

PART II. REPLICATION IS REFRESHING: How DNA Duplicates

A. PREPARATION

1. Read the section in your text which explains DNA replication (self-duplication of DNA).
2. The diagram on the next page represents only a very short piece of a DNA molecule, but will be referred to herein as the "DNA molecule". Note how it is constructed as two parallel chains of matching nucleotide pairs. This arrangement is a very simplified version of its true structure, so that you can discover its basic operation more easily.
3. Cut out the entire DNA molecule, in one piece, then carefully cut out the shaded spaces between the bases. The resulting ladder-like structure can now be twisted slightly to illustrate the helical (screw-like) shape of DNA.
4. In order to demonstrate the unique ability of DNA to duplicate itself ("replicate"), first cut out all the L-shaped DNA-nucleotides on the next page (pink). These will represent the "DNA-nucleotide pool" available in the cell's nucleus. (When not in use, keep all pieces in an envelope).

B. THE PROCESS OF REPLICATION (Read all steps first):

1. Replication begins when the DNA molecule "unzips". Show this by cutting down the middle of the "ladder", following the curved and angled shapes of the ENDS of each base pair where they meet (near the middle of each "rung" of the ladder). This will produce two strands, left and right. Move these two strands about 10 cm apart on your table.
2. Now, move the DNA-nucleotides from the nucleotide pool (already cut out) into positions so that their base ends fit with the exposed base-ends of each of the original, unzipped DNA strands. In a cell, this typically starts at one end of a strand and works toward the other. The other strand builds in the opposite direction. First bring an "A" nucleotide which fits the upper left hand "T" nucleotide, then move another "A" nucleotide to fit the lower right hand "T" nucleotide. Continue adding the nucleotides which fit as you go (moving down the left hand strand, and up the right hand strand) until both halves of the ladder have been matched with new nucleotides. (Not all of the pink nucleotides will be used up. They remain as part of the nucleotide "pool" for the next replication episode). This process is very fast. In a cell, new nucleotides are added at a rate of about 50 per second, involving more than a dozen enzymes.
3. Notice the pattern? What always matches (fits) with T (thymine)?___ What always matches with C (cytosine)?___ What always matches with A (adenine)?___ What always matches with G (guanine)?___ How many DNA molecules did we start with?___ How many DNA molecules do we have now?___ In terms of their respective sequences of base pairs, they are _____ (identical, similar, different).
4. As the nucleotides move into position, they would normally attach to the previously placed nucleotide (phosphate of one to sugar of the other), and the matching base pairs would join each other with weak Hydrogen bonds, forming two new double-stranded DNA molecules which are identical to each other. However, in order to practice this process and demonstrate it to others, do not actually attach the nucleotides in this model. DO practice the process. Be prepared to demonstrate and explain DNA replication to another student and/or your teacher upon request. Review the text material on DNA replication. Be sure to keep in mind that the primary purpose of replication is to provide identical sets of instructions (sets of identical DNA) to the two new cells when one cell divides.