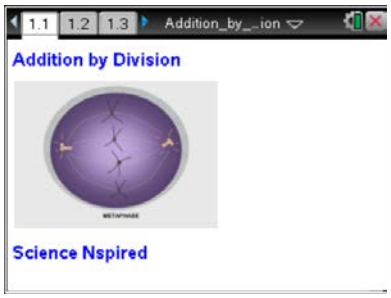
Science Objectives

- Students will identify the changes that occur in cells during each phase of the cell cycle.
- Students will correlate these changes to the duration of time cells spend in each phase.
- While looking at a section of an onion root tip, students will count the number of cells observed in each phase of the cell cycle They will then estimate the amount of time that a cell spends in each of the phases of the cell cycle.
- Students will watch a simulation of the process of mitosis and answer accompanying questions.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages

Tech Tips:

Make sure that students understand how to select an answer to a question using enter.

Lesson Materials:

Student Activity

- Addition_by_Division_Student.doc
- Addition_by_Division_Student.pdf

TI-Nspire document

- Addition_by_Division.tns

Vocabulary

- anaphase
- cell cycle
- chemotherapy
- interphase
- metaphase
- mitosis
- prophase
- spindle apparatus
- telophase

About the Lesson

- In this lesson students investigate the cell cycle, which includes interphase and mitosis.
- Students will:
  - Identify the major changes that occur in a cell during each phase of the cell cycle by watching a simulation.
  - Correlate the time a cell spends in each phase with the number of cells in a rapidly dividing region of an onion root tip undergoing each phase.
  - Understand the implications of the differences between cells that have long or short cell cycles.
  - Evaluate how an understanding of the cell cycle helps healthcare providers in the treatment of cancer with chemotherapy.

TI-Nspire™ Navigator™

- Send out the *Addition_by_Division.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- *Addition_by_Division.tns* document
- TI-Nspire™ Technology

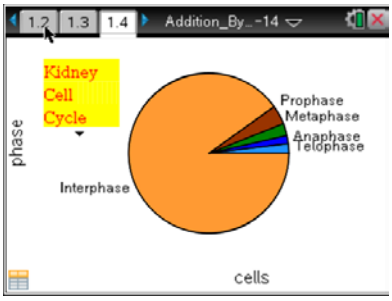
Discussion Points and Possible Answers

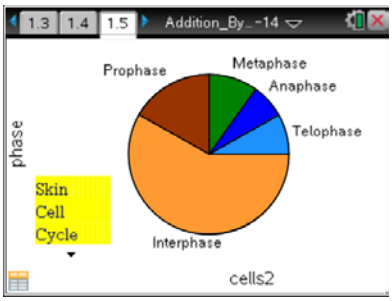
Move to pages 1.4 and 1.5.

Have students answer the questions on the activity sheet.

1. When the students analyze the pie charts of the cell cycles of kidney and skin cells, remind them that the mitosis portion of the cell cycle generally lasts for the same amount of time for each type of cell. The variation in the lengths of the cell cycle occurs in the interphase. For example, some cells may have a cell-cycle duration of 48 hours, of which half is in interphase and half is in mitosis. Liver cells, on the other hand, may divide only once a year, even though the mitosis portion may last only 24 hours, just as with a skin cell.

Press ctrl ▶ and ctrl ◀ to navigate through the lesson.





Q1. If the mitosis portion of the cell cycle lasts for 24 hours in both kidney cells and skin cells, estimate how long interphase lasts in each cell.

Answer: Kidney Cell: Approx. 8–9 days Skin Cell: Approx. 30 hours

Q2. Estimate how long each of the 4 mitotic phases (P,M,A,T) lasts in skin cell mitosis.

Answer: Prophase: 10 hours Metaphase: 6 hours
Anaphase: 4 hours Telophase: 4 hours

Q3. How long is each of the 4 phases in kidney cell mitosis?

Answer: Prophase: 10 hours Metaphase: 6 hours
Anaphase: 4 hours Telophase: 4 hours

Q4. Estimate the length of one entire cell cycle in each of the cells that was modeled.

Answer: Kidney Cell: Approx. 10 days Skin Cell: Approx. 55 hours

Q5. You're looking in a microscope at a tissue sample of living cells. In which stage of the cell cycle would you expect to find the most cells? In which stage would you expect to find the fewest cells?

Answer: Most: Interphase Fewest: Anaphase

Q6. Which of the two types of cells, kidney or skin, divides more often? How did you determine this? Why do you think this is this so?

Possible Answer: Skin cells divide more often. The cell cycle is shorter, which means that they go through mitosis more frequently. This is so because skin cells need to be replaced more frequently than kidney cells do.

Q7. When, during a human's lifetime, would you expect to find lots and lots of cells undergoing mitosis? When would you expect to find fewer? Explain both your answers.

Possible Answer: Find lots in a developing fetus, in an infant, during the "growth spurt" years. Find fewer in middle-age and beyond.

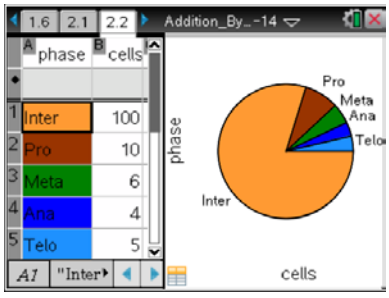
Q8. The process of mitosis produces new body cells for you. What are two reasons why your body needs to produce new cells?

Possible Answers: growth, repair, replacing dead cells

Q9. Chemotherapy is a treatment for cancer. Cancer cells typically have a short cell cycle, and chemotherapy often "attacks" non-cancerous cells that also have a short cell cycle. This is called a "side effect". What are some of the side-effects of chemotherapy? Based on what you now know about the cell cycle, what causes these side effects?

Possible Answer: Side-effects include nausea and hair falling out from the body. Chemotherapy targets cells—hopefully cancer cells—that divide frequently. Since the cells of the digestive lining, and the cells in hair follicles, also divide frequently, these become potential "targets" of the chemotherapy drugs, as well. In addition, anemia can result because of the destruction of red blood cells.

Discussion Points and Possible Answers



2. In this portion of the activity, students will interact with the .tns document. The spreadsheet on page 2.2 contains arbitrary data collected from an imaginary biology student. The student looked at a prepared microscope slide with a longitudinal section of actively dividing onion root tip tissue and counted the number of cells that she observed in each phase of the cell cycle. The numbers have been recorded in Column 2 of the spreadsheet, and then displayed in the adjacent pie chart. In order for your students to interact with this page, you may choose one of four possible options.

   Have students examine their own onion root tip slides and count the number of cells in each phase. If this is what you wish to do, have the students count cells while looking at the section on either medium or high power, and have them look in the area just "above" the tip of the root. If time permits,

have them do cell counts from 3-4 different areas on the same slide, or on different slides. and enter the total number of cells from all of the counts. The more cells they count, the more accurate their results may be.

Many biological supply companies sell "flash cards" with pictures of onion root tip sections on them. This is a quick, easy, and accurate way to count the cells, although the students will not be given the opportunity to use the microscope.

Have the students simply change the numbers in the spreadsheet to their liking. However, ask them to be realistic, as cell cycles always include more interphase than mitosis. You may wish to challenge them to change the numbers to generate pie charts that look identical to the pie charts included in Problem 1.

Have students actually prepare their own slides from living onion root tips. The protocol for that process will not be included here, but can be found on several websites.

Q10. The entire cell cycle in an onion root tip cell lasts for about 24 hours. Based on your cell counts, how long does the entire process of mitosis last? How long does each of the 5 phases of the cell cycle last? Explain how you determined your answers.

Answer: Answers will vary depending on the student cell counts.

Move to pages 3.1 and 3.2.

Have students answer the questions on either the handheld, on the activity sheet, or both.

3. Students should move to page 3.1, read the information on that page, and then proceed to page 3.2 for the mitosis simulation. After students have watched the simulation as many times as needed—they may pause and reset as many times as they'd like—they should answer the questions that follow. They may answer them on the handheld, to be collected via TI-Nspire Navigator, or they may be answered on the student .tns document.

Q11. What evidence can you see that the cell in the simulation is an animal cell?

Answer: The cell is round and there are centrioles present.

Q12. During which phase does the nuclear membrane disappear?

Answer: A. Prophase

Q13. In the cell shown, how many PAIRS of chromosomes are present?

Answer: A. 1

Q14. What is the fibrous network called that is visible in the cell from prophase through anaphase?

Answer: D. spindle apparatus

Q15. During which phase to the chromatids separate from one another?

Answer: C. Anaphase

Q16. At the end of the process shown, how many chromosomes are shown as present in each "new" cell?

Answer: A. 2

Q17. If you had been watching a simulation of a human cell undergoing mitosis, how many chromosomes would have been present in each new cell?

Answer: C. 46

TI-Nspire Navigator Opportunities

Use TI-Nspire Navigator to capture screen shots of student progress and to retrieve the file from each student at the end of the class period. The student questions can be electronically graded and added to the student portfolio.
Make a several students Live Presenters while doing Problem 2. Cell counts will be different from student to student, and it is interesting to see how these differences show up in the pie charts.
Additionally, the class screen capture feature allows you to see all (or at least most) of the students' handheld screens at one time. This is also a good way to compare the results that students get. In Problem 3, student answers may be collected and analyzed using TI-Nspire Navigator, if desired.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show. A possible extension would be to "pool" the class data from Problem 2 if the students are doing actual cell counts. This will make the numbers in the spreadsheet much larger, and it is interesting to observe whether the increased numbers of cells appreciably changes the distribution shown in the pie chart.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved by TI-Nspire Navigator. The TI-Nspire Navigator Slide Show can be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test, inquiry project, performance assessment, or an application/elaborate activity.
- Assessment questions are included on the Student Handout.