Summary

Unit 7 - Nucleic Acids

Subject	Year	Start date	Duration
Biology	IB1	Week 1, May	3 weeks 9 hours

Course Part

Additional

Curriculum

Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

Acquire a body of knowledge, methods and techniques that characterize science and technology

Apply and use a body of knowledge, methods and techniques that characterize science and technology

Develop an ability to analyse, evaluate and synthesize scientific information

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop experimental and investigative scientific skills including the use of current technologies

Develop and apply 21st century communication skills in the study of science

Become critically aware, as global citizens, of the ethical implications of using science and technology

Develop an appreciation of the possibilities and limitations of science and technology

Develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge

Objectives

Demonstrate knowledge and understanding of

- facts, concepts, and terminology
- methodologies and techniques
- communicating scientific information

Apply

- facts, concepts, and terminology
- methodologies and techniques
- methods of communicating scientific information

Syllabus Content

Additional higher level

7. Nucleic acids

7.1 DNA structure and replication

Nature of science:

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

Understandings:

Nucleosomes help to supercoil the DNA.

DNA structure suggested a mechanism for DNA replication.

DNA polymerases can only add nucleotides to the 3' end of a primer.

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

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

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

Applications and skills:

Application: Rosalind Franklin's and Maurice Wilkins' investigation of DNA structure by X-ray diffraction.

Application: Use of nucleotides containing dideoxyribonucleic acid to stop DNA replication in preparation of samples for base sequencing.

Application: Tandem repeats are used in DNA profiling.

Skill: Analysis of results of the Hershey and Chase experiment providing evidence that DNA is the genetic material.

Skill: Utilization of molecular visualization software to analyse the association between protein and DNA within a nucleosome.

7.2 Transcription and gene expression

Nature of science:

Looking for patterns, trends and discrepancies - there is mounting evidence that the environment can trigger heritable changes in epigenetic factors.

Understandings:

Transcription occurs in a 5' to 3' direction.

Nucleosomes help to regulate transcription in eukaryotes.

Eukaryotic cells modify mRNA after transcription.

Splicing of mRNA increases the number of different proteins an organism can produce.

Gene expression is regulated by proteins that bind to specific base sequences in DNA.

The environment of a cell and of an organism has an impact on gene expression.

Application and skills:

Application: The promoter as an example of non-coding DNA with a function.

Skill: Analysis of changes in the DNA methylation patterns.

7.3 Translation

Nature of science:

Developments in scientific research follow improvements in computing - the use of computers has enabled scientists to make advances in bioinformatics applications such as locating genes within genomes and identifying conserved sequences.

Understandings:

Initiation of translation involves assembly of the components that carry out the process.

Synthesis of the polypeptide involves a repeated cycle of events.

Disassembly of the components follows termination of translation.

Free ribosomes synthesize proteins for use primarily within the cell.

Bound ribosomes synthesize proteins primarily for secretion or for use in lysosomes.

Translation can occur immediately after transcription in prokaryotes due to the absence of a nuclear membrane.

The sequence and number of amino acids in the polypeptide is the primary structure.

The secondary structure is the formation of alpha helices and beta pleated sheets stabilized by hydrogen bonding.

The tertiary structure is the further folding of the polypeptide stabilized by interactions between R groups.

The quaternary structure exists in proteins with more than one polypeptide chain.

Application and skills:

Application: tRNA-activating enzymes illustrate enzyme–substrate specificity and the role of phosphorylation.

Skill: Identification of polysomes in electron micrographs of prokaryotes and eukaryotes.

Skill: The use of molecular visualization software to analyse the structure of eukaryotic ribosomes and a tRNA molecule.

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will
  - ask students to formulate a reasoned argument to support their opinion or conclusion
  - give students time to think through their answers before asking them for a response
  - reward a new personal understanding, solution or approach to an issue
  - ask open questions
  - set students a task which required higher-order thinking skills (such as analysis or evaluation)
  - build on a specific prior task
  - help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)
  - require students to take an unfamiliar viewpoint into account when formulating arguments
  - ask questions that required the use of knowledge from a different subject from the one you are teaching
  - include a reflection activity
  - make a link to TOK

Social

- In this unit, we will
  - have students work in small groups
  - allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity
  - have students peer assess their group performance or process
  - support students in resolving a conflict in a team
  - give a group assessment task
  - give students feedback on how they worked as a group
  - have students discuss their understanding of a text or idea among themselves and come up with a shared understanding
  - provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance
  - encourage students to consider alternative points of view or to take the perspective of others
  - provide opportunities for students to make decisions

Developing IB Learners

Learner Profile

Inquirers

Knowledgeable

Thinkers

Reflective