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# Determining the Time Needed for Mitosis

## Pre-Lab Discussion

Mitosis is the process by which the cell nucleus is divided into two nuclei. Mitosis takes place in four phases: prophase, metaphase, anaphase, and telophase. The period between one mitosis and the next is called interphase. Chromosome replication occurs during interphase.

Organisms such as the common intestinal bacteria *E. coli* can complete mitosis in 30 minutes. Other cells require days. In some cells, such as human muscle cells, mitosis never occurs.

In this investigation, you will determine the time required for plant and animal cells to go through each phase of mitosis.

## Problem

How can the time needed for each phase of mitosis be determined in a plant and an animal cell?

## Materials *(per group)*

Textbook
Prepared slide of plant mitosis (onion root tip)
Prepared slide of animal mitosis (whitefish blastula)
Microscope

## Safety

Handle all glassware carefully. Always handle the microscope with extreme care. You are responsible for its proper care and use. Use caution when handling glass slides as they can break easily and cut you. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

## Procedure

1. Review the phases of plant and animal cell mitosis by studying the illustrations and photographs on pages 164 through 171 in your textbook.
2. Place the prepared onion root tip slide on the stage of the microscope. Using the low-power objective, focus on the cells just above the tip of the root. Switch to high power and count the total number of cells in the field of view. Record this information in the appropriate place in Data Table 1. (OBSERVE A TOTAL OF 100 CELLS)
3. Without changing the field of view, count the number of cells in each phase of mitosis: prophase, metaphase, anaphase, and telophase. Record this information in the appropriate place in Data Table 1.
4. To determine the approximate proportion of time a cell spends in each phase of mitosis, divide the number of cells in each phase by the total number of cells in the field of view. To convert each decimal to a percent, multiply by 100. Record this information in the appropriate place in Data Table 1.
5. Repeat steps 2 through 4 using the prepared animal mitosis slide. Record all of the information in the appropriate places in Data Table 2.
6. On the back of lab, make 5 drawings: prophase, metaphase, anaphase, telophase, interphase. Label cell structures.

## Observations

**Data Table 1**

| Phase | Plant Cell Mitosis | | |
|---|---|---|---|
| | Number of Cells in Phase | Number of Cells in Phase / Total Number of Cells | Percentage of Time Spent in Phase |
| Prophase | | | |
| Metaphase | | | |
| Anaphase | | | |
| Telophase | | | |
| Total number of cells in field of view | | | |

**Data Table 2**

| Phase | Animal Cell Mitosis | | |
|---|---|---|---|
| | Number of Cells in Phase | Number of Cells in Phase / Total Number of Cells | Percentage of Time Spent in Phase |
| Prophase | | | |
| Metaphase | | | |
| Anaphase | | | |
| Telophase | | | |
| Total number of cells in field of view | | | |

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## Analysis and Conclusions

1. In which phase of plant cell mitosis is the most time spent? In which phase of animal cell mitosis? _____

2. In which phase of plant cell mitosis is the least time spent? In which phase of animal cell mitosis? _____

3. Based on this investigation, what is the total percentage of time the plant and animal cells spend undergoing mitosis? _____

4. What percentage of the time are the plant and animal cells not undergoing mitosis?

5. What are the plant and animal cells doing when they are not undergoing mitosis?

## Critical Thinking and Application

1. Determine the percentages of time spent in each phase of mitosis for the onion root tip using the total number of cells undergoing mitosis instead of the total number of cells in the field of view.

$$\text{percentage} = \frac{\text{Number of cells in phase}}{\text{Number of cells undergoing mitosis}}$$

prophase _____

metaphase _____

anaphase _____

telophase _____

2. In the Pre-Lab Discussion you were told that *E. coli* is capable of undergoing mitosis in 30 minutes. Using the information from the previous problem, determine how long *E.coli* spends in each phase of mitosis.

prophase _____

metaphase _____

anaphase _____

telophase _____

## Going Further

Using reference sources, investigate the relationship between mitosis and cancer. What phases of mitosis might you expect to observe most frequently?

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# Mitosis

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A single fertilized human egg cell will divide to form two cells. These two cells will each divide into two cells. In time, millions of cells are produced. The division of nuclear material in which each new nucleus obtains the same number of chromosomes and the same nuclear code as the original nucleus is called mitosis. Mitosis occurs in four phases. There is an interphase between each mitosis.

In this investigation, you will

(a) locate cells in prepared onion root slides that are in the process of dividing by mitosis.
(b) identify cells in interphase and in each of the four stages of mitosis in the onion root tips by comparing them with diagrams.
(c) study the changes which occur in a cell as it undergoes mitosis.

## Materials

microscope
prepared slides of onion root tip *(Allium)*, longitudinal section

## Procedure

• Locate with a microscope the region of rapidly dividing cells on the prepared slide of onion root tip as shown in Figure 15-1. After locating the cells under low power, switch to high power.

• Locate cells that appear to be in the various stages of mitosis. Use Figure 15-2 as a guide.

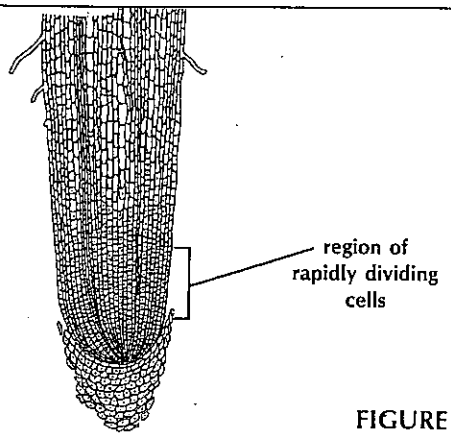



FIGURE 15-1

• Identify and label the following stages by using the brief description provided. Write the correct stage name on the lines provided in Figure 15-2.

(a) *Interphase*—cell contains easily seen nucleus and nucleolus—chromosomes appear as fine dots within nucleus

(b) *Prophase*—cell nucleus enlarged—nucleolus no longer visible—chromosomes appear as short strands within nucleus

(c) *Metaphase*—chromosomes long and thin strands—chromosomes lined up along cell center and look like "spider on a mirror"

(d) *Anaphase*—two sets of separate chromosomes can be seen—look as if they are being pulled apart from one another

(e) *Telophase*—chromosomes appear at opposite ends of cell—middle of cell has line across center that divides it almost into two new cells

(f) *Daughter cells*—appear as cells in interphase but smaller and side by side—actually start of new interphase

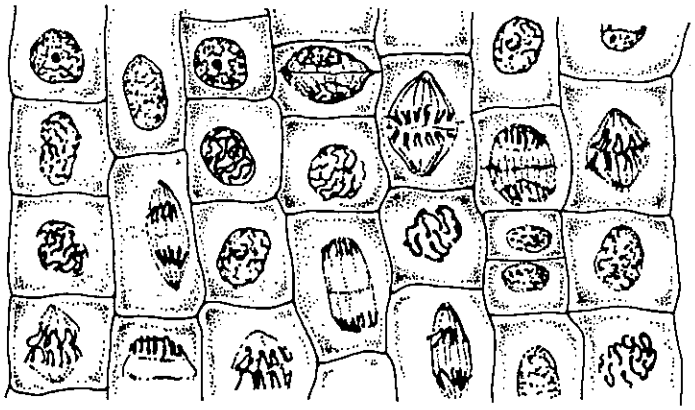
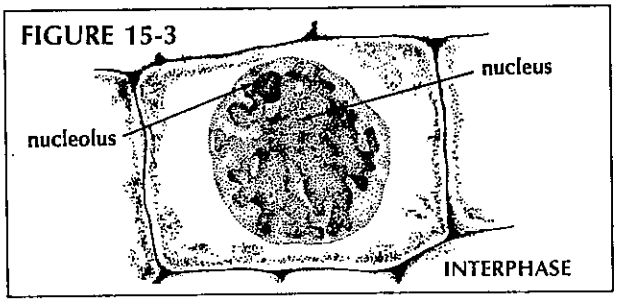


FIGURE 15-2

• Answer the following questions about each of the phases of mitosis.




**Interphase**

• Locate cells resembling Figure 15-3. Answer questions 1-3 while observing these cells.

1. Describe the contents of a nucleus during interphase. _____

2. Are a nucleolus and nuclear membrane present in the cell? _____

3. Are distinct rod-shaped structures called chromosomes easily observed in the nucleus at this time? _____

• Use your text for reference while answering questions 4-6.

4. Are chromosomes present in cells during interphase? _____

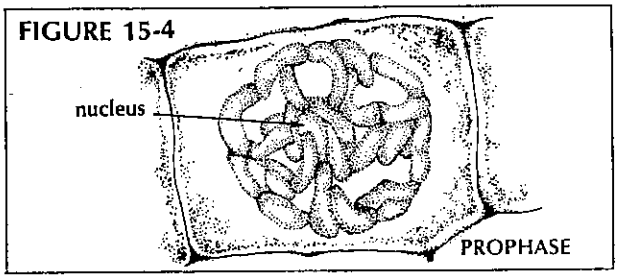
5. What term is used to describe nuclear contents during interphase? _____

6. (a) What important event occurs to chromosomes during interphase? _____

_____

(b) What other important events occur during interphase? _____

_____




**Prophase**

• Locate cells resembling Figure 15-4. Answer questions 7 and 8 while observing these cells.

7. Are chromosomes now visible during prophase? _____

8. Describe the changes that have occurred to the nucleolus and nuclear membrane from interphase to prophase. _____

_____

• Use your text for reference while answering question 9.

9. Explain why chromosomes can now be observed but were not observable during interphase. _____

_____

## Analysis

1. The term "mitosis" comes from the Greek word meaning "thread." Explain why this word may be helpful in describing this process of nuclear division. _____

_____

2. Explain how the process of mitosis helps an organism to grow in size. _____

_____

3. Complete Figure 15-9 to show the structures visible during each stage of mitosis. Draw in and/or label the structures listed below on the appropriate diagram. Be sure to label each animal cell with the correct mitosis stage name.
   (a) *Interphase:* draw and label *nuclear membrane, nucleolus, chromatin, centriole.*
   (b) *Prophase:* label *disappearing nuclear membrane, disappearing nucleolus, original chromosomes* (shaded), *chromosome copies* (unshaded).
   (c) *Metaphase:* draw in the two chromosome pairs as they would appear during metaphase. Label *chromosomes, spindle fibers.*
   (d) *Anaphase:* draw in the two chromosome pairs as they separate in anaphase. Label *centromeres.*
   (e) *Telophase:* label *reforming nuclear membrane, reforming nucleolus, pinching in of cell membrane.*
   (f) *Interphase:* draw in and label *nucleus, nucleolus, nuclear membrane,* and *chromatin* in each cell.

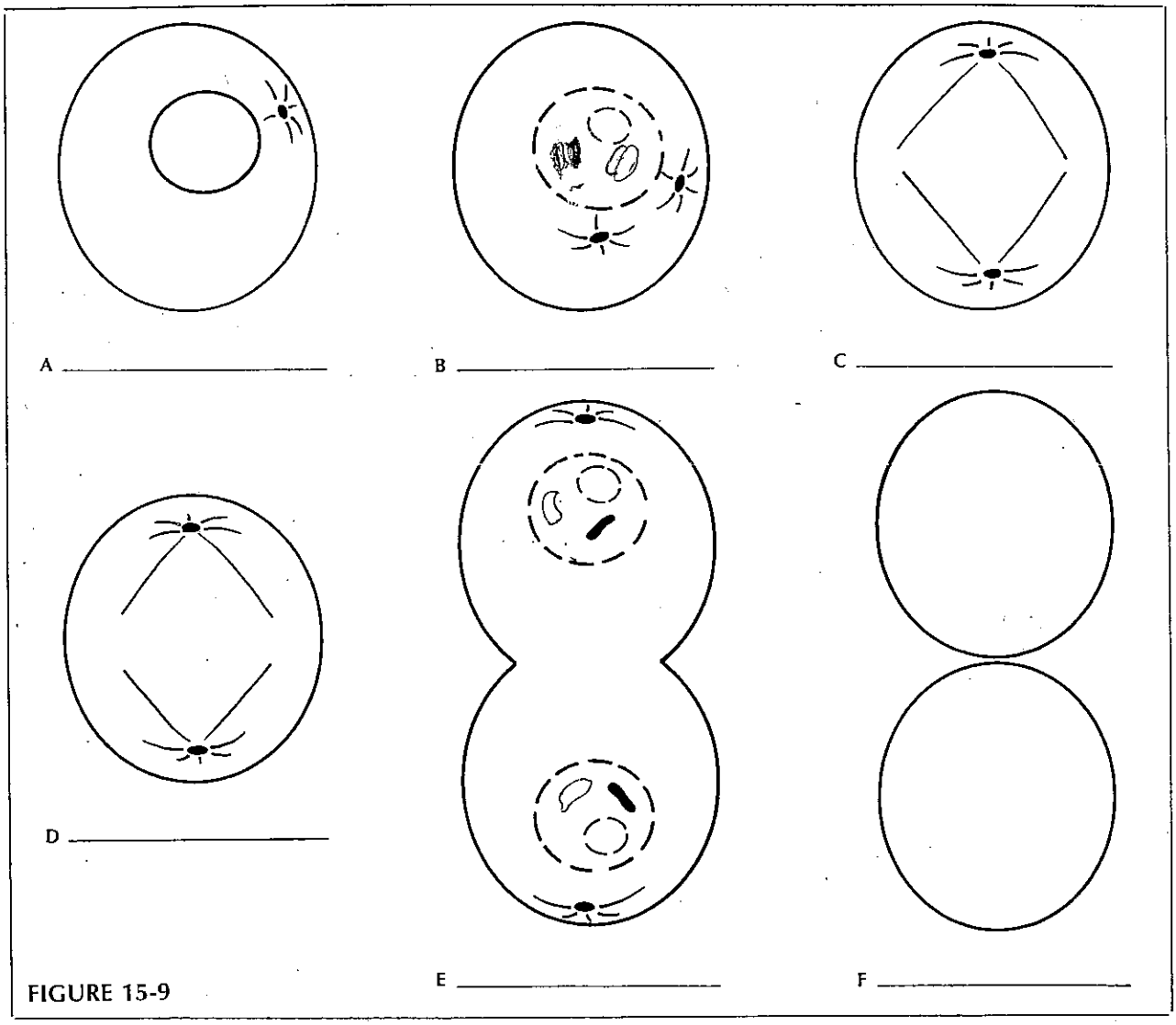



FIGURE 15-9

 IDENTIFY THE DIPLOID NUMBER OF THIS CELL. ____

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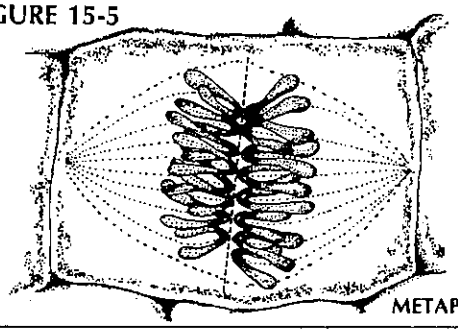
FIGURE 15-5



METAPHASE

**Metaphase**

• Locate cells resembling Figure 15-5. Answer questions 10 and 11 while observing these cells.

**10.** Describe where the chromosomes are now located in relation to the cell. _____

_____

**11.** Can evidence of chromosome duplication (replication) now be observed? _____

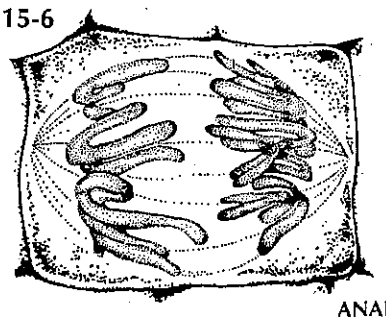
• Use your text for reference while answering questions 12 and 13.

**12.** What are the fibers called that become visible during this phase? _____

**13.** What term is used to describe the structure at which each fiber attaches to a chromosome?

_____

FIGURE 15-6



ANAPHASE

**Anaphase**

• Locate cells resembling Figure 15-6. Answer questions 14 and 15 while observing these cells.

**14.** In metaphase, chromosome pairs were lined up along the cell's center. Describe what is occurring to each chromosome pair during anaphase. _____

**15.** Toward what area of the cell are the chromosomes being directed? _____

• Use your text for reference while answering question 16.

**16.** What structure is responsible for the movement of chromosomes during this phase?

_____

**Telophase**

• Locate cells resembling Figure 15-7. Answer question 17 while observing these cells.

**17.** What cell parts begin to reappear during this phase? (See question 8.) _____

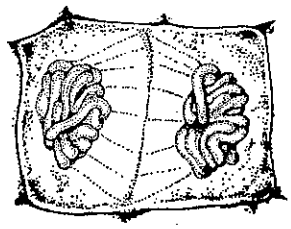
_____

**18.** Describe the location of the chromosomes now compared to where they were during metaphase. _____

_____

_____

FIGURE 15-7



TELOPHASE

FIGURE 15-8

DAUGHTER CELLS

**Daughter Cells**

• Locate cells resembling Figure 15-8. Answer questions 19 and 20 while observing these cells.

**19.** How many cells have now formed from an original cell? _____

**20.** Explain how the number of chromosomes found in each daughter cell compares to the number found in the original cell before mitosis. (HINT: Read introduction.) _____

_____