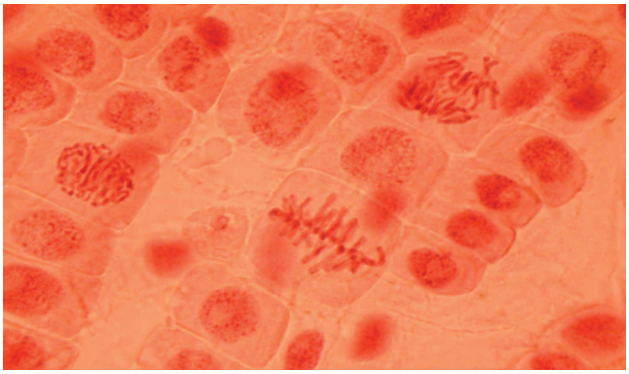


Stained Onion Root Tip Cells

Activity 13: Mitosis

Through mitosis and the rest of the cell division process, one cell is divided into two genetically identical cells. In this activity, you explore the process of mitosis, observing, categorizing, and counting cells in each phase.

Purpose:

To consider the process of mitosis

Overview:

Students examine a prepared slide of onion root tip or whitefish blastula cells. They identify differences in the cells, relate these to the various stages of mitosis, and categorize the cells into the stages in order to understand the entire process. They then compare and contrast plant and animal mitosis.

Time:

Two (50 minute) sessions

Materials:

- *Swift* Digital Microscopes
- Computers
- Microscope slides and cover slips
- Projector (for one computer)
- Prepared onion root tip slides (or other plant mitosis slides)
- Prepared whitefish blastula slides (or other animal mitosis slides)
- Pipettes or eyedroppers

Standards:

- Florida: SC.912.L.16.14
- New York: 2, 4
- Texas: 6E, 10A

Textbook Matching:

BSCS Biology: An Ecological Approach

- *Chapter 5: The Cell; 5.9 — The Cell's Life Is a Cycle. 5.10 — Mitosis Is a Continuous Process*
- *Chapter 6: Continuity Through Reproduction; 6.1 — Reproduction Is Essential for the Continuity of Life, 6.2 — Reproduction May Be Sexual or Asexual*
- *Chapter 7: Continuity Through Development, 7.1 — A Zygote Gives Rise to Many Cells*

Glencoe Science Biology (National Geographic)

- *Chapter 9: Cellular Reproduction; Section 9.1 — Cellular Growth, The Cell Cycle, Section 9.2 — Mitosis and Cytokinesis*
- *Chapter 10: Sexual Reproduction and Genetics; Section 10.1 — Meiosis (Table 10.1)*

McDougal Littell Biology (Stephen Nowicki)

- *Chapter 5: Cell Growth and Division; 5.1 — The Cell Cycle, 5.2 — Mitosis and Cytokinesis, Investigation — Mitosis in Onion Root Cells*
- *Chapter 6: Meiosis and Mendel; 6.1 — Chromosomes and Meiosis (Figure 6.2)*

Prentice Hall Biology (Miller and Levine)

- *Chapter 10: Cell Growth and Division; 10-2 — Cell Division, Exploration — Modeling the Phases of the Cell Cycle*
- *Chapter 11: Introduction to Genetics; 11-4 — Meiosis*

Background:

Cell division is a process by which a cell divides into two or more cells. Cell division can be accomplished through mitosis, the process by which a eukaryotic cell's nucleus divides into two genetically identical nuclei. There are four phases of mitosis: prophase, metaphase, anaphase, and telophase. A cell prepares for mitosis during a fifth phase, the interphase. And the cell actually divides during the process of cytokinesis. Interphase and cytokinesis are not technically parts of the process of mitosis.

Procedure:

1. Have students work in pairs or small teams to complete the activity.
2. When they reach the stage of combining and analyzing class data, project a data table in front of the class and have students enter their data.

	Interphase	Prophase	Metaphase	Anaphase	Telophase
Onion Root Tip					
Whitefish Blastula					

   Also project one set of categorized images for each type (plant and animal).
3. Consider having your students prepare a longer, more accurate animation, slide show, or sequence.
   - Instead of selecting four images in each phase, have them use all their images, making a sequence that is 100 images long.
   - Or, to shorten this somewhat, have them use all the images from the mitosis process, but only some of those from interphase.
4. Lead a discussion on the process of mitosis and what your students have done.
   - They have represented mitosis by taking images of cells at different points within the process, and they have divided a continuous process into distinct phases. They have determined that cells spend much of their time in interphase, relative to how long they spend in mitosis.

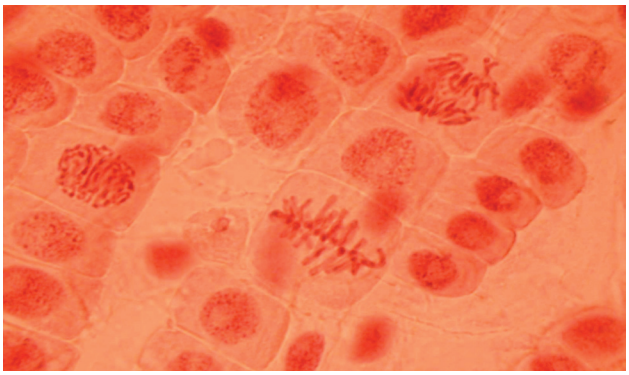
Assessment:

Have your students prepare a write-up on mitosis and its phases that will accompany their categorized images and/or mitosis animation, slide show, or sequence. Have them describe the entire process of cell division and the details of each phase of mitosis.

Give them a “quiz”—present them with images of cells undergoing mitosis and ask them to identify the stage of each.

Extension:

To extend your investigation of reproduction, have your students explore one of the following: Search the *Daphnia* used in Activities 12 and 16 for eggs (which will appear as greenish circles), force the germination of pollen grains, or observe the hatching of brine shrimp.



Stained Onion Root Tip Cells

Student Sheet
Activity 13: Mitosis

Through mitosis and the rest of the cell division process, one cell is divided into two genetically identical cells. In this activity, you explore the process of mitosis, observing, categorizing, and counting cells in each phase.

1. Mount the prepared onion root tip (plant mitosis) slide or prepared whitefish blastula (animal mitosis) slide on the *Swift* Digital Microscope.

2. With a partner, examine the cells at 400X, and if possible, 1000X.
   - Find one cell that has visible internal structures (dark regions) and sketch it. (Note: While some cells don't appear to have any internal structures, this is simply the result of the fact that the cells are 3-dimensional—recall Activity 1—and that some cells are being viewed or "cut" at a level where their internal structures aren't visible.)
   - Locate another cell in this region that has the same shape but that you and your partner agree has different internal structures. Sketch it.
   - Repeat this three more times, so that you have a total of five sketches, each showing a cell with a different internal structure.

3. Compare and contrast your sketches with those drawn by another team.
   - *Are any of the sketches identical? Are any of them similar? Are any of them completely different?*
   - Looking at the ten sketches (five from you and five from the other team), are there five sketches that you, as a team, think are most clearly different?
   - Place all ten sketches in some order that makes sense to all of you. Record this order.

4. Apply official phase names to stages of mitosis.
   - Using your textbook or other reference materials, study interphase and the four main phases of mitosis: prophase, metaphase, anaphase, and telophase.
   - Compare your sketches with the ones provided for each phase. Note: These phases are part of a continuum, not completely distinct steps. Your sketches will probably—and should probably—not completely match the official ones.
   - Compare the order in which you placed the ten sketches to the order of the phases of mitosis.

! REMEMBER to practice proper safety techniques in all science laboratory activities!

5. Return to the microscope, and with your partner, take images of and identify the phase of the onion root tip or whitefish blastula cells.
   - Take an image of the cells.
   - Create five new image files, one for interphase and one for each phase of mitosis.
   - Using the Marquee tool, trace around a cell, and copy this image.
   - Identify the phase of the cell, using your textbook and other references.
   - Paste the image into the appropriate file.
   - Repeat this process until you have imaged and categorized all the complete cells on your image.
   - Take a new image of another part of the onion root tip or whitefish blastula.
   - Repeat the above until you have imaged and categorized 50 cells.
   - Record the number of cells that you have in each phase.

6. Compare your results to those of another team using the same type of prepared slide, and discuss the cells and their categorization into phases.
   - *Are there any cells you think belong in a different phase?* Discuss these cells, and, if appropriate, move them from one phase into another.
   - *Are there any cells you think are in the correct phase but represent an early or late stage of that phase?*
   - *How do the number of cells you have in interphase compare to the number of cells the other team has in interphase? In each phase of mitosis?*

7. Assemble a table of class data and calculate the percentage of time a cell spends in each phase.
   - Combine all the data for the onion root tip slides.
   - Count the number of cells in each phase.
   - Calculate the percentage of time a cell spends in interphase and each of the phases of mitosis.

$$\% \text{ time cell in interphase} = \frac{\#\text{ in interphase}}{\text{total \# of cells}} \times 100$$

   - *What do these calculations tell you about how long a cell spends in interphase as compared to in mitosis?*
   - *In which phase of mitosis does a cell spend the most time? The least time?*
   - Repeat the above for whitefish blastula (animal mitosis) cells.

8. Compare and contrast the mitosis process in the onion root tip and whitefish blastula cells.
   - *How is onion root tip mitosis similar to whitefish blastula mitosis? How is it different?*
   - *Do the cells of these two organisms spend similar amounts of time in each phase?*

9. Prepare an animation or sequence of images showing the process of mitosis in onion root tip cells or whitefish blastula cells.
   - From your image files, select 4 images in each phase. Try to represent the range within each phase.
   - Assemble these images in order from interphase through mitosis.
   - As possible, create an animation or slide show of these images. Or print them out and prepare a flip book.
   - Consider what this sequence shows and what it doesn't show.
     > *If your animation or sequence was going to be 100 images long and include both interphase and mitosis, how many images would you need for each phase?* (Hint: You just calculated these as percentages.)