

# Year 1, Unit 8 HL Topic 7 - Nucleic Acids

Content Area: **Science**  
Course(s): **IB Biology, HL**  
Time Period: **Second Marking period**  
Length: **3 Weeks**  
Status: **Published**

## Unit Overview

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Students will have an understanding of the importance and structure of genetic material. Students will learn that although DNA contains instructions, those instructions must be carried out by the process of protein synthesis.

## STAGE 1- DESIRED RESULTS

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

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

7.3 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.

## Standards

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### 2020 New Jersey Student Learning Standards- Science

## Science and Engineering Practices

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- Developing and Using Models
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

## Cross Cutting Concepts

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- Cause and Effect
- Patterns
- Scale, Proportion, and Quantity
- Stability and Change
- Structure and Functions
- Systems and System Models

## **Disciplinary Core Ideas**

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### **Life Sciences**

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- LS1A: Structure and Functions
- LS1B: Growth and Development of Organisms
- LS1C: Organization for Matter and Energy Flow in Organisms
- LS1D: Information Processing
- LS3A: Inheritance of Traits
- LS3B: Variation of traits

### **Engineering. Technology. and Applications of Science**

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- ETS1A: Defining and Delimiting an Engineering Problem

### **Essential Questions**

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7.1 How is the structure of DNA ideally suited to its function?

7.2 How is the information stored as a code in DNA copied onto mRNA?

7.3 How does information transferred from DNA to mRNA get translated into an amino acid sequence?

### **Enduring Understanding**

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Students will have a lasting understanding of the importance of DNA structure and the function of the fundamental units of nucleic acids.

**Students will know...**

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## 7.1

- 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.

## 7.2

- 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.

## 7.3

- 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.

**Students will be able to...**

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## 7.1

- Connect Rosalind Franklin's and Maurice Wilkins' investigation of DNA structure by X-ray diffraction.
- Explain the use of nucleotides containing dideoxyribonucleic acid to stop DNA replication in preparation of samples for base sequencing.

- Elaborate on how tandem repeats are used in DNA profiling.

7.2

- Summarize how the promoter as an example of non-coding DNA with a function.

7.3

- Explain how tRNA-activating enzymes illustrate enzyme–substrate specificity and the role of phosphorylation.

## **STAGE 2- EVIDENCE OF LEARNING**

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### **Formative Assessment**

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- Debriefing
- Index Card Summaries
- Journal Entry
- Observation
- Quiz
- Think-Pair-Share
- Web or Concept Map

### **Authentic Assessments**

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7.1

- 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 analyze the association between protein and DNA within a nucleosome.

7.2

- Skill: Analysis of changes in the DNA methylation patterns.

7.3

- 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.

Laboratories will be used for assessment

Quizzes will be given.

## **Benchmark Assessments**

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Chapter tests will be given.

## **STAGE 3- LEARNING PLAN**

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### **Instructional Map**

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Guidance to help implement the IB Biology program

#### 7.1

- Details of DNA replication differ between prokaryotes and eukaryotes. Only the prokaryotic system is expected.
- The proteins and enzymes involved in DNA replication should include helicase, DNA gyrase, single strand binding proteins, DNA primase and DNA polymerases I and III.
- The regions of DNA that do not code for proteins should be limited to regulators of gene expression, introns, telomeres and genes for tRNAs.

#### 7.2

- RNA polymerase adds the 5' end of the free RNA nucleotide to the 3' end of the growing mRNA molecule.

#### 7.3

- Names of the tRNA binding sites are expected as well as their roles.
- Examples of start and stop codons are not required.
- Polar and non-polar amino acids are relevant to the bonds formed between R groups.
- Quaternary structure may involve the binding of a prosthetic group to form a conjugated protein.

## **Modification/Differentiation of Instruction**

### Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

### Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study

- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

### Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

### Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”

- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

## 504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy



## **Modification Strategies**

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- Cooperative Grouping
- Highlighted Text
- Preferential Seating
- Repeated Drill and Practice

## **Differentiation Strategies**

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### **High Preparation**

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- Group Investigations
- Varying Graphic Organizers

### **Low Preparation**

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- Flexible Grouping
- Varied Supplemental Materials
- Work Alone / Together

## **Horizontal Intergration- Interdisciplinary Connections**

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See Appendix

## **Vertical Integration- Discipline Mapping**

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Previous courses

6<sup>th</sup> grade – Diversity of life

7<sup>th</sup> grade – Populations and Ecosystems

8<sup>th</sup> grade – Human Systems Interactions and Heredity and Adaptations

9<sup>th</sup> grade – Honors Biology

10<sup>th</sup> grade – Honors Chemistry

Possible next courses

Honors Physics

Anatomy & Physiology

IB Physics

Zoology

Forensics

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### **Additional Materials**

Videos used through McGraw Hill, Crash Course and Howard Hughes Medical Institute.

Current Research articles supplied through Newsela.