

Cell Division Lab
Pre-Lab Exercise

Name _____

1. Using your own words, define the following terms:

a. Mitosis:

b. Meiosis:

c. Chromosome

d. Chromatid

e. Centromere

f. Homologous pair

2. What is the purpose of mitosis?

3. What is the purpose of meiosis?

Cell Division Lab

Work in groups of two

Cell theory says that all organisms are made of cells and that all cells come from preexisting cells. This means that cells must have some way of reproducing themselves. They have two ways of reproducing:

Mitosis: the chromosome number in the daughter cells is identical to the parent cell.

Meiosis: the chromosome number in the daughter cells is 1/2 that in the parent cell.

Summary of Activities

1. Use pop-beads to simulate mitosis.
2. Identify the phases of mitosis in plant and animal cells.
3. Use pop-beads to simulate meiosis. Compare and contrast this process to mitosis.
4. Use the computer model to compare chromosome segregation during mitosis and meiosis.
5. Explain the genetic consequences of both mitosis and meiosis.

I. Mitosis

A. Simulating Mitosis with Pop-Beads

1. Use pop-beads as chromosomes to simulate the process of mitosis. Assume the chromosome number of the organisms is 4 (each cell has 4 chromosomes, or 2 **homologous pairs**).

Make a total of 4 chromosomes: one long chromosome and one short chromosome of each color. The two long chromosomes should each have the same number of beads, as should the two short chromosomes. The two long chromosomes (one red, one yellow) together are one homologous pair. The two short chromosomes are the second homologous pair.

2. Replicate your chromosomes by making an identical set of pop-bead chromosomes. Attach the identical replicas (**chromatids**) by their magnetic **centromeres**. You are now ready to proceed with mitosis.
3. Show how the “chromosomes” are arranged in each of the four stages of mitosis.

B. Microscopic Observations of Mitosis

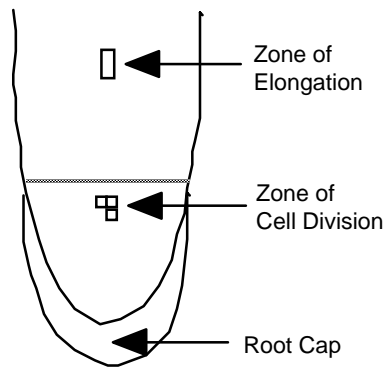
Most of the cells you will observe will be in **interphase**, since this is the longest phase of the cell cycle. In this phase, DNA is being used to make protein and the DNA itself will have to undergo replication, so the chromosomes are loose and unwound and impossible to see even using a microscope.

The chromosomes will not become visible until the cells enter **prophase**, the first phase of mitosis. It will be possible to see condensed chromosomes in all the various stages of mitosis, although the process of mitosis is continuous and the separations of the various stages are arbitrary. Many of the mitotic cells you see may be in some intermediate point between the phases you have learned about.

Mitosis in Plant Cells: Onion Root Tip

The tip of a plant root is the growing portion of the root and contains many cells undergoing mitosis. Following the procedure below, make a squash of an onion root tip to stain and visualize these cells.

Onion Root Tip



- Root tips have already been treated with hydrochloric acid (HCl) to loosen the cell walls and make the cells easier to separate.
- Remove a root tip and carefully place it on a clean microscope slide.
- With a razor blade, cut off and discard all but 3-4 millimeters of the whitish tip. Using two probes tease apart the tissue so that it is reduced to very small pieces.
- Add some acetocarmine stain so that the tissue is completely covered.
- Heat for 5 to 10 seconds by constantly moving the glass slide 1/2 to 1 inch above the flame. Do not let the slide dry out and do not let the stain boil off. Add more stain while you are heating if necessary. It takes some practice to know how much heat is necessary, so don't be discouraged if your root tip gets fried the first time.
- Add a coverslip and then gently squash the tissue flat with the wooden end of a probe or with your finger. Hold the preparation up to the light and look for a light reddish color in the bits of tissue.
- Find a cell in each stage of mitosis using the 40X lens. Look for different mitotic phases. Make a drawing of a cell in interphase and cells in at least two different phases of mitosis. Make sure that each of your drawings is large (~ 1/4 page) and clear! Label each drawing with a description of what is happening in the cell during that stage of mitosis.

Mitosis in Animal Cells: Whitefish Blastula

The blastula is an early embryonic stage of development in animals. The cells were rapidly dividing to form a spherical mass of cells when they were preserved. Condensed chromosomes will be visible as black bodies inside the cells that become more worm-like as the stages progress.

- Observe the prepared slides of whitefish blastula. After using the low power lens to focus your microscope, use the 40X (or 45X) objective lens to scan the entire blastula to find cells containing black chromosomes.
- Find a cell in each stage of mitosis and use the 100X lens to observe the mitotic cells in more detail. Make a drawing of each stage. Again, make sure that each of your drawings is large (~ 1/4 page) and clear. Label each drawing with a description of what is happening in the cell during that stage of mitosis.

Note: The mitotic spindle will also be visible as a dark pink network of fibers connected to the chromosomes. The aster is a group of spindle fibers that radiate from the centriole, a microtubule organizing center, which can be seen at the poles of the spindle. Include and label these structures in your drawings.

c. Be sure to clean the oil off the lens before you put your microscope away.

Q1. The life cycle of a cell consists of interphase and four phases of mitosis. In which part of the life cycle does a cell spend most time? What observation did you make during the lab to support your answer?

Q2. Why can you not see chromosomes in interphase cells?

Q3. Why can you not see a nucleus in mitotic cells?

Q4. How would you explain to someone what they should look for to decide whether a cell is in anaphase or telophase?

Q5. When plants are propagated by cuttings, is this meiosis or mitosis?

II. Meiosis

A. Simulating Homologous Pairing

Use the colored socks to simulate homologous pairs of chromosomes and how they segregate during meiosis. The whole class must do this together, as you need 23 pairs of socks for the human chromosome. Each sock represents one chromosome.

B. Simulate Crossing-over

Use your pop-bead chromosomes to simulate crossing-over of homologous chromosomes during Prophase I of meiosis. As before, assume the chromosome number is 4.

1. Draw the arrangement of the chromosomes in Prophase I during synapsis.

2. Draw the arrangement of the chromosomes in Prophase I after crossing-over is complete.

Q6. In your own words, explain crossing-over.

Q7. What is the importance of crossing-over to your children?

Q8. What would be the result of a mistake where homologous chromosomes did not segregate?

B. Reviewing the Stages of Meiosis

Using your book as a guide and the four pop-bead chromosomes, simulate each of the phases of meiosis in division I and division II. In particular, pay attention to how meiosis differs from mitosis.

C. Chromosomes or Chromatids?

The parasitic worm *Ascaris* has four chromosomes in each of its diploid (2N) cells.

Q9. How many chromosomes are present in each roundworm cell at the end of each of the following stages?
How many chromatids?

<u>stage</u>	<u># chromosomes</u>	<u># chromatids</u>
Prophase I		
Prophase II		
Telophase II		

Remember: a *chromosome* is defined by its centromere. Whatever is attached to *one* centromere is considered *one* chromosome. When two identical DNA molecules are attached to one centromere after replication, each is called a *chromatid*.

Cell Division Lab
Data Sheets

Name _____

A COMPARISON OF MITOSIS AND MEIOSIS

	MITOSIS	MEIOSIS
Number of cells at <i>start</i> of process		
Number of cells at <i>end</i> of process		
Number of cell divisions		
Number of chromosomes in the cell at <i>start</i> of process in terms of N		
Number of chromosomes in the cell at <i>end</i> of process in terms of N		
Number of chromosomes in a <i>human</i> cell at <i>start</i> of process		
Number of chromosomes in a <i>human</i> cell at <i>end</i> of process		
Number of molecules of DNA in each human cell at <i>start</i> of process		
Number of molecules of DNA in each human cell at <i>end</i> of process		
Are the daughter cells diploid or haploid?		
Is the genetic make-up of daughter cells unique or identical to other cells in the organism?		
Role of process in the life cycle of an organism		
Type of cells in a human that can undergo this process		

Simulating Mitosis and Meiosis: Illustrate how your pop-bead “chromosomes” are arranged in each of the stages of mitosis and meiosis. Use different colors to distinguish the chromosome pairs. Note the chromosome number at each stage. Include an example of crossing-over.

