EXERCISE 9

Cell Division

LEARNING OBJECTIVES

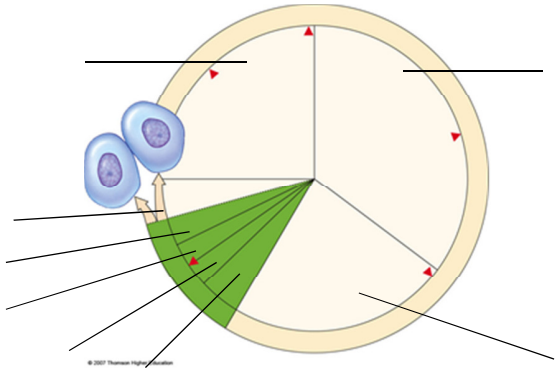
- Describe the stages of interphase
- Model and draw the stages of mitosis and meiosis
- Compare and contrast mitosis and meiosis
- Identify the stages of mitosis in plant and animal cells
- Explain the importance of synapsis and crossing over

INTRODUCTION

Cell division is important to living organisms for reproduction, growth, repair of injured tissue, and replacement of dead cells. Prokaryotic organisms, such as bacteria, have a single chromosome and simply replicate that chromosome and split into two by the process of binary fission. Eukaryotic organisms, on the other hand, have multiple paired chromosomes. Their cells divide by a process known as the cell cycle, during which the nucleus divides. This division of the nucleus is called mitosis when they divide asexually and meiosis when the cell division produces gametes. Because they have multiple chromosomes, eukaryotic cells employ the use of the spindle to organize the chromosomes and ensure that they are distributed correctly to the daughter cells.

Answer the following questions before you come to lab:

The diagram below is of the cell cycle. Label each part of the cycle and describe (next to the label) what happens during that stage.



In which stage of the cell cycle does the cell spend most of its time?_____

What is the spindle made of?_____

What do the following terms mean?
Cytokinesis_____

Centromere_____

Chromatid_____

Homologous chromosomes_____

A duplicated chromosome is shown below. Label it.

Figure 2

Exercise 1: Mitosis/Meiosis Video

Pay close attention to the information in the video, since it will be followed by a video quiz.

Exercise 2: Modeling the stages of Mitosis

1. Use the playdoh to model two pairs of homologous chromosomes, each consisting of two chromatids. Make one long pair (about 6 cm long) of one color e.g. blue and then make its homologous pair of a different color e.g. red. Since they are homologous they must be of the same length.
   Also make one short pair (about 3 cm), also using different colors for each homologue.

2. Model the stages of mitosis using the chromosomes you have made and record the stages using colored pencils in the spaces provided on the next page.

Exercise 2: Modeling stages of Mitosis

Interphase	Prophase
Metaphase	Anaphase
Telophase/Cytokinesis	

Exercise 3: Mitosis in animal cells (whitefish blastula) mitosis.

A blastula is the ball of cells produced as an embryo divides. After an egg (haploid) and sperm (haploid) fuse during fertilization, the resulting cell is called the zygote (diploid). This cell divides by mitosis and the resulting cells continue dividing repeatedly to produce the ball of cells called the blastula.
In this exercise, you will examine slides of the whitefish blastula to observe the cell cycle of animal cells.

1. Obtain a slide labeled "whitefish blastula." Examine the slide under scanning power (4X). You will note round circles. Each circle contains numerous sections of blastula. Each blastula section has many cells, which maybe in various stages of mitosis or in interphase.

2. Select a section and switch to low power and then high power for detailed observation. (Follow the appropriate rules for using the microscope that you microscopy learned in previously).

3. Work in groups and find the following stages of the animal cell's life cycle. You may refer to your text book and the diagram on the below.

Identify all the stages of the cell cycle in cells of the prepared slide of whitefish blastula and draw them in the spaces provided on the next page.

- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase/cytokinesis

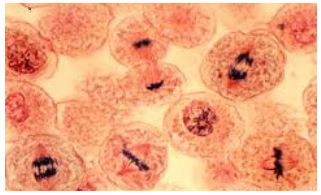


Figure 3 Mitosis in whitefish blastula

Exercise 3: Mitosis in animal cells (whitefish blastula) mitosis.

Interphase	Prophase
Metaphase	Anaphase
Telophase/Cytokinesis	

Exercise 4: Mitosis in plant cells (onion root tip).

Mitotic divisions in plant cells take place only in specialized regions called **meristems**. Meristems are present in the root tips and shoot tips of the plant and are regions of active growth that result in the elongation of tips in stems and roots. There is also a meristem in the trunk of the plant and mitotic division of cells in this region result in expansion of girth of plants. Cell division continuously occurs in these meristem regions of plants; there are no comparable regions in animals. In this exercise, you will examine prepared slides of the root tip meristem of *Allium* (onion).

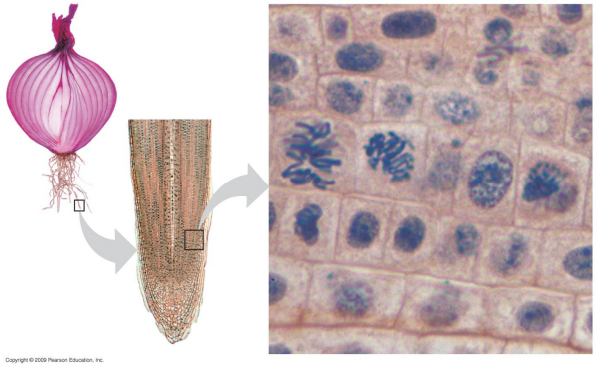
1. Obtain a prepared slide of a longitudinal section of *Allium* (onion) root tip.

2. Focus first with scanning power to get an overall view of the root tip (see diagram below). Examine the region behind the root cap, which is the apical meristem of the root tip.

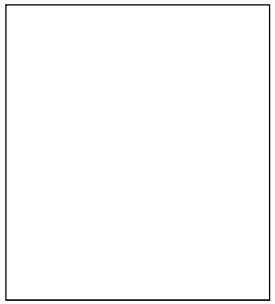
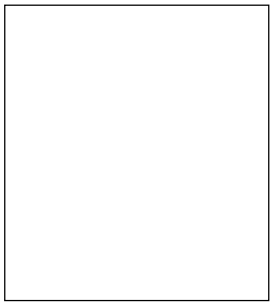
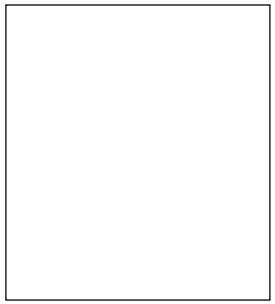
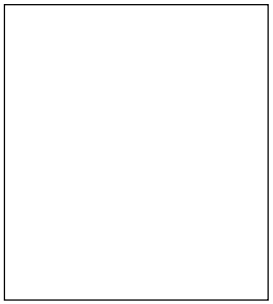
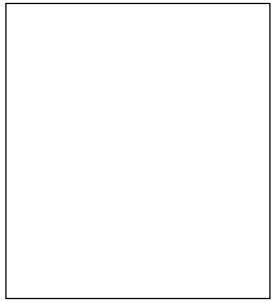
3. Switch to high power and observe the stained chromosomes within the nuclei of the cells in this region, and the cells undergoing mitosis (where no nucleus in present).

4. Work in groups and find the following stages of the animal cell's life cycle. You may refer to your text book and the diagram on the below.

Identify all the stages of the cell cycle in cells of the prepared slide of onion root tip and draw them in the spaces provided on the next page. Also note any similarities and differences between plant and animal cell mitosis.



Exercise 4: Mitosis in plant cells (onion root tip).

 Interphase	 Prophase
 Metaphase	 Anaphase
 Telophase/Cytokinesis	

INTRODUCTION TO MEIOSIS

Answer these questions before you come to lab:

What do the following terms mean?

Tetrad_____

Synapsis_____

Gonads _____

Crossing over_____

Gamete_____

How are the daughter cells produced from meiosis different from those produced from mitosis?

_____

_____

Meiosis is a form of cell division that occurs in the gonads, the ovaries and testes, of animals. The purpose of meiosis is production of **gametes** which are haploid do that fertilization will restore the diploid number of chromosomes. This process is called **gametogenesi**s. Meiosis also occurs in plants. In flowering plants this takes place in the anther and ovary of the flower.
Meiosis occurs in two cycles. Meiosis I consists of prophase I, metaphase I, anaphase I, and telophase I, accompanied by cytokinesis. The second cycle consists of prophase II, metaphase II, anaphase II, and telophase II, also accompanied by cytokinesis.

The chromosomes in diploid somatic (body) cells of eukaryotes exist in pairs called **homologous chromosomes**. One chromosome of each pair comes from the father, and the other comes from the mother. Homologous pairs contain similar, but not always identical, generic material for a series of traits. They carry the same genes at specific loci, but they are often in alternate forms called **alleles**. Somatic cells are **diploid** (2n), containing two sets of homologs in the same nucleus. Following meiosis, all four daughter cells contain only one of each of the paired homologs and are **haploid** (n).

Prophase I is unique in that homologous chromosomes pair with each other and intertwine as a **tetrad** (see your textbook as a reference). This pairing of homologous chromosomes is called **synapsis**. At this time, genetic material may be exchanged between non-sister chromatids during a process called **crossing over**, in a form of genetic recombination. This process does not occur during mitosis. Generally, each pair of homologues has at least one cross over.

Exercise 5: Modeling the stages of meiosis

1. Use the playdoh to model two pairs of homologous chromosomes, each consisting of two chromatids, as you did in Exercise 2.

2. Model the stages of meiosis using the chromosomes you have made. Simulate one cross over event between the long pair and one cross over event between the short pair.

3. Record the stages using colored pencils in the spaces provided on the next page.

You may refer to the diagram on the following page.

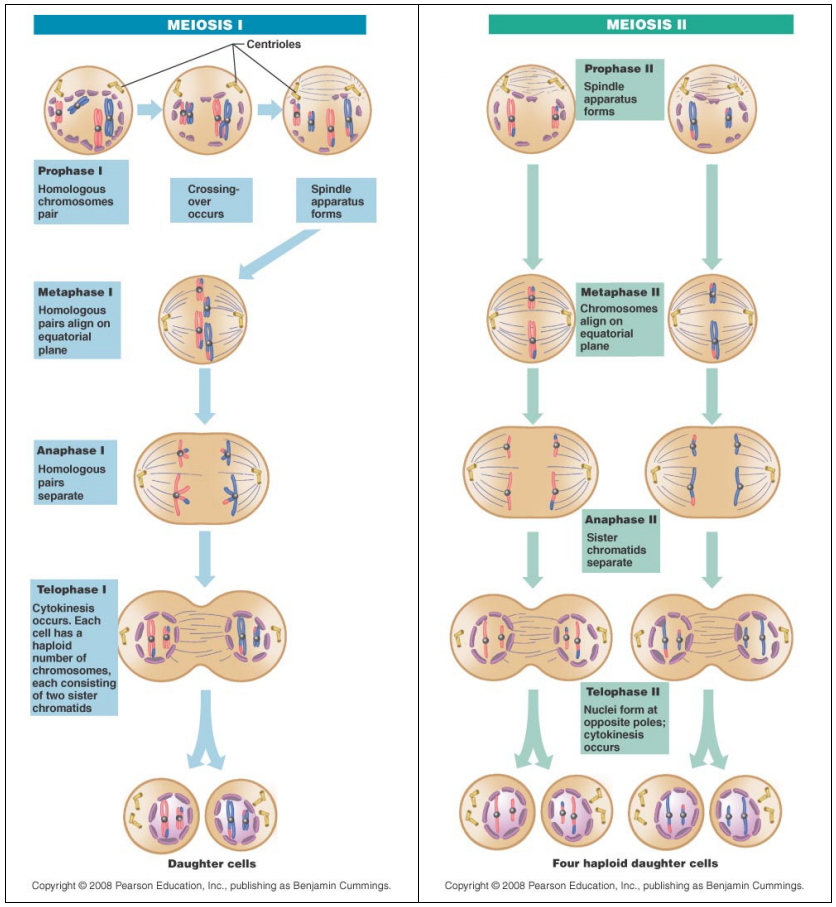
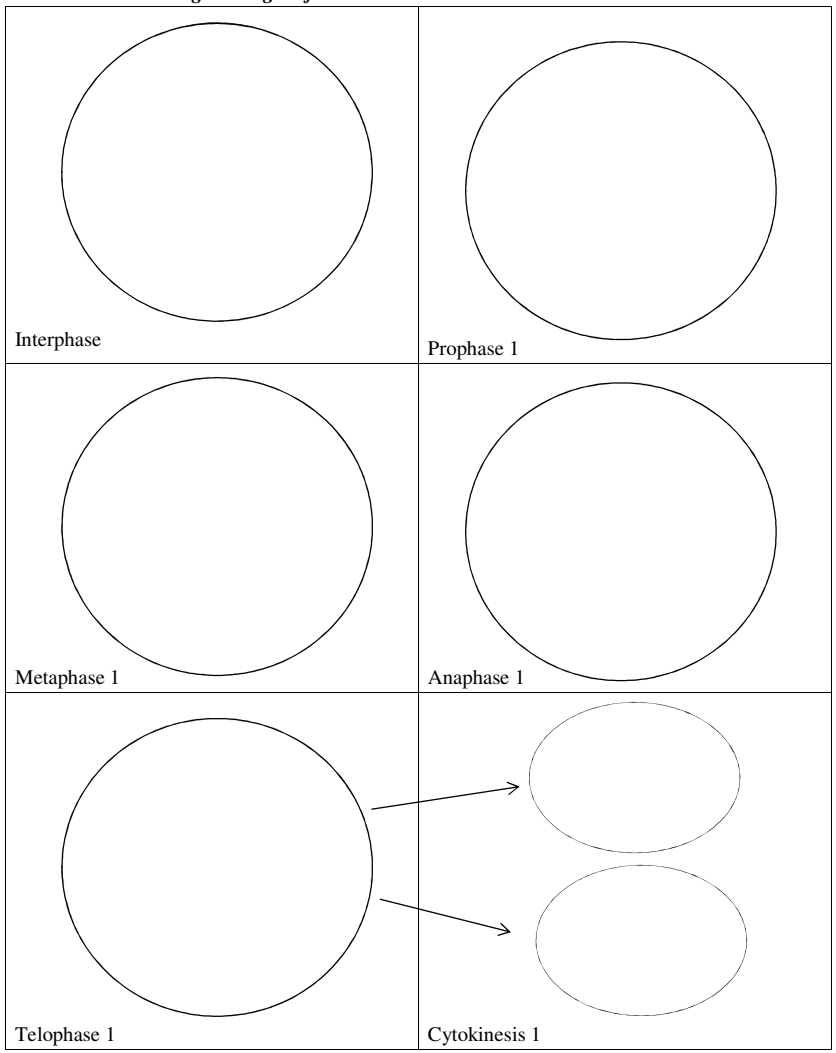


Figure 4. Meiosis

Exercise 5: Modeling the stages of meiosis 1



Exercise 5: Modeling the stages of meiosis II