TIPS, TRICKS & TECHNIQUES

The Cell Cycle: An Activity Using Paper Plates to Represent Time Spent in Phases of the Cell Cycle

YVETTE D. SCHERER

Abstract

In this activity, students are given the opportunity to combine skills in math and geometry for a biology lesson in the cell cycle. Students utilize the data they collect and analyze from an online onion-root-tip activity to create a paper-plate time clock representing a 24-hour cell cycle. By dividing the paper plate into appropriate phases of the cell's cycle on the basis of the data they collected, they can visualize the data, hypothesize, and predict how the time spent in each of the phases in the cycle might change in abnormal situations, such as in cancer or other diseases that affect control of the cell cycle.

Key Words: *Cell cycle; mitosis; onion root tip; interphase; prophase; metaphase; anaphase; telophase.*

In teaching the cell cycle, I have noticed that students are adept at identifying, matching pictures, and describing events of the phases of the cycle. Using data to construct bar graphs that show the numbers of cells in each phase poses no problems, but interpretation of these data for analysis of time spent in each phase is often misunderstood. The simple paper-plate activity presented here is an extension of an online cell-cycle activity often done as either an introductory or a review lesson in biology classes. The comparison to clock time engages the student's prior knowledge of familiar time intervals and utilizes geometry skills to create the clock model for data analysis. By manipulating tools, data, and pictures of cells from the online activity, students not only create a time clock of the onion cell cycle but also engage in discussion about placement of cells into the proper cell phase.

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The outcome of this two-part lesson is a combination of science, math, and writing skills that encourages peer discussion and critical thinking. The paper-plate model reinforces students' previous observations and analysis in microscope lab activities in which they examine, count, and record the numbers of cells from an onion root tip or from animal cells in each of the phases of the cell cycle. The teacher may choose to have students analyze and construct paper-plate models from their microscope labs instead of, or in addition to, the online activity. The paper-plate activity is an extension of the usual data-and-bar-graph analysis and can be used to pose questions about cause and effect in control of the cell cycle. For example, why are so many cells seen in interphase compared with metaphase? What activities are going on in the cell at this time, and what structures do you see as involved with these activities?

Materials

- Dinner-size paper plate
- Protractor
- Ruler
- Colored pencils

Part A: Collecting & Recording Data in Onion Online Activity

Students should work in groups of two to four. The online onion-root-tip activity, with diagrams,

Table 1. Sample data chart for analysis of time spent in different phases.

	Interphase	Prophase	Metaphase	Anaphase	Telophase	Total
Number of cells						36
Percentage of cells						100%

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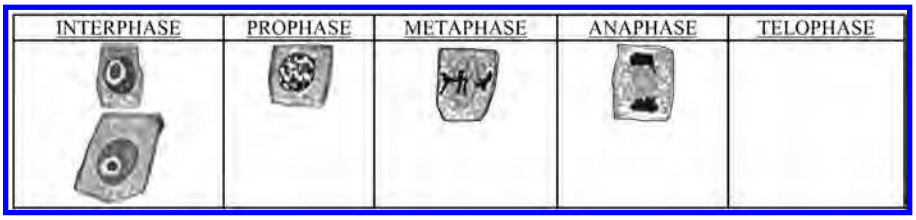

Figure 1. Online onion-root-tip cell-cycle data-collection sample.

cell-cycle descriptions, and student worksheets, can be found at http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html. Figure 1 shows a portion of this online activity in which students are presented onion-root-tip cells one at a time and asked to place them into the correct phase of the cell cycle on the basis of structures they observe. They are cued to correct choices, with explanation if necessary, and the result is a visual chart of 36 onion root cells that are divided into their appropriate phases of the cell's cycle. At the end of this activity, students cut out and assemble these cell pictures onto their paper-plate models (Figure 2).

Figure 1 shows how the recorded pictures of cell data are analyzed to show time spent in each phase. In my experience, this part of the activity serves as an excellent preview for the microscope part of the cell-cycle lesson. Students can work in groups if enough computers are available, or the activity can be done as a whole class, with group discussion to decide logically in which stage of the cycle a cell that is presented should be placed on the data chart, considering specific cell structures seen and activities that the cell is undergoing at this point in the cycle (Table 1).

At the conclusion of Part A, students have a printed record sheet for 36 onion-root-tip cells, each placed in the appropriate column for phases in the cell cycle. They have data charts calculating the percentage of cells found in each phase of the cycle (e.g., 20 cells in interphase, 20/36 = 55.5%) and data calculating the time spent in each phase (e.g., 55.5% × 24 = 13.3 hours). Students cut out the pictures of cells from the data chart for use in Part B.

Figure 2. Student product: a paper-plate model of the onion root tip's time spent in phases of the cell cycle.

○ Part B: Visualizing Time Spent in Each Phase of the Cycle by Constructing a Paper-plate Pie Graph

The paper plate represents 24 hours in the cell cycle. Applying rules of geometry, students use the protractor to divide the plate into 24 equal hours. Allow time for student discussion of the most efficient way of accomplishing this task. Some quickly find that dividing the plate down the middle vertically with a ruler, and then in half again horizontally, provides four quarters of 90° each that can easily be divided into 6 hours of 15° each. Many students are surprised when handed a protractor in biology class! That is the value in this part of the activity – to use skills across the curriculum.

Once the plate is divided into segments and the hours are labeled (24 at the top), students use data for time spent in each phase from Part A and label each phase (Interphase, Prophase, Metaphase, Anaphase, and Telophase) on the clock at the appropriate time intervals. The appropriate number and pictures of the cells from their data record from Part A are pasted into the correct phases, and a brief description of each phase is written on the plate.

Peer discussion and division of labor are key for completion of the group paper-plate model during one block class period. Reflection and application to the real world and individual written assessment serve as lead-ins for the next class. Students summarize data and explain how this activity helps them understand cell-cycle timing. Using their model as comparison, students explain changes they might expect in the timing of cancer cell cycles.

References

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YVETTE D. SCHERER retired after 22 years of teaching high school biology, most recently at West Boca Raton High School's Medical Academy, in Boca Raton, Florida. Her experience also includes biochemical laboratory research work. She can be reached by e-mail: ydscherer@yahoo.com.

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