**Topic 7.1: DNA Structure and Replication**

**Essential Idea: The structure of DNA is ideally suited to its function.**

**Statements & Objectives:**

**7.1.U1 DNA structure suggested a mechanism for DNA replication.**

Outline the features of DNA structure that suggested a mechanism for DNA replication.

(**Outline** Give a brief account or summary.)

**7.1.U2 Nucleosomes help to supercoil the DNA.**

Draw and label the structure of a nucleosome, including the H1 protein, the octamer core proteins, linker DNA and two wraps of DNA.

(**Draw**: Represent by means of a labeled, accurate diagram or graph, using a pencil. A ruler(straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted (if appropriate) and joined in a smooth curve.)

(**Label** Add title, labels or brief explanation(s) to a diagram or graph.)

Explain the levels of supercoiling (DNA→ nucleosome → beads on a string → 30nm fiber → unreplicated interphase chromosome → replicated metaphase chromosome).

(**Explain**: Give a detailed account including reasons or causes)

**7.1.U3 DNA replication is continuous on the leading strand and discontinuous on the lagging strand.**

Compare replication on the leading strand and the lagging strand of DNA.

(**Compare** Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.)

Explain why replication is different on the leading and lagging strands of DNA.

(**Explain**: Give a detailed account including reasons or causes)

Outline the formation of Okazaki fragments on the lagging strand.

(**Outline** Give a brief account or summary.)

**7.1.U4 DNA replication is carried out by a complex system of enzymes.**

Outline the role of the following proteins in DNA replications: helicase, topoisomerase (AKA gyrase), single stranded binding proteins, primase, DNA polymerase III, DNA polymerase I, and DNA ligase.

(**Outline** Give a brief account or summary.)

**7.1.U5 DNA polymerases can only add nucleotides to the 3’ end of a primer.**

Explain the need for RNA primers in DNA replication.

(**Explain**: Give a detailed account including reasons or causes)

Explain what is meant by DNA replication occurring in a 5' to 3' direction.

(**Explain**: Give a detailed account including reasons or causes)

**7.1.U6 Some regions of DNA do not code for proteins but have other important functions.**

Define “coding sequences” and “repetitive sequences” of DNA.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Outline five functions of non-coding DNA sequences found in genomes, one of which must be the telomere.

(**Outline** Give a brief account or summary.)

**7.1.A1 Rosalind Franklin and Maurice Wilkins’ investigation of DNA structures by X-ray diffraction.**

Outline the process of X-ray diffraction.

(**Outline** Give a brief account or summary.)

Outline the deductions about DNA structure made from the X-ray diffraction pattern.

(**Outline** Give a brief account or summary.)

**7.1.A2 Tandem repeats are used in DNA profiling.**

Define VNTR.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Explain why VNTR are used in DNA profiling

(**Explain**: Give a detailed account including reasons or causes)

**7.1.A3 Use of nucleotides containing dideoxyrubonucleic acid to stop DNA replication in preparation of samples for base sequencing.**

Outline the process of DNA sequencing, including the role of chain terminator nucleotides, fluorescence, and electrophoresis.

(**Outline** Give a brief account or summary.)

**7.1.S1 Analysis of results of the Hershey and Chase experiment providing evidence that DNA is the genetic material.**

State the experimental question being tested in the Hershey and Chase experiment.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Explain the procedure of the Hershey and Chase experiment.

(**Explain**: Give a detailed account including reasons or causes)

Explain how the results of the Hershey and Chase experiment supported the notion of nucleic acids as the genetic material.

(**Explain**: Give a detailed account including reasons or causes)

**7.1.S2 Utilization of molecular visualization software to analyze the association between protein and DNA profiling.**

Identify nucleosome structures using molecular visualization software.

(**Identify** Provide an answer from a number of possibilities. Recognize and state briefly a distinguishing factor or feature.)

Outline the mechanism of histone-DNA association.

(**Outline** Give a brief account or summary.)

**7.1.NOS Making careful observations-Rosalind Franklin’s X-ray diffraction provided crucial evidence that DNA is a double helix.**

Describe Rosalind Franklin’s role in the elucidation of the structure of DNA **(Describe**: Give a detailed account)

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**Key Terms**

H1 protein

Hershey-Chase

​leading strand

DNA primase

​3'

​DNA profile

​topoisomerase (AKA gyrase)

​Franklin-Wilkins

single stranded binding proteins

x-ray diffraction

​lagging strand

DNA polymerase I

​5'

​short tandem

supercoiling

​DNA ligase

coding sequences

nucleosomes

​Okazaki fragments

​DNA polymerase III

octamer core proteins

​hyper-variable

repetitive sequences​

chain terminator nucleotides

​replication

helicase

​RNA primer

​parent DNA

​non-coding

linker DNA

​primase

​telomere

​VNTR