CHAPTER 8
GENETIC INFORMATION

Khadijah Hanim Abdul Rahman

8.1 INTRODUCTION

In the previous chapter, nucleic acids have been described as biological molecules that are essential for life. Nucleic acids include DNA and RNA and together with proteins, make up the most important macromolecules in all living organisms. Basically, nucleic acids act as genetic material in all living organisms. The genetic material is the material that contains the information inherited in organisms.

The process flow of genetic information from DNA through RNA and ultimately to protein synthesis and the processes involved in transferring genetic information is known as the central dogma of molecular biology. It was first introduced by Francis Crick in 1950. The central dogma also described that the information cannot be transferred back from protein to nucleic acid. **Figure 8.1** illustrates the central dogma of molecular biology.

In **Figure 8.1**, solid arrows indicate types of information transfers that occur in cells. DNA directs its own replication to produce new DNA molecule; DNA is transcribes into RNA; RNA is translated into protein. The dashed lines represent information transfers that occur in certain organisms.

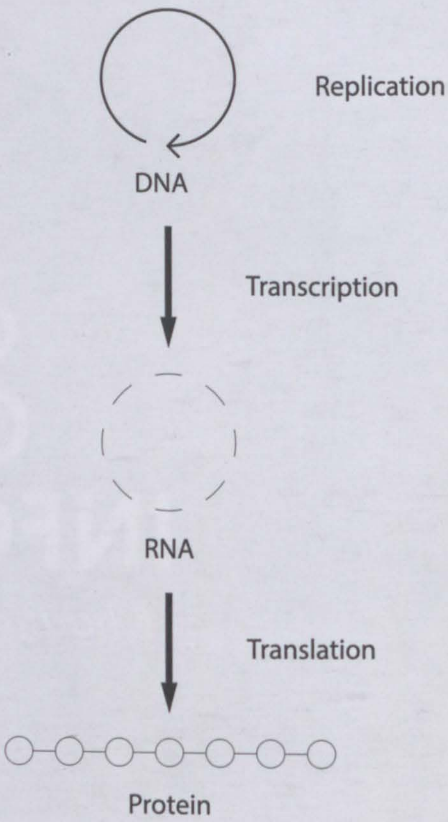

Figure 8.1:
Central dogma of
molecular biology.

8.2 DNA REPLICATION

8.2.1 Semiconservative Replication

Genetic information is transferred from parental DNA molecules to progeny molecule by a replication process. DNA replication is demonstrated to be achieved by semiconservative replication by Matthew Meselson and Franklin Stahl in 1958. During replication, it was observed that each of the parental strands act as a template for the synthesis of a new daughter strand. The nucleotide monomers are added one by one to the growing strands by the enzyme **DNA**

polymerase. As the new strand is formed, it is hydrogen bonded to its parental strand **(Figure 8.2)**.Therefore, each of the double helix contains one parent DNA strand and one newly synthesized daughter DNA strand.

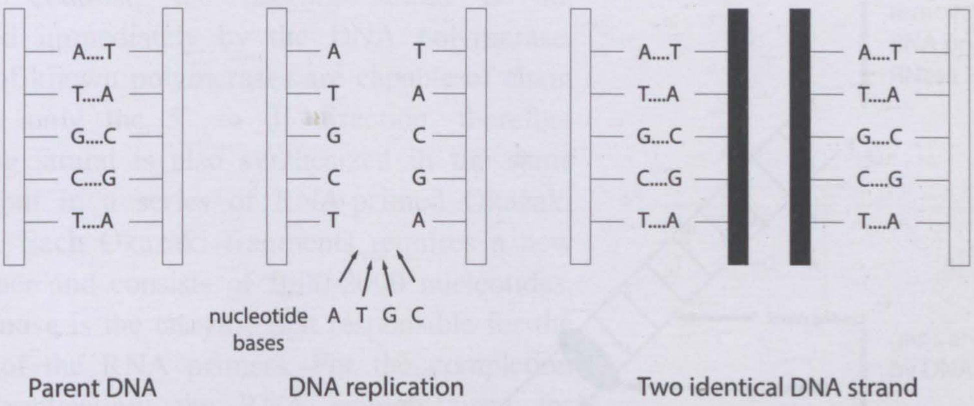

Figure 8.2: Semiconservative replication. The semiconservative nature of DNA replication was demonstrated by Matthew Meselson and Franklin Stahl in 1958. The two replicas consist of one parent strand and one daughter strand (shaded in black)

8.2.2 DNA Replication System

8.2.2.1 *Initial of DNA Replication*

DNA replication begins at a specific nucleotides sequence known as **"origin of replication" (ori)**. In order to begin the synthesis of a new daughter strand, the DNA template needs to unwind to let the enzyme to start polymerization. Normally, three steps are required to prepare the DNA template for replication. The first step is to unwind the double helix, followed by the breakage of the hydrogen (H) bond holding the two DNA strands together revealing the single strand template DNA for synthesis. Ultimately, the single stranded DNA template need to stay unwinded so that re-annealing will not take place before DNA polymerase had a chance to act.

The unwinding of double-stranded DNA is accomplished by the DNA **helicase** enzymes. The unwinding action of helicase involves breaking H-bonds and eliminating hydrophobic interactions between complimentary nucleotide bases revealing the bases in replication fork.