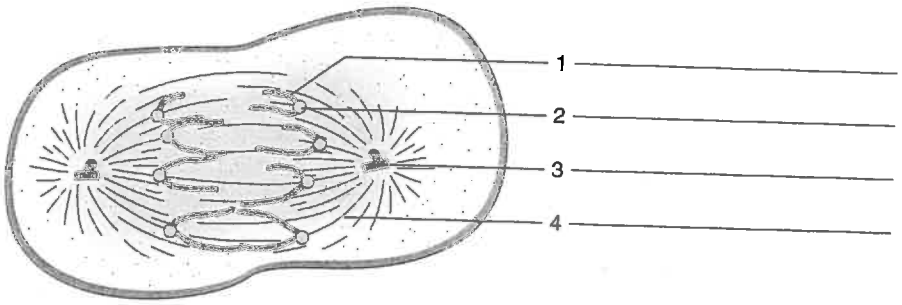


Figure 7.2 Label the structures indicated in the dividing cell. A1

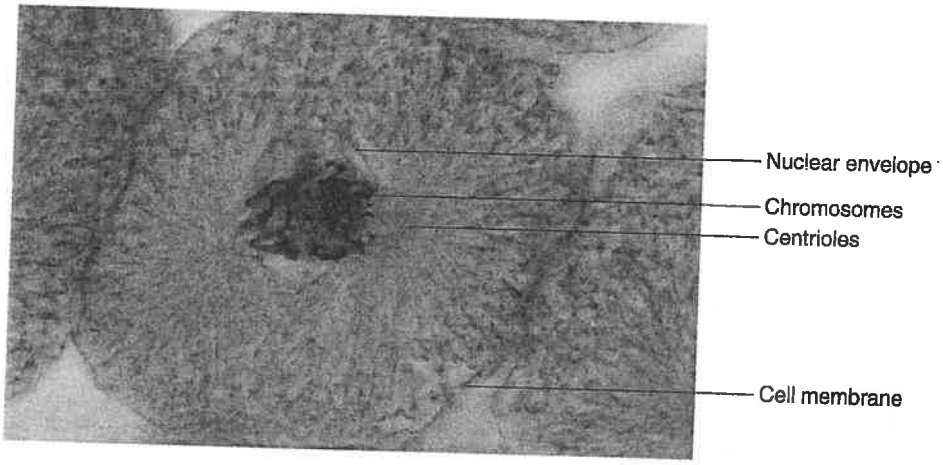
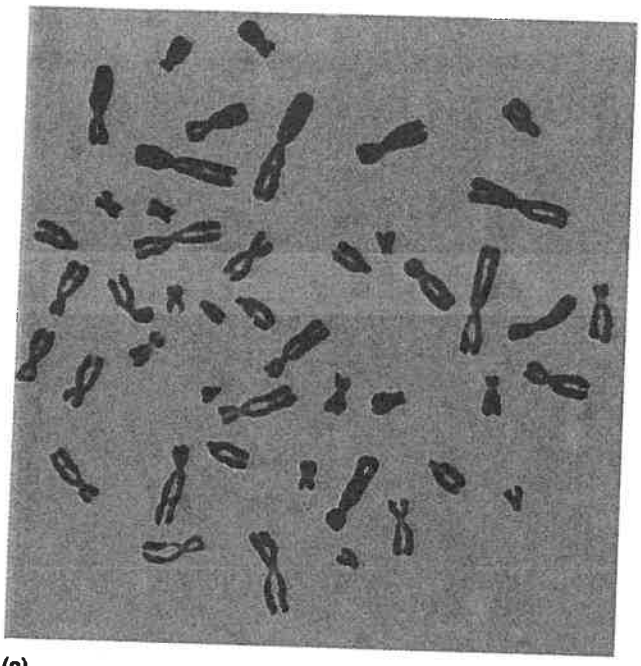


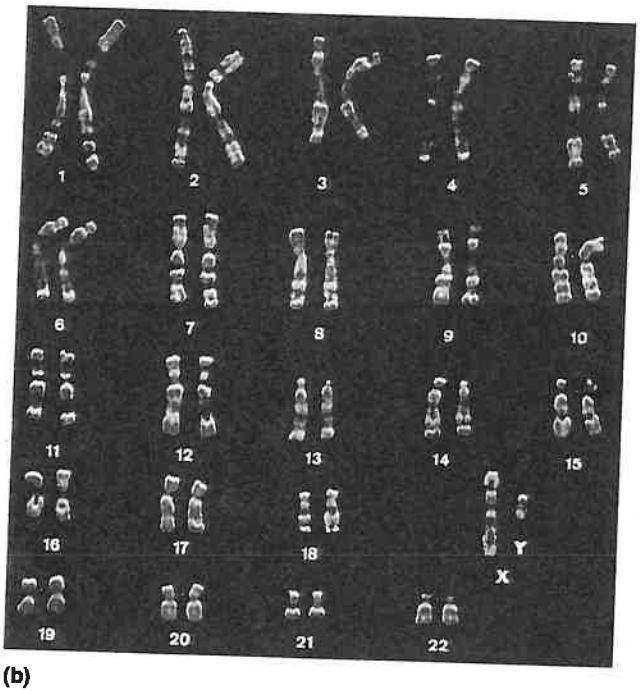
Figure 7.3 Cell in prophase (250× micrograph enlarged to 1,000×).

Demonstration

Using the oil immersion objective of a microscope, see if you can locate some human chromosomes by examining a prepared slide of human chromosomes from leukocytes. The cells on this slide were cultured in a special medium and were stimulated to undergo mitosis. The mitotic process was arrested in metaphase by exposing the cells to a chemical called colchicine, and the cells were caused to swell osmotically. As a result of this treatment, the chromosomes were spread apart. A complement of human chromosomes should be visible when they are magnified about 1,000×. Each chromosome is double-stranded and consists of two chromatids joined by a common centromere (fig. 7.4).



(a)



(b)

Figure 7.4 (*a*) A complement of human chromosomes (2,700×). (*b*) A *karyotype* can be constructed by arranging the homologous chromosome pairs together in a chart. The completed karyotype indicates a normal male.