Marietta City Schools

2024–2025 District Unit Planner

IB HL Biology Y1 Unit 4: Genetics

Teacher(s)	IB Biology Y1 - Trotter PLC Logue/Trotter	**Subject group and course**	Group 4/IB Biology Y1 HL MHS Y1 SGO		
Course part and topic	Unit 4: Genetics D1.3, D2.1, D2.2, D3.2	**SL or HL/Year 1 or 2**	HL Y1	**Dates**	7 weeks

Unit description and texts	**DP assessment(s) for unit**
● Every living organism inherits a blueprint for life from its parents. ● Chromosomes carry genes in a linear sequence that is shared by members of a species. ● The inheritance of genes follows patterns. ● Meiosis leads to independent assortment of chromosomes and unique composition of alleles in daughter cells. ● What might happen during meiosis if two genes are located next to each other on a chromosome? ● If three genes control a single feature how many different combinations are there of alleles, assuming 2 alleles for each gene? Sickle Cell Theme throughout the course New IB Biology Guide First Assessment 2025	● Unit Formative and Summative assessment(s) ● Data analysis: Human Genome project: base sequencing analysis **Applications of Skills:** ▪ Identify phases of mitosis and meiosis using diagrams, viewed with a microscope, and/or micrograph (D2.1) ▪ Distinction between continuous variables such as skin color and discrete variables such as ABO blood groups – apply measures of central tendency – mean, median, and mode (D3.2) ● Use Box and Whisker plots to display six aspects of data: outliers, minimum, , first quartile, median, third quartile, and maximum

Topic Abbreviations:

Themes: A = Unity & Diversity, B = Form & Function, C = Interaction & Interdependence, D = Continuity & Change

Level of Organization: 1 = Molecules, 2 = Cells, 3 = Organisms, 4 = Ecosystems

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INQUIRY: Establishing the purpose of the unit

Statement of Inquiry:
Advancements in biotechnology supports complex research into the inheritance patterns and genetics of all living things.

Phenomenon:
The causes and effects of sickle cell anemia – A base substitution mutation drives significant phenotypical change in humans.

Crosscutting Concepts
- Structure and Function
- Systems and System models
- Patterns

CORE IDEAS
- Genes: Mutations/Variation
- Cell Division: Mitosis/Meiosis/ Cytokinesis
- Down Syndrome/Non-Disjunction
- Inheritance: Patterns
- Haploid/Diploid
- Phenotype/Genotype
- Phenylketonuria (PKU)
- Single Nucleotide Polymorphisms (SNPs)
- ABO Blood Groups
- Incomplete
- Codominance
- Sex determination
- Sex Linked Traits
- Continuous inheritance due to Polygenic inheritance or environmental factors

SEP:
- Asking Questions and Defining Problems
- Carry out Investigations
- Engage in Argument from Evidence

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ACTION: teaching and learning through inquiry

Content/skills/concepts—essential understandings **Themes: A = Unity & Diversity, B = Form & Function, C = Interaction & Interdependence, D = Continuity & Change** **Level of Organization: 1 = Molecules, 2 = Cells, 3 = Organisms, 4 = Ecosystems** **GQ - Guiding Questions** **NOS - Nature of Science** **AOS - Application of Skills** **LQ - Linking Question**	**Learning process** *Check the boxes for any pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.*
D1.3, D2.1, D3.2 Students will know the following content/Students will grasp the following concepts: **D1.3 Mutations and Gene Editing (Continuity and Change - Molecules)** **GQ -** ● **How do gene mutations occur?** ● **What are the consequences of gene mutation?** **Guidance:** **D1.3.1—Gene mutations as structural changes to genes at the molecular level** Distinguish between substitutions, insertions, and deletions. **D1.3.2—Consequences of base substitutions** Students should understand that single-nucleotide polymorphisms (SNPs) are the result of base substitution mutations and that because of the degeneracy of the genetic code they may or may not change a single amino acid in a polypeptide. **D1.3.3—Consequences of insertions and deletions**	**Learning experiences and strategies/planning for self-supporting learning:** Labs and Hands On Activities Lecture Socratic Seminar Small Group/Pair Work PowerPoint Lecture Notes Individual Presentations Group Presentations Student Lecture/Leading the class Interdisciplinary Learning Details: Modeling, Think/Pair/Share, CER, Writing Prompts, Videos, etc. **Accommodations:** ● *SWD/504 – Accommodations Provided* ● *ELL – Reading & Vocabulary Support* ● *Intervention Support*

Include the likelihood of polypeptides ceasing to function, either through frameshift changes or through major insertions or deletions. Specific examples are not required.

D1.3.4—Causes of gene mutation

Students should understand that gene mutation can be caused by mutagens and by errors in DNA replication or repair. Include examples of chemical mutagens and mutagenic forms of radiation.

D1.3.5—Randomness in mutation

Students should understand that mutations can occur anywhere in the base sequences of a genome, although some bases have a higher probability of mutating than others. They should also understand that no natural mechanism is known for making a deliberate change to a particular base with the purpose of changing a trait.

D1.3.6—Consequences of mutation in germ cells and somatic cells

Include inheritance of mutated genes in germ cells and cancer in somatic cells.

D1.3.7—Mutation as a source of genetic variation

Students should appreciate that gene mutation is the original source of all genetic variation. Although most mutations are either harmful or neutral for an individual organism, in a species they are in the long term essential for evolution by natural selection.

NOS: Commercial genetic tests can yield information about potential future health and disease risk. One possible impact is that, without expert interpretation, this information could be problematic.

Additional higher level

D1.3.8—Gene knockout as a technique for investigating the function of a gene by changing it to make it inoperative

Students are not required to know details of techniques. Students should appreciate that a library of knockout organisms is available for some species used as models in research.

D1.3.9—Use of the CRISPR sequences and the enzyme Cas9 in gene editing

Students are not required to know the role of the CRISPR–Cas system in prokaryotes. However, students should be familiar with an example of the successful use of this technology.

- *Extensions – Enrichment Tasks and Project*

Guidance:

- ❖ Students should be able to recall one specific base substitution that causes glutamic acid to be substituted by valine as the sixth amino acid in the hemoglobin polypeptide.
- ❖ The number of genes in a species should not be referred to as genome size as this term is used for the total amount of DNA. At least one plant and one bacterium should be included in the comparison and at least one species with more genes and one with fewer genes than a human.
- ❖ The GenBank® database can be used to search for DNA base sequences. The cytochrome C gene sequence is available for many different organisms and is of particular interest because of its use in reclassifying organisms into three domains.
- ❖ Deletions, insertions, and frameshift mutations do not need to be included.
- ❖ The terms karyotype and karyogram have different meanings. Karyotype is a property of a cell—the number and type of chromosomes present in the nucleus, not a photograph or diagram of them.
- ❖ Genome size is the total length of DNA in an organism. Examples of genome and chromosome number have been selected

NOS: Certain potential uses of CRISPR raise ethical issues that must be addressed before implementation. Students should understand that scientists across the world are subject to different regulatory systems. For this reason, there is an international effort to harmonize regulation of the application of genome editing technologies such as CRISPR.

D1.3.10—Hypotheses to account for conserved or highly conserved sequences in genes

Conserved sequences are identical or similar across a species or a group of species; highly conserved sequences are identical or similar over long periods of evolution. One hypothesis for the mechanism is the functional requirements for the gene products and another hypothesis is slower rates of mutation.

LQ -

- **How can natural selection lead to both a reduction in variation and an increase in biological diversity?**
- **How does variation in subunit composition of polymers contribute to function?**

D2.1 Cell and Nuclear Division (Continuity and Change - Cells)

GQ -

- **How can large numbers of genetically identical cells be produced?**
- **How do eukaryotes produce genetically varied cells that can develop into gametes?**

Guidance:

D2.1.1—Generation of new cells in living organisms by cell division

In all living organisms, a parent cell—often referred to as a mother cell—divides to produce two daughter cells.

D2.1.2—Cytokinesis as splitting of cytoplasm in a parent cell between daughter cells

Students should appreciate that in an animal cell a ring of contractile actin and myosin proteins pinches a cell membrane together to split the cytoplasm, whereas in a plant cell vesicles assemble sections of membrane and cell wall to achieve splitting.

D2.1.3—Equal and unequal cytokinesis

Include the idea that division of cytoplasm is usually, but not in all cases, equal and that both daughter to allow points of interest to be raised.

- The two DNA molecules formed by DNA replication prior to cell division are sister chromatids until the splitting of the centromere at the start of anaphase. After this, they are individual chromosomes.
- Preparation of microscope slides showing meiosis is challenging and permanent slides should be available in case no cells in meiosis are visible in temporary mounts.
- Drawings of the stages of meiosis do not need to include chiasmata.
- The process of chiasmata formation need not be explained.
- Alleles carried on X chromosomes should be shown as superscript letters on an upper case X, such as Xh .
- The expected notation for ABO blood group alleles is:

Phenotype	*Genotype*
O	ii
A	I^AI^A or I^Ai
B	I^BI^B or I^Bi
AB	I^AI^B

- Students should be able to deduce whether a man could be the father of a child from the pattern of bands on a DNA profile.
- Dolly can be used as an example of somatic-cell transfer.
- A plant species should be chosen for rooting experiments that forms roots readily in water or a solid medium.

cells must receive at least one mitochondrion and any other organelle that can only be made by dividing a pre-existing structure. Include oogenesis in humans and budding in yeast as examples of unequal cytokinesis. **D2.1.4—Roles of mitosis and meiosis in eukaryotes** Emphasize that nuclear division is needed before cell division to avoid production of anucleate cells. Mitosis maintains the chromosome number and genome of cells, whereas meiosis halves the chromosome number and generates genetic diversity. **D2.1.5—DNA replication as a prerequisite for both mitosis and meiosis** Students should understand that, after replication, each chromosome consists of two elongated DNA molecules (chromatids) held together until anaphase. **D2.1.6—Condensation and movement of chromosomes as shared features of mitosis and meiosis** Include the role of histones in the condensation of DNA by supercoiling and the use of microtubules and microtubule motors to move chromosomes. **D2.1.7—Phases of mitosis** Students should know the names of the phases and how the process as a whole produces two genetically identical daughter cells. **D2.1.8—Identification of phases of mitosis** **AOS: Students should do this using diagrams as well as with cells viewed with a microscope or in a micrograph.** **D2.1.9—Meiosis as a reduction division** Students should understand the terms “diploid” and “haploid” and how the two divisions of meiosis produce four haploid nuclei from one diploid nucleus. They should also understand the need for meiosis in a sexual life cycle. Students should be able to outline the two rounds of segregation in meiosis. **D2.1.10—Down syndrome and non-disjunction** Use Down syndrome as an example of an error in meiosis.	**Assessment Objectives:** The assessment objectives for biology reflect those parts of the aims that will be formally assessed either internally or externally. It is the intention of this course that students can fulfill the following assessment objectives. 1. Demonstrate knowledge of: A. terminology, facts, and concepts B. skills, techniques, and methodologies. 2. Understand and apply knowledge of: A. terminology and concepts B. skills, techniques, and methodologies. 3. Analyze, evaluate, and synthesize: A. experimental procedures B. primary and secondary data C. trends, patterns, and predictions. 4. Demonstrate the application of skills necessary to carry out insightful and ethical investigations

D2.1.11—Meiosis as a source of variation Students should understand how meiosis generates genetic diversity by random orientation of bivalents and by crossing over. **Additional higher level** **D2.1.12—Cell proliferation for growth, cell replacement and tissue repair** Include proliferation for growth within plant meristems and early-stage animal embryos as examples. Include skin as an example of cell proliferation during routine cell replacement and during wound healing. Students are not required to know details of the structure of skin. **D2.1.13—Phases of the cell cycle** Students should understand that cell proliferation is achieved using the cell cycle. Students should understand the sequence of events including G1, S and G2 as the stages of interphase, followed by mitosis and then cytokinesis. **D2.1.14—Cell growth during interphase** Students should appreciate that interphase is a metabolically active period and that growth involves biosynthesis of cell components including proteins and DNA. Numbers of mitochondria and chloroplasts are increased by growth and division of these organelles. **D2.1.15—Control of the cell cycle using cyclins** Limit to the concentration of different cyclins increasing and decreasing during the cell cycle and a threshold level of a specific cyclin required to pass each checkpoint in the cycle. Students are not required to know details of the roles of specific cyclins. **D2.1.16—Consequences of mutations in genes that control the cell cycle** Include mutations in proto-oncogenes that convert them to oncogenes and mutations in tumour suppressor genes, resulting in uncontrolled cell division. **D2.1.17—Differences between tumours in rates of cell division and growth and in the capacity for metastasis and invasion of neighbouring tissue** Include the terms “benign”, “malignant”, “primary tumour” and “secondary tumour”, and distinguish	

between tumours that do and do not cause cancer.

Application of skills: Students should observe populations of cells to determine the mitotic index.

LQ -

- **What processes support the growth of organisms?**
- **How does the variation produced by sexual reproduction contribute to evolution?**

D2.2 Gene expression Continuity and change—Cells
Additional higher level: 3 hours
GQ-
- **How is gene expression changed in a cell?**
- **How can patterns of gene expression be conserved through inheritance?**

Additional higher level
Note: There is no SL in D2.2.

D2.2.1—Gene expression as the mechanism by which information in genes has effects on the phenotype
Students should appreciate that the most common stages in this process are transcription, translation and the function of a protein product, such as an enzyme.

D2.2.2—Regulation of transcription by proteins that bind to specific base sequences in DNA
Include the role of promoters, enhancers and transcription factors.

D2.2.3—Control of the degradation of mRNA as a means of regulating translation
In human cells, mRNA may persist for time periods from minutes up to days, before being broken down by nucleases.

D2.2.4—Epigenesis as the development of patterns of differentiation in the cells of a multicellular organism
Emphasize that DNA base sequences are not altered by epigenetic changes, so phenotype but not genotype is altered.

D2.2.5—Differences between the genome, transcriptome and proteome of individual cells No cell expresses all of its genes. The pattern of gene expression in a cell determines how it differentiates. **D2.2.6—Methylation of the promoter and histones in nucleosomes as examples of epigenetic tags** Methylation of cytosine in the DNA of a promoter represses transcription and therefore expression of the gene downstream. Methylation of amino acids in histones can cause transcription to be repressed or activated. Students are not required to know details of how this is achieved. **D2.2.7—Epigenetic inheritance through heritable changes to gene expression** Limit to the possibility of phenotypic changes in a cell or organism being passed on to daughter cells or offspring without changes in the nucleotide sequence of DNA. This can happen if epigenetic tags, such as DNA methylation or histone modification, remain in place during mitosis or meiosis. **D2.2.8—Examples of environmental effects on gene expression in cells and organisms** Include alteration of methyl tags on DNA in response to air pollution as an example. **D2.2.9—Consequences of removal of most but not all epigenetic tags from the ovum and sperm** Students can show this by outlining the epigenetic origins of phenotypic differences in tigons and ligers (lion–tiger hybrids). **D2.2.10—Monozygotic twin studies** Limit to investigating the effects of the environment on gene expression. **D2.2.11—External factors impacting the pattern of gene expression** Limit to one example of a hormone and one example of a biochemical such as lactose or tryptophan in bacteria. **LQ-** **• What mechanisms are there for inhibition in biological systems?** **• In what ways does the environment stimulate diversification?**	

D3.2 Inheritance (Continuity and Change - Organisms) **GQ -** ● **What patterns of inheritance exist in plants and animals?** ● **What is the molecular basis of inheritance patterns?** **Guidance:** **D3.2.1—Production of haploid gametes in parents and their fusion to form a diploid zygote as the means of inheritance** Students should understand that this pattern of inheritance is common to all eukaryotes with a sexual life cycle. They should also understand that a diploid cell has two copies of each autosomal gene. **D3.2.2—Methods for conducting genetic crosses in flowering plants** **Use the terms "P generation", "F1 generation", "F2 generation" and "Punnett grid".** Students should understand that pollen contains male gametes and that female gametes are located in the ovary, so pollination is needed to carry out a cross. They should also understand that plants such as peas produce both male and female gametes on the same plant, allowing self-pollination and therefore self-fertilization. Mention that genetic crosses are widely used to breed new varieties of crop or ornamental plants. **D3.2.3—Genotype as the combination of alleles inherited by an organism** Students should use and understand the terms "homozygous" and "heterozygous", and appreciate the distinction between genes and alleles. **D3.2.4—Phenotype as the observable traits of an organism resulting from genotype and environmental factors** Students should be able to suggest examples of traits in humans due to genotype only and due to environment only, and traits due to interaction between genotype and environment. **D3.2.5—Effects of dominant and recessive alleles on phenotype** Students should understand the reasons that both a homozygous-dominant genotype and a heterozygous genotype for a particular trait will produce the same phenotype.	

D3.2.6—Phenotypic plasticity as the capacity to develop traits suited to the environment experienced by an organism, by varying patterns of gene expression Phenotypic plasticity is not due to changes in genotype, and the changes in traits may be reversible during the lifetime of an individual. **D3.2.7—Phenylketonuria as an example of a human disease due to a recessive allele** Phenylketonuria (PKU) is a recessive genetic condition caused by mutation in an autosomal gene that codes for the enzyme needed to convert phenylalanine to tyrosine. **D3.2.8—Single-nucleotide polymorphisms and multiple alleles in gene pools** Students should understand that any number of alleles of a gene can exist in the gene pool but an individual only inherits two. **D3.2.9—ABO blood groups as an example of multiple alleles** Use IA, IB and i to denote the alleles. **D3.2.10—Incomplete dominance and codominance** Students should understand the differences between these patterns of inheritance at the phenotypic level. In codominance, heterozygotes have a dual phenotype. Include the AB blood type (IAIB) as an example. In incomplete dominance, heterozygotes have an intermediate phenotype. Include four o'clock flower or marvel of Peru (*Mirabilis jalapa*) as an example. ***Note: When students are referring to organisms in an examination, either the common name or the scientific name is acceptable.*** **D3.2.11—Sex determination in humans and inheritance of genes on sex chromosomes** Students should understand that the sex chromosome in sperm determines whether a zygote develops certain male-typical or female-typical physical characteristics and that far more genes are carried by the X chromosome than the Y chromosome. **D3.2.12—Hemophilia as an example of a sex-linked genetic disorder** Show alleles carried on X chromosomes as superscript letters on an uppercase X. **D3.2.13—Pedigree charts to deduce patterns of inheritance of genetic disorders**	

Students should understand the genetic basis for the prohibition of marriage between close relatives in many societies. **NOS:** Scientists draw general conclusions by inductive reasoning when they base a theory on observations of some but not all cases. A pattern of inheritance may be deduced from parts of a pedigree chart and this theory may then allow genotypes of specific individuals in the pedigree to be deduced. Students should be able to distinguish between inductive and deductive reasoning. **D3.2.14—Continuous variation due to polygenic inheritance and/or environmental factors** Use skin color in humans as an example. **AOS:** Students should understand the distinction between continuous variables such as skin color and discrete variables such as ABO blood group. They should also be able to apply measures of central tendency such as mean, median and mode. **D3.2.15—Box-and-whisker plots to represent data for a continuous variable such as student height** **AOS:** Students should use a box-and-whisker plot to display six aspects of data: outliers, minimum, first quartile, median, third quartile and maximum. A data point is categorized as an outlier if it is more than 1.5 × IQR (interquartile range) above the third quartile or below the first quartile. **Additional higher level** **D3.2.16—Segregation and independent assortment of unlinked genes in meiosis** Students should understand the link between the movements of chromosomes in meiosis and the outcome of dihybrid crosses involving pairs of unlinked genes. **D3.2.17—Punnett grids for predicting genotypic and phenotypic ratios in dihybrid crosses involving pairs of unlinked autosomal genes** Students should understand how the 9:3:3:1 and 1:1:1:1 ratios are derived. **NOS:** 9:3:3:1 and 1:1:1:1 ratios for dihybrid crosses are based on what has been called Mendel's second law. This law only applies if genes are on different chromosomes or are far apart enough on one chromosome for recombination rates to reach 50%. Students should recognize that there are exceptions to all biological "laws" under certain conditions. **D3.2.18—Loci of human genes and their polypeptide products**	

Application of skills: Students should explore genes and their polypeptide products in databases. They should find pairs of genes with loci on different chromosomes and also in close proximity on the same chromosome. **D3.2.19—Autosomal gene linkage In crosses involving linkage, the symbols used to denote alleles should be shown alongside vertical lines representing homologous chromosomes.** Students should understand the reason that alleles of linked genes can fail to assort independently. **D3.2.20—Recombinants in crosses involving two linked or unlinked genes** Students should understand how to determine the outcomes of crosses between an individual heterozygous for both genes and an individual homozygous recessive for both genes. Identify recombinants in gametes, in genotypes of offspring and in phenotypes of offspring. **D3.2.21—Use of a chi-squared test on data from dihybrid crosses** Students should understand the concept of statistical significance, the p=0.05 level, null/alternative hypothesis and the idea of observed versus expected results. **NOS:** Students should recognize that statistical testing often involves using a sample to represent a population. In this case the sample is the F2 generation. In many experiments the sample is the replicated or repeated measurements. **LQ -** ● **What are the principles of effective sampling in biological research?** ● **What biological processes involve doubling and halving?**	
Students may 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.	**Formative assessment:** Quiz/Test Lab Analysis or Report Project/Model CER/Reflection Essay/Writing Assignment

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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	**Summative assessment:** Quiz/Test Lab Analysis or Report 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 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

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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	Personal and Shared Knowledge Ways of Knowing Areas of Knowledge The Knowledge Framework Details: There is a link between sickle cell anemia and the prevalence of malaria. How can we know whether there is a causal link in such cases or simply a correlation? Sequencing of the rice genome involved cooperation between biologists in 10 countries. In 1922 the number of chromosomes counted in a human cell was 48. This remained the established number for 30 years, even though a review of photographic evidence from the time clearly showed that there were 46. For what reasons do existing beliefs carry a certain inertia? Mendel's theories were not accepted by the scientific community for a long time. What factors would encourage the acceptance of new ideas by the scientific community? The use of DNA for securing convictions in legal cases is well established, yet even universally accepted theories are overturned in the light of new evidence in science. What criteria are necessary for assessing the reliability of evidence?	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.

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International Mindedness/Aims:
International Mindedness: (Research/Reflections/Writing) Sequencing of the human genome shows that all humans share most of their base sequences but also that there are many single nucleotide polymorphisms that contribute to human diversity Sequencing of the rice genome involved cooperation between biologists in 10 countries. **Aims: (Labs/Activities/Student Reflections/CER Activities)** **The course enables students, through the overarching theme of the NOS, to:** **1. develop conceptual understanding that allows connections to be made between different areas of the subject, and to other DP sciences subjects** **2. acquire and apply a body of knowledge, methods, tools, and techniques that characterize science** **3. develop the ability to analyze, evaluate and synthesize scientific information and claims** **4. develop the ability to approach unfamiliar situations with creativity and resilience** **5. design and model solutions to local and global problems in a scientific context** **6. develop an appreciation of the possibilities and limitations of science** **7. develop technology skills in a scientific context** **8. develop the ability to communicate and collaborate effectively** **9. develop awareness of the ethical, environmental, economic, cultural, and social impact of science.**

Resources
● Textbook TBD – evaluation of resources ● IB Biology Guide First Assessment 2025 ● Van de Lagemaat, R. www.inthinking.net: Andorra la Vella, Andorra, 2019. ● IB Biology Schoology Course ● Discovery Education Biology and Chemistry Resources Additional Resources: Old Syllabus ● 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. ● Hodder Study and Revision Guide for the IB Diploma Hodder IA Internal Assessment for Biology

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*