**Replication and synthesis**

After Watson and Crick proposed their model for the structure of DNA, scientists focused attention on how molecule replicates. Replication is an essential function of the genetic material and must be executed precisely if genetic continuity following cell division. This is enormous and complex task. Consider for a moment that in the human genome, over 3 billion base pairs exist within the 23 chromosomes. To duplicate a molecule of this size faithfully requires a mechanism of extreme precision. Even an error rate of only 10-6 (one in million) will still create 3000 errors, obviously an excessive number during each replication cycle. While it is not error-free, an extremely accurate system of DNA replication has evolved in all organisms.

As Watson and Crick wrote in their 1953 paper, the model of the double helix provided their initial insight into how replication could occur. This mode, called semiconservative replication, is strongly supported form numerous studies of viruses, prokaryotes, and eukaryotes.

Once the general mode of replication was clarified, research to determine the precise details of DNA synthesis intensified. What has been discovered is that numerous enzymes and other proteins are necessary to copy a DNA helix. Because of the complexity of the chemical events during synthesis, this subject remains an extremely active area of research.

DNA Is Reproduced by Semiconservative Replication

It was apparent to Watson and Crick that, because of the arrangement and nature of the nitrogenous bases, each strand of a DNA double helix could serve as a template for the synthesis of its complement. They proposed that if the helix were unwound, each nucleotide along the two parent strands would have an affinity for its complementary nucleotide. Complementarity is due to the hydrogen bonds that form. If thymidylic acid (T) were present, it would "attract" adenylic acid (A); if guanidylic acid (G) were present, it would attract cytidylic acid (C). The reverse is also true. A would attract T, and C would attract G. If these nucleotides were then linked covalently into polynucleotide chains along both templates, result would be two new but identical double strands of DNA. Each replicated DNA molecule would consist of one "old" and one "new" strand, hence the reason for the name semiconservative replication.

