**Chromosome Bead Simulation**

In this activity, you will model the processes of mitosis and meiosis, and compare the number of chromosomes in the resulting daughter cells, as well as the way meiosis can result in genetic variation in offspring.

The “chromosomes” provided represent a relative simple genome (just two sets of chromosomes). The blue strands were inherited from the organism’s father; the red and white strands were inherited from the organism’s mother. The beads on each strand represent individual genes that are present on the chromosomes. Follow the instructions below to walk through the stages of mitosis, and later in the day, meiosis.

**Part I – Mitosis**

* Locate the sheets labeled “Mitosis” and lay out a complete set of chromosomes (1 large blue, 1 small blue, 1 large red, 1 small red) in the cell labeled “Interphase.” Simulate S phase of Interphase, in which chromosomes are duplicated.
* Move the chromosomes to “Prophase.” Simulate prophase. Include the degradation of the nuclear membrane, and the appearance of the centromeres by drawing these features on the paper.
* Move the chromosomes to “Metaphase” Simulate metaphase; draw in the spindle fibers
* Move the chromosomes to “Anaphase.” Simulate anaphase, drawing in the action of the spindle fibers
* Move to “Telophase/Cytokinesis.” Simulate these processes; draw a circle around the chromosomes in their new positions, to represent the new nuclear membranes that have formed.

In the space below, draw a diagram of each of the daughter cells. Use different colors to represent the chromosomes inherited from mom, and those from dad.

1. How many copies of each chromosome were present in the cell before S phase?
2. How many copies of each chromosome are present in each of the resulting daughter cells?
3. What is the genetic relationship of the daughter cells to one another? To the parent cell?

**Part II – Meiosis I**

* Locate the sheets labeled “Meiosis I” and lay out a complete set of chromosomes (1 large blue, 1 small blue, 1 large red, 1 small red) in the cell labeled “Interphase.” Simulate S phase of Interphase, in which chromosomes are duplicated.
* Move the chromosomes to “Prophase I.” Simulate prophase. Include the degradation of the nuclear membrane, and the appearance of the centromeres by drawing these features on the paper.
* Move the chromosomes to “Metaphase I,” and simulate metaphase; draw in the spindle fibers. Now, simulate **crossing over** between homologous chromosomes (move beads from one strand to another to represent the swapping of genes between mom’s chromosomes and dad’s).
* Move the chromosomes to “Anaphase.” Simulate anaphase, drawing in the action of the spindle fibers
* Move to “Telophase/Cytokinesis,” and simulate these processes; draw a circle around the chromosomes in their new positions, to represent the new nuclear membranes that have formed.

1. How many copies of each chromosome were present in the cell prior to S phase?
2. How many copies of each chromosome are present in the new daughter cells?
3. What do we call the structures that were pulled apart during anaphase I?

**Part III – Meiosis II**

* Locate the sheets labeled “Meiosis II” and lay out the daughter cells from Meiosis I into “Prophase I.” Simulate prophase. Include the degradation of the nuclear membrane, and the appearance of the centromeres by drawing these features on the paper.
* Move the chromosomes to “Metaphase II,” and simulate metaphase; draw in the spindle fibers.
* Move the chromosomes to “Anaphase.” Simulate anaphase, drawing in the action of the spindle fibers.
* Move to “Telophase/Cytokinesis.” Simulate these processes; draw a circle around the chromosomes in their new positions, to represent the new nuclear membranes that have formed.

1. How many copies of each chromosome were present in the cell during prophase II?
2. Which structures were pulled apart during anaphase II?
3. How many daughter cells were produced? How many copies of each chromosome are present in the new daughter cells?
4. What is the significance of chromosome number given the role the cells produced in meiosis have in reproduction?

1. Describe the genetic relationship of each of the new daughter cells to one another, and also to the parent cells. (Hint: look at the colors of the beads on the chromosomes).
2. Explain the benefit of this diversity between daughter cells for sexually reproducing species.

Adapted from:

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<http://brearleyhigh.kenilworthschools.com/UserFiles/Servers/Server_7985/File/meiosis%20pop%20bead%20activity%20(1).pdf>

<https://www.somsd.k12.nj.us/site/handlers/filedownload.ashx?moduleinstanceid=3123&dataid=9016&FileName=Meiosis%20simulation-pop%20beads.pdf>