

Mitosis Model

Overview

Students use the chromosome models to investigate the mechanics of cell division and mitosis.

Textbook References

McDougal Littell

Unit C Chapter 3, pp. 80-87, Cell Division Is Part of the Cell Cycle

Prentice Hall

Not included in text

Materials

*Materials to be supplied by the teacher or the students are marked with an asterisk.

Materials for the whole class

- 1 transparency of *Chromosome Models for Mitosis*
- 1 transparency of *Mitosis Answer Key* (at the very end of this teachers guide)
- Glue sticks

Materials for small groups

- 1 set of Bead Boxes including magnetic beads (2 boxes per set)

Materials for individual students

- 2 long blue pipe cleaner
- 2 long pink pipe cleaner
- 2 short blue pipe cleaner
- 2 short pink pipe cleaner
- 1 *Mitosis Cut-Out* sheet
- *Science notebook

Procedure

- *“So, here’s the problem. Every cell in your body has the same genetic information. You started out as one cell, but you have grown to billions of cells. How can that happen? In our plant model, each plant had 4 chromosomes—2 longs and 2 shorts. How can you start with one cell containing 4 chromosomes and end up with 2 cells, both with 4 chromosomes and both with the same genetic information?”*
- Pass out the mitosis puzzle sheets and ask the students to cut out the pieces and to arrange them in order following two criteria:
 - Start with one cell and end with two cells.
 - The two final cells must have the same number and kinds of chromosomes as the starting cell.

- After the students have finished the puzzle, have them compare their results with another student and see if they agree.
- [During the following procedure, we suggest that the teacher lead the students through mitosis one step at a time. First, they will make pipe cleaner chromosomes. Then, as they move through mitosis step by step, show each mitotic stage using the transparency *Mitosis Answer Key*, and have the students move their chromosome models appropriately.]

- *“Cells have a way of dividing into two. We will go through each step, and as we do, we will discuss what is happening while looking at the puzzle and then model the process with the pipe cleaners.”*
- *“Get out your pipe cleaner chromosomes—1 long blue, 1 long pink, 1 short blue and 1 short pink. Let’s put the genes of our original plant on these chromosomes.”* Show the transparency of *Chromosome Models for Mitosis* for students to follow. These will be identical to the chromosomes they made in the previous exercise.

“Can they be divided to give two cells with the exact same genetic information?” [No.]

“What could we do to produce two cells with the exact same genetic composition?” [Make copies of the chromosomes we have.]

- *“We need to make copies first and that is just what cells do. When this happens in a cell, a special section of the chromosome becomes important. This centromere is a special, sticky region of the chromosome. When a new copy of a chromosome is made, the centromere holds the two copies together. The old and new pieces that are stuck together are called chromatids during this copying process (called replication).”*
- Ask the students to make an exact copy of the long blue chromosome and place a *magnetic bead* between the green and yellow beads on both copies. Once they are replicated, stick the two long, blue chromosomes together. The location of the centromeres, just like the location of the genes on the chromosome, is a fixed and definite position. So the long pink chromosome will have its centromeres in the same location as the long blue chromosome. Replicate a copy of the long pink chromosome with the centromere between the green and yellow beads and stick the two long, pink chromosomes together.
- Ask the students to replicate the short chromosomes with the centromeres between the color gene and the stem gene. Show the replication steps of the *Mitosis Answer Key* transparency (the first two steps on the sheet, puzzle pieces #4 and #2) and have the students mimic what they see with their

models.

- “Now is there a way to get two cells with the exact genetic information as our original 4 chromosome cell?”
- “The chromatids inside a cell that is ready to reproduce do a special ‘dance.’ This choreography gets things aligned so that when this one cell splits in two, both daughter cells end up with exactly the same genetic material. It’s as if there is a machine inside the cell that lines up the chromosomes in the center of the cell, and then pulls on each centromere to separate the two copies and pull them to either side of the cell. Then, the cell splits down the middle to form two cells.” [Yes, they are referred to as daughter cells, never as sons!]
- “Inside the cell, there are special organelles that control the movements of the chromatids. The replicated chromosomes (pairs of chromatids) line up in the middle of the cell and then as the cell divides in two, the chromatids pull apart at the centromere.” [Puzzle pieces #5 and #1 on the overhead. Students can pull them apart by separating the magnets.]

Textbooks may refer to the genetic material during cell division as either chromosomes or chromatids or both! This can be confusing for students, especially since it is so abstract. It may help to stress the point that they are called chromosomes before they are replicated, chromatids after replication and during the cell division process, and then daughter chromosomes once they move apart to go their separate ways.

- Lead the students through the last two steps of mitosis (puzzle pieces #6 and #3). Using the *Mitosis Answer Key* overhead, describe what is happening and why, and have the students mimic these actions with their pipe cleaner models.
- After the students have their puzzle pieces in the correct order, have them glue them into their science notebooks and write a sentence or two describing what is happening at each step.
- Ask students to consider where things could go wrong in the mitosis simulation that they just did with the pipe cleaners. Tell students that these are ways that mitotic mutations occur. These mutations can result in cancer or other diseases and may be a part of aging.

Assessment

Describe in words and pictures what has to happen when a cell divides so that each cell in a living organism has the exact same genetic material.

Chromosome Models

Mitosis



