

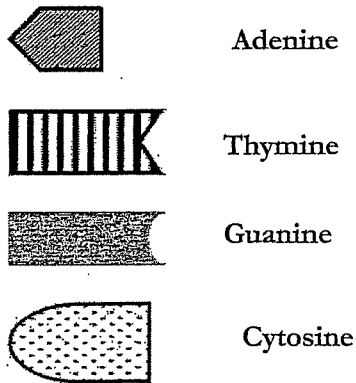
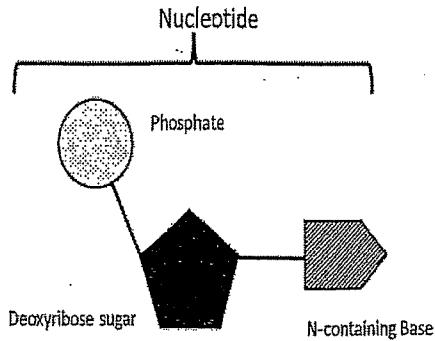
# DNA Structure

How is the genetic information stored?

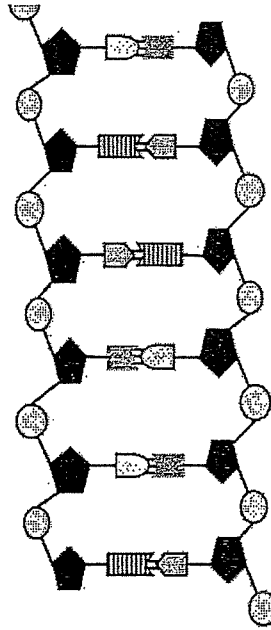
## Why?

DNA is the molecule of heredity. It contains the genetic blueprint for life. For organisms to grow and repair damaged cells, each cell must be capable of accurately copying itself.

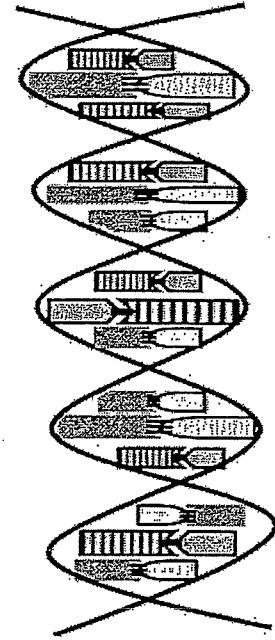
## Model 1: The Structure of DNA



Ladder model of DNA



Helix model of DNA



1. What are the 3 parts of a nucleotide?
2. What kind of sugar is found in a nucleotide?
3. Which nucleotide component contains nitrogen?
4. How many different nitrogen bases are there? Name them.
5. Circle a single nucleotide on each side of the ladder model of DNA.
6. In the ladder model of DNA, how are the nucleotides arranged?

7. Which components of the nucleotides pair together to form the "rungs" of the ladder?
8. On the ladder model of DNA label each of the bases with the letter A, T, C or G.
9. Which components of the nucleotides form the sides (backbone) of the ladder?
10. When one nucleotide contains adenine, to what type of base will the adenine attach on the opposite nucleotide strand?
11. How many hydrogen bonds (lines) connect these two bases?
12. When one nucleotide contains cytosine, to what type of base will the cytosine attach on the opposite nucleotide strand?
13. How many hydrogen bonds connect these two bases?
14. Using complete sentences, with your group write a rule for how the bases are arranged in the ladder model of DNA.
15. The ladder model of DNA is a simplified representation of the actual structure and shape of a DNA molecule. According to the final diagram in Model 1, what is the actual shape of the DNA molecule?
16. The DNA molecule is usually referred to as a double helix. Explain why.

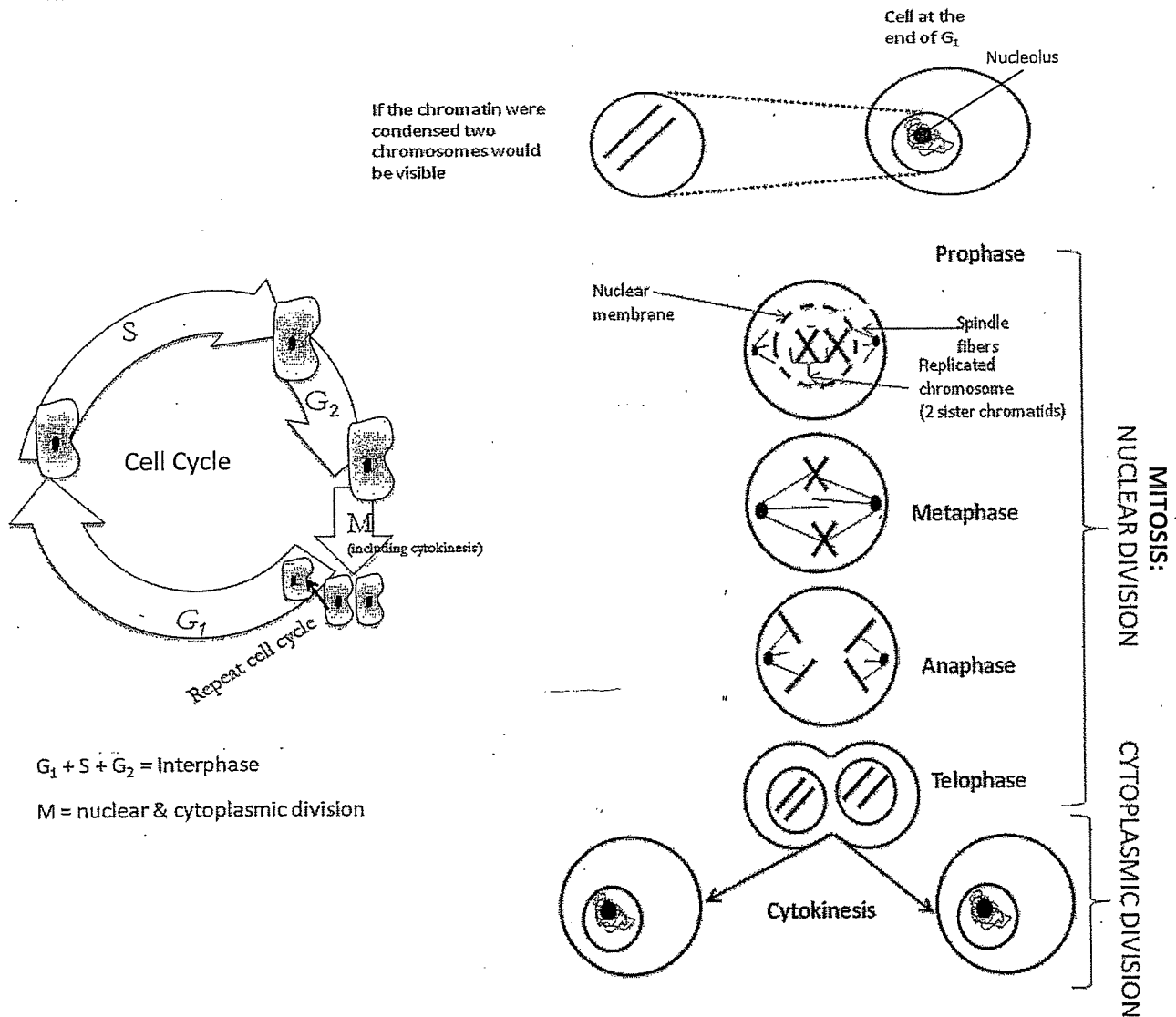
# Mitosis

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 living thing to survive.

## Model 1



1. List the phases in the mitosis process by looking at Model 1. There are four phases.

2. Where is mitosis in the cell cycle? Before \_\_\_\_\_ and after \_\_\_\_\_

3. What three phases of the cell cycle are considered "interphase"?
4. a) How many cells are present at the end of G<sub>2</sub>?  
b) How many cells are present at the end of M?
5. What shape do the replicated chromosomes look like in prophase of the original cell?
6. How many chromatids are in each replicated chromosome?
7. How many replicated chromosomes are there in the original cell during prophase? (Hint: When counting chromosomes, count "1" for a *pair* of sister chromatids)
8. How many single chromosomes are there in each of the new cells in telophase?
9. Your answers to 7 and 8 should be the same. Why is this important?



### Read This!

**Chromosomes** are made of DNA wound around proteins. They contain all the genetic information of the living organism. Before the cell divides the chromosomes in the original parent cell must first be doubled (replicated). This happens so that when the cell divides into two new cells, both will be identical to the parent cell.

10. As a group, write a grammatically correct sentence that explains what a chromosome is and why it is important.
11. The chromosomes that are shaped like "X's" (made of two sister chromatids) have double the amount of DNA than the chromosomes that are shaped like "I's". During what phase of the cell cycle do you think the chromosomes are replicated (copied)?
12. Describe the difference in appearance between the chromosomes during prophase in the original cell and the chromosomes in the two new cells in telophase.
13. The S phase stands for **synthesis**, which means to make something. 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?
14. At what stage of mitosis do the replicated chromosomes (sister chromatids) separate?



15. During what phase do you see the spindle fibers forming?
16. During what phase do you see that the spindle fibers have disappeared?
17. Look at metaphase and anaphase. What do you think the function of the spindle fibers is during mitosis?
18. Describe what happens to the nuclear membrane after prophase.
19. Why do you think it is necessary to disintegrate the nuclear membrane during mitosis?
20. By the end of what phase of mitosis has the nuclear membrane reformed?
21. What structure reappears in the nucleus after cytokinesis?
22. What is actually dividing during cytokinesis?
23. 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.
24. During cytokinesis the chromosomes unwind and become a pile of very long, thin, threadlike DNA and the cell goes back to looking "normal" until mitosis begins. Brainstorm with your group ideas why the DNA must coil up into chromosome structures *before* it divides.
25. Make a table below where you list each of the phases of nuclear and cell division in the left hand column and a word description of what is happening during that phase in the right hand column.

Phase of Cellular Division	Word description of what is occurring in the cell during this phase.
P	
M	
A	
T	

C	

26. In some cells, mitosis occurs **WITHOUT** cytokinesis. What would the resulting cell look like?

27. Explain the importance of mitosis of cells in a skinned knee and during the growth of a plant.



28. 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

29. 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.

30. 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.