Nucleic Acids IB/AP Biology
Reading and Objectives

Objectives

1. Recognize scientists and the experiments that lead to the understanding of the molecular basis of inheritance.
2. Identify the double helix composition and structure of DNA.
3. Identify the process and steps of DNA replication.
4. Recognize the relationship between genes and enzymes as demonstrated by the experiments of Beadle and Tatum.
5. Identify the flow of genetic information from DNA to RNA to polypeptide.
6. Read DNA or RNA messages using the Genetic code.
7. Recognize the steps and procedures in Transcription.
8. Identify methods of RNA modification.
9. Recognize the steps and procedures in Translation.
10. Recognize categories and consequences of base-pair mutations.

I. DNA Structure *76-79, 344-348, 278-284

2.4.1Outline DNA nucleotide structure in terms of sugar (deoxyribose), base and phosphate. 2
2.4.2 State the names of the four bases in DNA. 1
2.4.3 Outline how the DNA nucleotides are linked together by covalent bonds into a single strand. 2
2.4.4 Explain how a DNA double helix is formed using complementary base pairing and hydrogen bonds. 3
2.4.5 Draw a simple diagram of the molecular structure of DNA. 1
6.1.1 Outline the structure of nucleosomes. 2
6.1.2 State that only a small proportion of the DNA in the nucleus constitutes genes and that the majority of DNA consists of repetitive sequences. 1
6.1.3 Describe the structure of DNA including the antiparallel strands, 3´–5´ linkages and hydrogen bonding between purines and pyrimidines. 2

➔ Transformation, Griffith, Watson and Crick

II. DNA Replication *284-292

2.5.1 State that DNA replication is semi-conservative. 1
2.5.2 Explain DNA replication in terms of unwinding of the double helix and separation of the strands by helicase, followed by formation of the new complementary strands by DNA polymerase. 3
6.2.1 State that DNA replication occurs in a 5´ --> 3´ direction. 1
6.2.2 Explain the process of DNA replication in eukaryotes including the role of enzymes (helicase, DNA polymerase III, RNA primase, DNA polymerase I and DNA ligase), Okazaki fragments and deoxynucleoside triphosphates. 3
6.2.3 State that in eukaryotic chromosomes, replication is initiated at many points.1
2.5.3 Explain the significance of complementary base pairing in the conservation of the base sequence of DNA. 3

➔ Replication fork, DNA polymerase, leading/lagging strands, DNA ligase, primer, primase, helicase, telomeres

IV. Transcription *294-304

2.6.1 Compare the structure of RNA and DNA. 2
2.6.2 Outline DNA transcription in terms of the formation of an RNA strand complementary to the DNA strand by RNA polymerase. 2
6.3.1 State that transcription is carried out in a 5´--> 3´ direction. 1
6.3.3 Explain the process of transcription in eukaryotes including the role of the promoter region, RNA polymerase, nucleoside triphosphates and the terminator. 3
6.3.4 Distinguish between the sense and antisense strands of DNA. 2

6.3.5 State that eukaryotic RNA needs the removal of introns to form mature mRNA. 1

➔ Beadle and Taum, 1 gene-1polypeptide, mRNA, codons, introns, exons, snRNP

IV. Translation *304-312

Translation (2h)

2.6.3 Describe the genetic code in terms of codons composed of triplets of bases. 2

2.6.5 Define the terms degenerate and universal as they relate to the genetic code. 1

6.4.1 Explain how the structure of tRNA allows recognition by a tRNA-activating enzyme that binds a specific amino acid to tRNA, using ATP for energy. 3

6.4.2 Outline the structure of ribosomes including protein and RNA composition, large and small subunits, two tRNA binding sites and mRNA binding sites. 2

6.4.3 State that translation consists of initiation, elongation and termination. 1

6.4.4 State that translation occurs in a 5-->3 ´ direction. 1

6.4.5 Explain the process of translation including ribosomes, polysomes, start codons and stop codons. 3

2.6.4 Explain the process of translation, leading to peptide linkage formation. 3

6.4.6 State that free ribosomes synthesize proteins for use primarily within the cell and that bound ribosomes synthesize proteins primarily for secretion or for lysosomes. 1

➔ Wobble, aminoacyl tRNA synthetase, E-, P-, A- sites, rRNA

VI. Mutations * 312-314

3.1.5 Define gene mutation. 1

3.1.6 Explain the consequence of a base substitution mutation in relation to the process of transcription and translation, using the example of sickle cell anemia. 3

VII. Gene Expression *337-341 (Ch19)

6.3.2 Outline the lac operon model as an example of the control of gene expression in prokaryotes. 2

➔ What are some mechanisms by which gene expression is regulated by prokaryotes and eukaryotes?

➔ How do the structures of nucleic acids relate to their functions of information storage and protein synthesis?

➔ What are the similarities and differences between prokaryotic and eukaryotic genomes?