IB Biology Y1 Unit 2: Molecular Biology

Teacher(s)	IB Biology PLC	**Subject group and course**	Group 4/IB Biology Y1 SL		
Course part and topic	Unit 2: Molecular Biology: Structure and Function Topic 2.1-2.4 & 2.6	**SL or HL/Year 1 or 2**	SL Y1	**Dates**	5 weeks
Unit description and texts		**DP assessment(s) for unit**			
Molecular biology explains living processes in terms of chemical reactions and substances involved. Molecules to Metabolism, Water, Carbohydrates and Lipids, Proteins, and the Structure of Nucleic Acids (Subtopics 2.1-2.4, & 2.6, Pearson IB Biology Textbook)		• Unit Summative assessment • Projects/Practicals • Formative/Summative assessment quizzes per subtopic to check for understanding			

INQUIRY: Establishing the purpose of the unit

Unit Statement of Inquiry: Various functions of a cell can be predicted through the complex structures of their molecules.

Essential Ideas/Inquiry Statements per Subtopic:
Living organisms control their composition by a complex web of chemical reactions.
Water is the medium of life.
Compounds of carbon, hydrogen, and oxygen are used to supply and store energy.
Proteins have a very wide range of functions in living organisms.
The structure of DNA allows efficient storage of genetic information.

Core Ideas: Properties of Water, Carbon functional groups and bonding, Metabolism, and Macromolecules

Phenomenon: Human health and diet - The health of a human body is correlated to the presence or absence of certain molecules. For example, the scientific evidence of the risk of ingesting trans fats and saturated fatty acids.

Crosscutting Concepts- Structure and function/Interactions/Stability and Change/Patterns

ACTION: teaching and learning through inquiry

Content/skills/concepts—essential understandings **U = Understandings** **NOS = Nature of Science** **A = Applications** **S = Skills**	**Learning process** *Check the boxes for any pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.*
Students will know the following content/Students will grasp the following concepts: 2.1 Understandings ● Molecular biology explains living processes in terms of the chemical substances involved. ● Carbon atoms can form four covalent bonds allowing a diversity of stable compounds to exist. ● Life is based on carbon compounds including carbohydrates, lipids, proteins and nucleic acids. ● Metabolism is the web of all the enzyme-catalyzed reactions in a cell or organism. ● Anabolism is the synthesis of complex molecules from simpler molecules including the formation of macromolecules from monomers by condensation reactions. ● Catabolism is the breakdown of complex molecules into simpler molecules including the hydrolysis of macromolecules into monomers. 2.2 Understandings ● Water molecules are polar and hydrogen bonds form between them. ● Hydrogen bonding and dipolarity explain the cohesive, adhesive, thermal and solvent properties of water. ● Substances can be hydrophilic or hydrophobic. 2.3 Understandings ● Monosaccharide monomers are linked together by condensation reactions to form disaccharides and polysaccharide polymers. Fatty acids can be saturated, monounsaturated or polyunsaturated. ● Unsaturated fatty acids can be cis or trans isomers. ● Triglycerides are formed by condensation from three fatty acids and one glycerol. 2.4 Understandings ● Amino acids are linked together by condensation to form polypeptides. ● There are 20 different amino acids in polypeptides synthesized on ribosomes. ● Amino acids can be linked together in any sequence giving a huge range of possible polypeptides.	Learning experiences and strategies/planning for self-supporting learning: ● Lecture ● Group Discussion Protocols ● Small Group/Pair Work ● PowerPoint Lecture Notes ● Individual Presentations ● Group Presentations ● Student Lecture/Leading the class ● Interdisciplinary Learning ● Hands on labs and activities Details: Modeling, Think/Pair/Share, CER, Writing Prompts, Videos, etc. Accommodations: ● *SWD/504 – Accommodations Provided* ● *ELL – Reading & Vocabulary Support* ● *Intervention Support* ● *Extensions – Enrichment Tasks and Project*

- The amino acid sequence of polypeptides is coded for by genes.
- A protein may consist of a single polypeptide or more than one polypeptide linked together.
- The amino acid sequence determines the three-dimensional conformation of a protein.
- Living organisms synthesize many different proteins with a wide range of functions.
- Every individual has a unique proteome.

2.6 Understandings

- The nucleic acids DNA and RNA are polymers of nucleotides.
- DNA differs from RNA in the number of strands present, the base composition and the type of pentose.
- DNA is a double helix made of two antiparallel strands of nucleotides linked by hydrogen bonding between complementary base pairs.

NOS

- Falsification of theories—the artificial synthesis of urea helped to falsify vitalism. (1.9)
- Use theories to explain natural phenomena—the theory that hydrogen bonds form between water molecules explains the properties of water. (2.2)
- Evaluating claims—health claims made about lipids in diets need to be assessed. (5.2)
- Looking for patterns, trends and discrepancies—most but not all organisms assemble proteins from the same amino acids. (3.1)
- Using models as representation of the real world—Crick and Watson used model making to discover the structure of DNA. (1.10)

Students will develop the following skills:

2.1 Applications and skills:

- Application: Urea as an example of a compound that is produced by living organisms but can also be artificially synthesized.
- Skill: Drawing molecular diagrams of glucose, ribose, a saturated fatty acid and a generalized amino acid.
- Skill: Identification of biochemicals such as sugars, lipids or amino acids from molecular diagrams.

Guidance:

- Only the ring forms of D-ribose, alpha–D-glucose and beta-D-glucose are expected in drawings.
- Sugars include monosaccharides and disaccharides.
- Only one saturated fat is expected and its specific name is not necessary.
- The variable radical of amino acids can be shown as R. The structure of individual R-groups does not need to be memorized.
- Students should be able to recognize from molecular diagrams that triglycerides, phospholipids and steroids are lipids. Drawings of steroids are not expected.
- Proteins or parts of polypeptides should be recognized from molecular diagrams showing amino acids linked by peptide bonds.

2.2 Applications and Skills:

- Application: Comparison of the thermal properties of water with those of methane.

• Application: Use of water as a coolant in sweat. • Application: Modes of transport of glucose, amino acids, cholesterol, fats, oxygen and sodium chloride in blood in relation to their solubility in water. Guidance: • Students should know at least one example of a benefit to living organisms of each property of water. • Transparency of water and maximum density at 4°C do not need to be included. • Comparison of the thermal properties of water and methane assists in the understanding of the significance of hydrogen bonding in water. 2.3 Applications and Skills: • Application: Structure and function of cellulose and starch in plants and glycogen in humans. • Application: Scientific evidence for health risks of trans fats and saturated fatty acids. • Application: Lipids are more suitable for long-term energy storage in humans than carbohydrates. • Application: Evaluation of evidence and the methods used to obtain the evidence for health claims made about lipids. • Skill: Use of molecular visualization software to compare cellulose, starch and glycogen. • Skill: Determination of body mass index by calculation or use of a nomogram. Guidance: • The structure of starch should include amylose and amylopectin. • Named examples of fatty acids are not required. • Sucrose, lactose and maltose should be included as examples of disaccharides produced by combining monosaccharides. 2.4 Applications and Skills: • Application: Rubisco, insulin, immunoglobulins, rhodopsin, collagen and spider silk as examples of the range of protein functions. Application: Denaturation of proteins by heat or by deviation of pH from the optimum. • Skill: Drawing molecular diagrams to show the formation of a peptide bond. Guidance: • The detailed structure of the six proteins selected to illustrate the functions of proteins is not needed. • Egg white or albumin solutions can be used in denaturation experiments. • Students should know that most organisms use the same 20 amino acids in the same genetic code although there are some exceptions. Specific examples could be used for illustration. 2.6 Applications and Skills: • Application: Crick and Watson's elucidation of the structure of DNA using model making. • Skill: Drawing simple diagrams of the structure of single nucleotides and of DNA and RNA, using circles, pentagons and rectangles to represent phosphates, pentoses and bases. Guidance: In diagrams of DNA structure, the helical shape does not need to be shown, but the two strands should be shown antiparallel. Adenine should be shown paired with thymine and guanine with cytosine, but the relative lengths of the purine and pyrimidine bases do not need to be recalled, nor the numbers of hydrogen bonds between the base pairs.	
Students will be assessed daily with classwork, discussions, group work, and reflections using a variety of formats with a focus on the applications and skills provided in the syllabus.	**Possible Formative Assignments/Assessments:** Quiz/Test

	Project/Model CER/Reflection Essay/Writing Assignment

Students will be assessed per subtopic and then at the end of the unit (Topic) to ensure understanding using IB exam style questions, modeling, reflection, lab reports, and writing prompts	**Possible Summative Assignments/Assessments:** Quiz/Test Project/Model CER/Reflection Essay/Writing Assignment
Students may be aware of many of the concepts within this unit, so building on prior knowledge using scaffolding techniques to aid students in a deeper understanding and extending learning to ensure that students can meet the goals set by the unit.	**Differentiation:** Affirm Identity - build self-esteem Value Prior Knowledge Scaffold Learning Extend Learning Student Choice when possible Details: Many concepts may be familiar to the students and others will need more scaffolding and extension.

Approaches to learning (ATL)

Check the boxes for any explicit approaches to learning connections made during the unit. For more information on ATL, please see the guide.

Thinking - Asking questions and defining problems
Social Communication- Constructing Explanations/Engaging in Argument from Evidence
Self-management - Carrying out Investigations
Research- Developing and using models

Language and learning *Check the boxes for any explicit language and learning connections made during the unit. For more information on the IB's approach to language and learning, please see the guide.*	TOK connections *Check the boxes for any explicit TOK connections made during the unit*	CAS connections *Check the boxes for any explicit CAS connections. If you check any of the boxes, provide a brief note in the "details" section explaining how students engaged in CAS for this unit.*
Activating Background Knowledge Scaffolding for new learning Acquisition of new learning through practice Demonstrating proficiency Potatoes have been genetically modified to reduce the level of amylose to produce a more effective adhesive. Proteomics and the production of proteins by cells cultured in fermenters offer many opportunities for the food, pharmaceutical and other industries.	Personal and Shared Knowledge Ways of Knowing Areas of Knowledge The Knowledge Framework Details: Claims about the "memory of water" have been categorized as pseudoscientific. What are the criteria that can be used to distinguish scientific claims from pseudoscientific claims? There are conflicting views as to the harms and benefits of fats in diets. How do we decide between competing views? The story of the elucidation of the structure of DNA illustrates that cooperation and collaboration among scientists exists alongside competition between research groups. To what extent is research in secret 'anti-scientific'? What is the relationship between shared and personal knowledge in the natural sciences?	Creativity Activity Service Details: Modeling and active participation in the learning process. Creating materials to aid their fellow classmates in understanding a particular concept through peer interaction and team/group activities.

International Mindedness/Aims:

International Mindedness: (Research/Reflections/Writing)

There are challenges for the increasing human population in sharing water resources equitably for drinking and irrigation, electricity generation and a range of industrial and domestic processes.

Variation in the prevalence of different health problems around the world could be discussed including obesity, dietary energy deficiency, kwashiorkor, anorexia nervosa

and coronary heart disease.

Aims: (Practicals/Activities/Student Reflections/CER Activities)
Aim 6: Food tests such as the use of iodine to identify starch or Benedict's reagent to identify reducing sugars could be carried out.
Aim 6: Probes can be used to determine the effect of different factors likely to influence cooling with water.
Aim 7: ICT can be used for molecular visualization of carbohydrates, lipids and proteins in this sub-topic and in 2.3 and 2.4.
Aim 7: ICT can be used for molecular visualization of the structure of proteins.
Aim 8: Obtaining samples of human blood for immunological, pharmaceutical and anthropological studies is an international endeavour with many ethical issues
Aim 8: There are social implications of obesity.

Resources
Damon, A.; McGonegal, R.; Tosto, P.; Ward, W. *Standard level biology*; Pearson Education Limited: Harlow, Essex, 2014. Greenwood, T.; Pryor, K.; Bainbridge-Smith, L.; Allan, R. Environmental science: student workbook; Biozone International: Hamilton, New Zealand, 2013. Van de Lagemaat, R. www.inthinking.net: Andorra la Vella, Andorra, 2019. IB Biology Schoology Course

Stage 3: Reflection—considering the planning, process and impact of the inquiry

What worked well *List the portions of the unit (content, assessment, planning) that were successful*	**What didn't work well** *List the portions of the unit (content, assessment, planning) that were not as successful as hoped*	**Notes/changes/suggestions:** *List any notes, suggestions, or considerations for the future teaching of this unit*