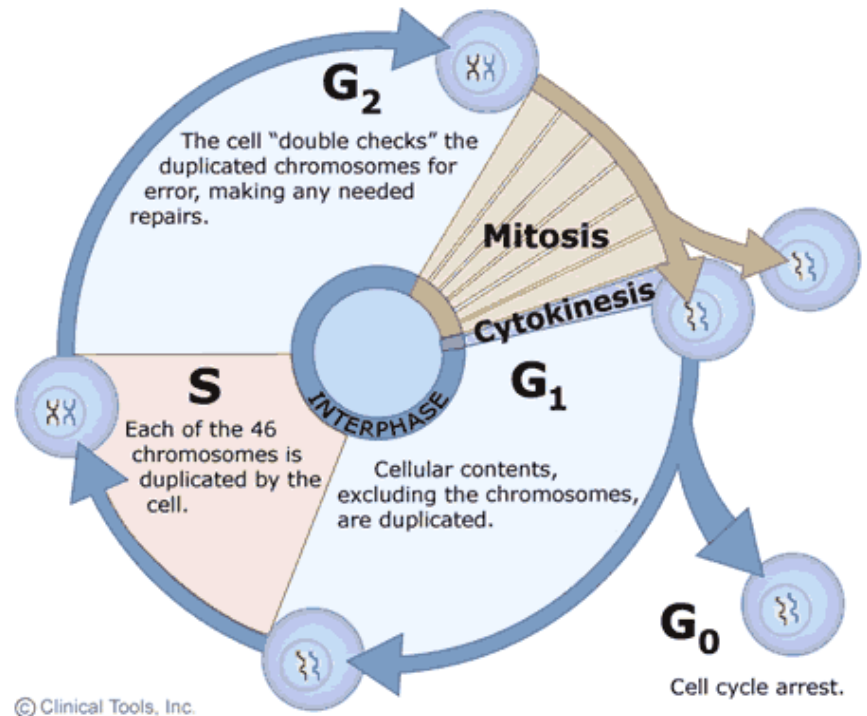


The Cell Cycle

During development from stem to fully differentiated, cells in the body alternately divide (mitosis) and "appear" to be resting (interphase). This sequence of activities exhibited by cells is called the cell cycle. Interphase, which appears to the eye to be a resting stage between cell divisions, is actually a period of diverse activities. Those interphase activities are indispensable in making the next mitosis possible. Interphase: Interphase generally lasts at least 12 to 24 hours in mammalian tissue. During this period, the cell is constantly synthesizing RNA, producing protein and growing in size. By studying molecular events in cells, scientists have determined that interphase can be divided into 4 steps: Gap 0 (G₀), Gap 1 (G₁), S (synthesis) phase, Gap 2 (G₂).



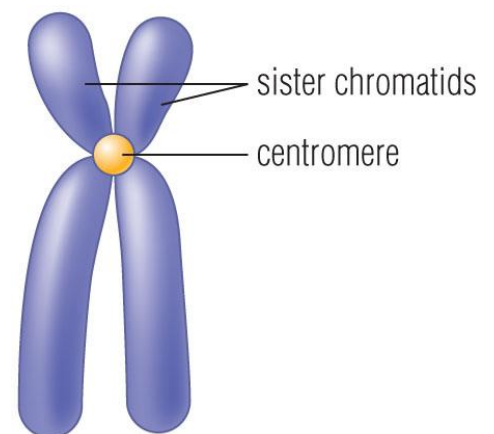
Gap 0 (G₀): There are times when a cell will leave the cycle and quit dividing. This may be a temporary resting period or more permanent. An example of the latter is a cell that has reached an end stage of development and will no longer divide (e.g. neuron).

Gap 1 (G₁): Cells increase in size in Gap 1, produce RNA and synthesize protein. An important cell cycle control mechanism activated during this period (G₁ Checkpoint) ensures that everything is ready for DNA synthesis.

S Phase: To produce two similar daughter cells, the complete DNA instructions in the cell must be duplicated. DNA replication occurs during this S (synthesis) phase. Synthesis produces sister chromatids or two identical chromosomes attached together.

Gap 2 (G₂): During the gap between DNA synthesis and mitosis, the cell will continue to grow and produce new proteins. At the end of this gap is another control checkpoint (G₂ Checkpoint) to determine if the cell can now proceed to enter M (mitosis) and divide.

Mitosis or M Phase: Cell growth and protein production stop at this stage in the cell cycle. All of the cell's energy is focused on the complex and orderly division into two similar daughter cells. Mitosis is much shorter than interphase, lasting perhaps only one to two hours. As in both G₁ and G₂, there is a Checkpoint in the middle of mitosis (Metaphase Checkpoint) that ensures the cell is ready to complete cell division. Actual stages of mitosis can be viewed at Animal Cell Mitosis.



“Cell Cycle Lab”

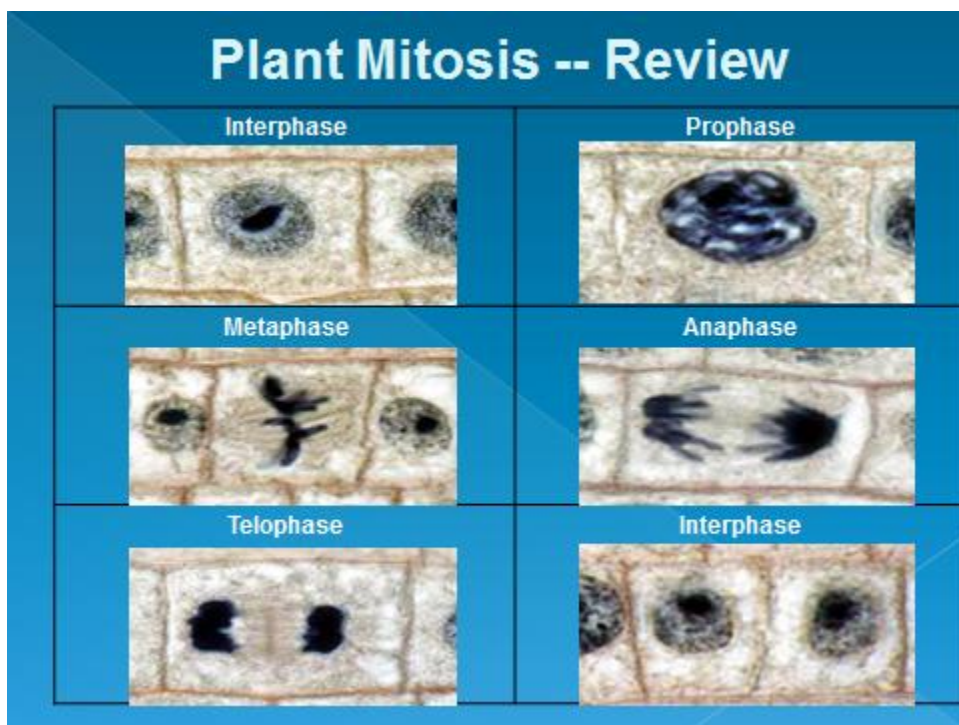
Experimental Question: What percentage of time do onion root cells remain in interphase compared to mitosis?

Prelab (completed in your binder)

1. Diagram the cell cycle. Along with defining each phase (G₀, G₁, S, G₂, M).

Procedure

1. Examine the onion root slides under low, medium and high power.
2. Spend some time identifying the different stages of the cell cycle visible in your root section squashes. Illustrate examples of interphase and mitotic stage (prophase, metaphase, anaphase, and telophase). Shown to the right are pictures of each stage.
3. In your root tip sections, identify the stage of the cell cycle for 50 random cells (in several different viewing fields). Add your data to the table below.
4. To increase your number of data points, pool your data together with your partner's. Then, estimate the percentage of time the onion root tip cells spend in each different stage of the cell cycle.



Data

Along with your sketches for each stage of the cell cycle, record your quantitative data in table below.

Stage of cell cycle		Number of cells: (your root tip)	Number of cells: (your partner's)	Proportion of time in each stage of the cell cycle (%)
Interphase				
M-Phase	Prophase			
	Metaphase			
	Anaphase			
	Telophase			

Conclusions

1. Analyze your data to compare the amount of time onion root cells spend in each phase of the cell cycle. Based on your knowledge of the cell cycle, propose an explanation for any time differences.
2. Do you think the proportion of time spent in M-phase would be greater or smaller in more mature regions of the root?
3. Evaluate the idea that, “Cells that undergo mitosis lose half of their DNA when they produce offspring”.
4. Doctors Biopsy (sample) tissue to examine under the microscope when testing for cancer. Predict the differences you would see between cancerous tissue and normally dividing tissue.

Extension

5. The cells from fish embryos are often used to observe mitosis using a microscope. Propose an explanation for why cells from an embryo may be suitable to examine cells dividing by mitosis.
6. Analyze the Biopsy images below from mice breast tissue. Based on your knowledge of mitosis and cancer which cells are most likely to be cancerous. Each cell's nucleus is stained dark blue. Justify your diagnosis.

