

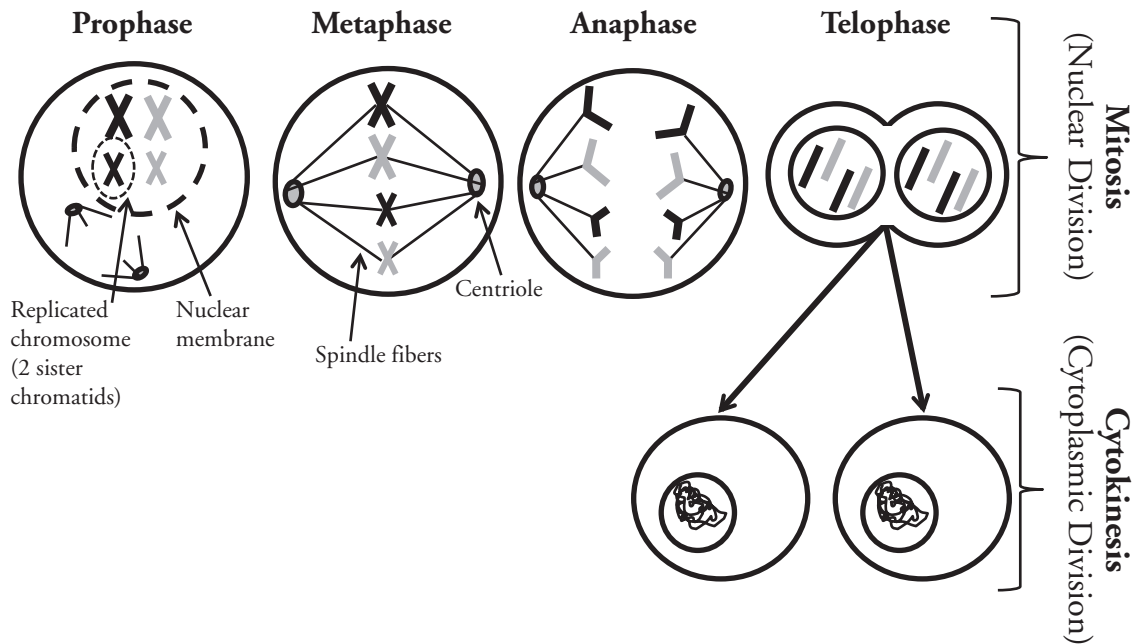
# Mitosis

How do living things grow and repair themselves?

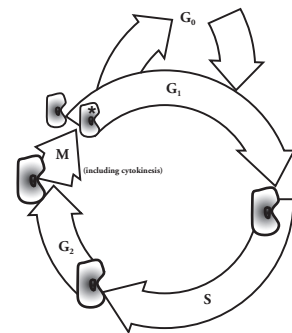
## Why?

Living things must grow and develop. At times they suffer injuries or damage, or cells simply wear out. New cells must be formed for the organism to survive. What process must occur to make a new, properly-functioning cell?

## Model 1 – Mitosis as Part of the Cell Cycle



1. Refer to Model 1. List the four phases in the mitosis process.
2. Where is mitosis in the cell cycle? Before \_\_\_\_\_ and after \_\_\_\_\_.
3. What three phases of the cell cycle are considered **interphase**?
4. Refer to the cell cycle shown.
  - a. How many cells are present at the beginning of mitosis?
  - b. How many cells are present at the end of mitosis?



5. Refer to the chromosomes in the cells in Model 1.
  - a. Draw a single chromosome as it appears in Model 1.
  - b. Draw a replicated chromosome as it appears in Model 1.
  - c. How many chromatids are in each replicated chromosome?
6. How many replicated chromosomes are in the original cell shown in Model 1 during prophase?  
*Hint: When counting chromosomes, count “1” for a pair of sister chromatids.*
7. How many single chromosomes are in each of the new cells in telophase?
8. As a group, write a grammatically correct sentence that explains what a chromosome is and why it is important.
9. Refer to the cells in telophase in Model 1.
  - a. Use a complete sentence to describe what the new cells in telophase might contain if replication of chromosomes did not occur before cytokinesis.
  - b. If the situation in part *a* occurred, would the new cells be viable? Explain.



10. The S phase stands for synthesis, which means to make or build something more complex out of simpler parts. Scientists know that during the S phase DNA is being made in the nucleus of the cell. Why do you think the cell needs to make more DNA at this time in the cell cycle?
11. Refer to Model 1. The chromosomes that are shaped like “X” (made of two sister chromatids) have double the amount of DNA than the chromosomes that are shaped like “I.” During what phase of the cell cycle do you think the chromosomes are replicated (copied)?

12. Refer to Model 1.
  - a. In which phase of mitosis do you see the spindle fibers forming?
  - b. At what phase of mitosis do the replicated chromosomes (sister chromatids) separate?
  - c. In which phase do you see that the spindle fibers have disappeared?
  - d. Look at metaphase and anaphase. Suggest the purpose of the spindle fibers during mitosis.
  
13. Refer to Model 1.
  - a. Describe what happens to the nuclear membrane after prophase.
  - b. Explain why it is necessary that the nuclear membrane disintegrates during mitosis.
  - c. At what point during mitosis has the nuclear membrane reformed?
  
14. What is actually dividing during cytokinesis?
  
15. Cellular division has two parts—mitosis is the division of the nucleus and cytokinesis is the division of the cell into two new cells. Explain why mitosis has to come before cytokinesis in the cell cycle.
  
16. During cytokinesis the chromosomes unwind and become a pile of very long, thin, thread-like DNA and the cell goes back to looking “normal” until mitosis begins again. Brainstorm with your group ideas why the DNA must coil up into chromosome structures before it divides.

17. Fill in the table below where each of the phases of nuclear and cell division is listed in the left hand column and write a description of what is happening during that phase in the right hand column.

<b>Phase of Cellular Division</b>	<b>Description of what is occurring in the cell during this phase.</b>
P	
M	
A	
T	
C	

18. In some cells, mitosis occurs without cytokinesis. What would the resulting cell look like?
19. Explain the importance of mitosis of cells in a skinned knee and during the growth of a plant.



20. With your group, consider the effect on a cell if the sister chromatids did not line up correctly during metaphase. For example, if some lined up side by side instead of single file along the middle, how might this affect the resulting cells?



## **Extension Questions**

21. Colchicine is a poison that acts to inhibit the development of spindle fibers. Describe the effects on mitosis in a cell that has been treated with colchicine.
  
  
  
  
  
  
  
  
  
  
22. Binary fission is cell division in prokaryotic organisms (bacteria), which have no nucleus. In addition, prokaryotic cells typically have only one circular chromosome. Together with your group, predict how binary fission in prokaryotic cells might be different than mitosis in eukaryotic organisms.