Purpose: To explore the phases of mitosis

Introduction:
Mitosis is the division of the cell nucleus in which the chromosomes in the parent cell divide into two identical sets. In body cells, also called somatic cells, mitosis is the process by which the number of cells is increased without changing the information contained in the DNA or the amount of DNA in those cells. In unicellular organisms, such as Amoeba, mitosis is a means of reproduction. All offspring have exactly the same DNA as the parent and hence contain the same genetic information. Mitosis is a continuous process that scientists divide into four phases: Prophase, Metaphase, Anaphase and Telophase.

Procedure:
As previously observed in lab, cells are undergoing rapid cell division in the root of an onion (Allium). Observe the prepared slides of Allium root; locate, observe and sketch the various stages of mitosis in the spaces provided. A description of each phase is provided to help locate the appropriate cells. Label ALL structures that you can identify.

As you work keep in mind that mitosis produces two identical nuclei with the same number of chromosomes as the parent.
**PART 1 - Phases of Mitosis**

**PROPHASE** is the *first phase* of mitosis. Prophase can be subdivided into three steps. During *early prophase*, the replicated chromatin material coils to form **chromosomes**. In organisms, other than plants two dark spots appear next to the **disappearing nucleus**. These small, dark cylindrical bodies, called **centrioles** move away from each other, going toward opposite ends of the cell. The middle step of prophase is marked by the initial development of **spindle fibers** (microtubules of protein).

**SKETCH PROPHASE**

**METAPHASE** is the *second phase* of mitosis. During metaphase spindle fibers move the chromosomes to the **center of the cell**. Metaphase is characterized by the arrangement of all chromosomes along the **equator of the cell**.

**SKETCH METAPHASE**
ANAPHASE is the third phase of mitosis. First the centromere of each pair of chromatids divides, the chromatids then move toward opposite poles of the cell. The movement of chromosomes is rapid and dramatic.

SKETCH ANAPHASE

TELOPHASE is the fourth stage of mitosis beginning with the two identical sets of chromatids clustered at opposite ends of the cell. During telophase, the centrioles and spindle fibers disappear. The chromatids unwind and elongate into the threadlike structures of DNA that are now called chromatin. A nuclear membrane forms again around each mass of chromatin, and finally a nucleolus appears.

SKETCH TELOPHASE
CYTOKINESIS takes place immediately after the completion of mitosis. The cell membrane “pinches” in after TELOPHASE, dividing the cell at its center and forming two daughter cells. Each newly formed cell houses one of the two nuclei formed during mitosis. In dividing the cytoplasm, cytokinesis also separates the other structures distributed throughout the cytoplasm, such as ribosomes, golgi bodies and mitochondria. The two new cells that have formed during cytokinesis are generally equal in size.

Note: A cell plate divides the two daughter cells and forms a new cell wall in a plant cell.

Conclusion:

1. In what phase does the replication of the chromosomes occur?

2. Why do cells divide equally and in an orderly process during mitosis?

3. Explain why size might trigger cell division.
4. The cell cycle is a continuous process. Why have biologist differentiated five distinct events in cell division?

5. Does the same cell go through the cell cycle more than once? **Explain?**

6. What function does a cell plate provide?

7. What does the term binary fission refer to? In what types of organisms does this process occur? How is this similar or different from cell division?
Part 2: Online Onion Root Tip

In this activity, you will be presented with cells from the tip of an onion root. You will classify each cell based on what phase it is in. At the end you will count up the cells found in each phase and use those numbers to predict how much time a dividing cell spends in each phase. **You can base your calculation on a total cell cycle of 24 hours.**

Go to: [http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html](http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html)

<table>
<thead>
<tr>
<th></th>
<th>Interphase</th>
<th>Prophase</th>
<th>Metaphase</th>
<th>Anaphase</th>
<th>Telophase</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>Percent of cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>during a 24 hour period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Which phase requires the longest time for completion during a 24 hour period? __________________________

9. Which phase requires the next longest time for completion?
  __________________________

10. Which phase requires the shortest time for completion?
    __________________________
Part 3: Mitosis in two normal living organisms

<table>
<thead>
<tr>
<th></th>
<th>Prophase</th>
<th>Metaphase</th>
<th>Anaphase</th>
<th>Telophase</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salamander kidney cells</td>
<td>60</td>
<td>50</td>
<td>6</td>
<td>70</td>
<td>186</td>
</tr>
<tr>
<td>Pea Root Cells</td>
<td>80</td>
<td>40</td>
<td>4</td>
<td>12</td>
<td>136</td>
</tr>
</tbody>
</table>

Table 2 shows the length of time (in minutes) needed for mitosis to occur in 2 different normal living organisms. Answer the following question based off the table.

11. Why is the time needed for mitosis different between these two organisms?

12. Draw cell division in an animal cell and cell division in a plant cell. Describe the difference using vocabulary.

<table>
<thead>
<tr>
<th>PLANT CYTOKINESIS</th>
<th>ANIMAL CYTOKINESIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Description:</td>
</tr>
</tbody>
</table>
Part 4: Disease chicken stomach cell

Table 1: Cell Cycle in a normal and cancerous chick stomach cells (in minutes)

<table>
<thead>
<tr>
<th></th>
<th>Normal Chicken Stomach Cells in Minutes</th>
<th>Cancerous Chicken Stomach Cells in Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interphase</td>
<td>540</td>
<td>380</td>
</tr>
<tr>
<td>Prophase</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>Metaphase</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Anaphase</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Telophase</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 1 shows average times required for normal and diseased chicken stomach cells to complete the cell cycle. Answer the following based off the table.

11. In a normal chicken cells, which phase requires the longest time for completion?

12. How does the time for interphase compare between the normal chicken cells compare to the cancerous cells?

13. What is the total time needed for a normal chicken stomach cell to complete mitosis? (Total up the time in minutes for each phase.)

14. What is the total time needed for a cancerous chicken stomach cell to complete mitosis?
15. What chemicals regulate the cell cycle? (Look at your notes from class)

16. What happens when cells do not respond to the external signals that normally regular their growth?

17. How do cells respond to contact with other cells normally?

18. Why can cancer be considered a disease of the cell cycle?