IB Biology Y2 Biodiversity & Environment Unit 3 Planner

Teacher(s)	IB Biology PLC	**Subject group and course**	Group 4/IB Biology Y2 SL		
Course part and topic	Unit 3:Bidiversity and Environment A4.1.1 - 4.1.7, D4.1.1-4.1.8, A3.1.1-3.1.11, A4.2.1-A4.2.8 Review D1.1, D1.2, D1.3, D2.2	**SL or HL/Year 1 or 2**	SL Y2	**Dates**	5 weeks

Unit description and texts	**DP assessment(s) for unit**
Biodiversity is the variety of life on Earth, including plants, animals, microorganisms, and their genes, as well as the ecosystems they inhabit. The environment is the area and conditions in which organisms live. Biodiversity is important because it provides essential services to ecosystems, such as water purification, air quality regulation, and climate regulation. These services are vital for human well-being and the planet's functioning. Biodiversity can also enhance ecosystem resilience to climate change, as diverse ecosystems are better at sequestering carbon. However, biodiversity is threatened by pollution, climate change, and population growth, which have led to an unprecedented increase in the rate of species extinction. Some scientists estimate that half of all species on Earth could be wiped out within the next century. Human activity, primarily for food production, is the main driver of biodiversity loss, as converting land for agriculture can cause some species to lose their habitat and face extinction. Conservation efforts are necessary to preserve biodiversity and protect endangered species and their habitats. Pearson Standard Level Biology for the IB Diploma Program 3rd Edition [New IB Biology Guide First Assessment 2025]	• Unit Summative assessment • Projects/Practicals • Formative/Summative assessment quizzes per subtopic to check for understanding **Application of skills:** **D4.1.8 Modelling of sexual and natural selection based on experimental control of selection pressures -Interpret data from John Endler's experiments with guppies.** **A3.1.7 Karyotyping and karyograms -classify chromosomes by banding patterns, length and** **centromere position-** **evaluate the evidence for the hypothesis that chromosome 2 in humans arose from the fusion of chromosomes 12 and 13 with a shared primate ancestor** **A3.1.10 Extract information about genome size for different taxonomic groups from a database to compare genome size to organism complexity**

INQUIRY: Establishing the purpose of the unit

Unit Statement of Inquiry: Changing environments cause selective pressures on organisms resulting in the diversity of life on earth.

Core Ideas: Evolution and Speciation, Natural Selection, Diversity of Organisms, Conservation of Biodiversity, & Extinction

Phenomenon: In some parts of the world, the infectious parasitic disease malaria and the genetic disease sickle cell anemia are intimately connected

Crosscutting Concepts-

- Systems & System models
- Patterns
- Cause and Effect

SEP:

- Developing and Using Models
- Obtaining, Evaluating, and Communicating information
- Analyzing and Interpreting Data

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.
A4.1 Evolution and Speciation GQ- • What is the evidence for evolution? • How do analogous and homologous structures exemplify commonality and diversity? **A4.1.1—Evolution as a change in the heritable characteristics of a population** This definition helps to distinguish Darwinian evolution from Lamarckism. Acquired changes that are not genetic in origin are not regarded as evolution. **NOS: The theory of evolution by natural selection predicts and explains a broad range of observations and is unlikely ever to be falsified. However, the nature of science makes it impossible to formally prove that it is true by correspondence. It is a pragmatic truth and is therefore referred to as a theory, despite all the supporting evidence.** **A4.1.2—Evidence for evolution from base sequences in DNA or RNA and amino acid sequences in proteins** Sequence data gives powerful evidence of common ancestry. **A4.1.3—Evidence for evolution from selective breeding of domesticated animals and crop plants** Variation between different domesticated animal breeds and varieties of crop plants, and between them and the original wild species shows how rapidly evolutionary changes can occur. **A4.1.4—Evidence for evolution from homologous structures** Include the example of pentadactyl limbs.	Learning experiences and strategies/planning for self-supporting learning: ❏ 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 Extensions – Enrichment Tasks and Project **Guidance:** **Note: When students are referring to organisms in an examination, either the common name or the scientific name is acceptable.**

A4.1.5—Convergent evolution as the origin of analogous structures Students should understand that analogous structures have the same function but different evolutionary origins. Students should know at least one example of analogous features. **A4.1.6—Speciation by splitting of pre-existing species** Students should appreciate that this is the only way in which new species have appeared. Students should also understand that speciation increases the total number of species on Earth, and extinction decreases it. Students should also understand that gradual evolutionary change in a species is not speciation. **A4.1.7—Roles of reproductive isolation and differential selection in speciation** Include geographical isolation as a means of achieving reproductive isolation. Use the separation of bonobos and common chimpanzees by the Congo River as a specific example of divergence due to differential selection. LQ- • How does the theory of evolution by natural selection predict and explain the unity and diversity of life on Earth? • What counts as strong evidence in biology? **D4.1 Natural Selection** GQ- • What processes can cause changes in allele frequencies within a population? • What is the role of reproduction in the process of natural selection? **D4.1.1—Natural selection as the mechanism driving evolutionary change** Students should appreciate that natural selection operates continuously and over billions of years, resulting in the biodiversity of life on Earth. **NOS: In Darwin's time it was widely understood that species evolved, but the mechanism was not clear. Darwin's theory provided a convincing mechanism and replaced Lamarckism. This is an example of a paradigm shift. Students should understand the meaning of the term "paradigm shift".** **D4.1.2—Roles of mutation and sexual reproduction in generating the variation on which natural selection** **acts**	**All review items will be flipped Schoology lessons with connections to Unit materials in class.**

Mutation generates new alleles and sexual reproduction generates new combinations of alleles. **D4.1.3—Overproduction of offspring and competition for resources as factors that promote natural selection** Include examples of food and other resources that may limit carrying capacity. D4.1.4—Abiotic factors as selection pressures Include examples of density-independent factors such as high or low temperatures that may affect survival of individuals in a population. **D4.1.5—Differences between individuals in adaptation, survival, and reproduction as the basis for natural** **selection** Students are required to study natural selection due to intraspecific competition, including the concept of fitness when discussing the survival value and reproductive potential of a genotype. **D4.1.6—Requirement that traits are heritable for evolutionary change to occur** Students should understand that characteristics acquired during an individual's life due to environmental factors are not encoded in the base sequence of genes and so are not heritable. **D4.1.7—Sexual selection as a selection pressure in animal species** Differences in physical and behavioral traits, which can be used as signs of overall fitness, can affect success in attracting a mate and so drive the evolution of an animal population. Illustrate this using suitable examples such as the evolution of the plumage of birds of paradise. **D4.1.8—Modelling of sexual and natural selection based on experimental control of selection pressures** **Application of skills: Students should interpret data from John Endler's experiments with guppies.** LQ • How do intraspecific interactions differ from interspecific interactions? • What mechanisms minimize competition? **A3.1 Diversity in Organisms** GQ- • What is a species?	

• What patterns are seen in the diversity of genomes within and between species? **A3.1.1—Variation between organisms as a defining feature of life** Students should understand that no two individuals are identical in all their traits. The patterns of variation are complex and are the basis for naming and classifying organisms. **A3.1.2—Species as groups of organisms with shared traits** This is the original morphological concept of the species as used by Linnaeus. **A3.1.3—Binomial system for naming organisms** Students should know that the first part of the name identifies the genus, with the second part of the name distinguishing the species. Species in the same genus have similar traits. The genus name is given an initial capital letter but the species name is lowercase. **A3.1.4—Biological species concept** According to the biological species concept, a species is a group of organisms that can breed and produce fertile offspring. Include possible challenges associated with this definition of a species and that competing species definitions exist. **A3.1.5—Difficulties distinguishing between populations and species due to divergence of noninterbreeding populations during speciation** Students should understand that speciation is the splitting of one species into two or more. It usually happens gradually rather than by a single act, with populations becoming more and more different in their traits. It can therefore be an arbitrary decision whether two populations are regarded as the same or different species. **A3.1.6—Diversity in chromosome numbers of plant and animal species** Students should know in general that diversity exists. As an example, students should know that humans have 46 chromosomes and chimpanzees have 48. Students are not required to know other specific chromosome numbers but should appreciate that diploid cells have an even number of chromosomes. **A3.1.7—Karyotyping and karyograms** **Application of skills: Students should be able to classify chromosomes by banding patterns, length, and centromere position. Students should evaluate the evidence for the hypothesis that chromosome 2 in humans arose from the fusion of chromosomes 12 and 13 with a shared primate ancestor.**	

NOS: Students should be able to distinguish between testable hypotheses such as the origin of chromosome 2 and non-testable statements. **A3.1.8—Unity and diversity of genomes within species** Students should understand that the genome is all the genetic information of an organism. Organisms in the same species share most of their genome but variations such as single-nucleotide polymorphisms give some diversity. **A3.1.9—Diversity of eukaryote genomes** Genomes vary in overall size, which is determined by the total amount of DNA. Genomes also vary in base sequence. Variation between species is much larger than variation within a species. **A3.1.10—Comparison of genome sizes** **Application of skills: Students should extract information about genome size for different taxonomic groups from a database to compare genome size to organism complexity.** **A3.1.11—Current and potential future uses of whole genome sequencing** Include the increasing speed and decreasing costs. For current uses, include research into evolutionary relationships, and potential future uses, including personalized medicine. LQ- • What might cause a species to persist or go extinct? • How do species exemplify both continuous and discontinuous patterns of variation? **A4.2 Conservation of Biodiversity** GQ- • What factors are causing the sixth mass extinction of species? • How can conservationists minimize the loss of biodiversity? **A4.2.1—Biodiversity is the variety of life in all its forms, levels, and combinations** Including ecosystem diversity, species diversity, and genetic diversity. **A4.2.2—Comparisons between the current number of species on Earth and past levels of biodiversity** Millions of species have been discovered, named, and described but there are many more species to be discovered. Evidence from fossils suggests that there are currently more species alive on Earth today than	

at any time in the past. **NOS: Classification is an example of pattern recognition but the same observations can be classified in different ways. For example, "splitters" recognize more species than "lumpers" in a taxonomic group.** A4.2.3—Causes of anthropogenic species extinction This should be a study of the causes of the current sixth mass extinction, rather than of non-anthropogenic causes of previous mass extinctions. To give a range of causes, carry out three or more brief case studies of species extinction: North Island giant moas (*Dinornis novaezealandiae*) as an example of the loss of terrestrial megafauna, Caribbean monk seals (*Neomonachus tropicalis*) as an example of the loss of a marine species, and one other species that has gone extinct from an area that is familiar to students. A4.2.4—Causes of ecosystem loss Students should study only causes that are directly or indirectly anthropogenic. Include two case studies of ecosystem loss. One should be the loss of mixed dipterocarp forest in Southeast Asia, and the other should, if possible, be of a lost ecosystem from an area that is familiar to students. A4.2.5—Evidence for a biodiversity crisis Evidence can be drawn from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services reports and other sources. Results from reliable surveys of biodiversity in a wide range of habitats around the world are required. Students should understand that surveys need to be repeated to provide evidence of change in species richness and evenness. Note that there are opportunities for contributions from both expert scientists and citizen scientists. **NOS: To be verifiable, evidence usually has to come from a published source, which has been peer reviewed and allows methodology to be checked. Data recorded by citizens rather than scientists brings not only benefits but also unique methodological concerns.** A4.2.6—Causes of the current biodiversity crisis Include human population growth as an overarching cause, together with these specific causes: hunting and other forms of over-exploitation; urbanization; deforestation and clearance of land for agriculture with the consequent loss of natural habitat; pollution and spread of pests, diseases, and invasive alien species due to global transport.	

A4.2.7—Need for several approaches to the conservation of biodiversity No single approach by itself is sufficient, and different species require different measures. Include in situ conservation of species in natural habitats, management of nature reserves, rewilding and reclamation of degraded ecosystems, ex situ conservation in zoos and botanic gardens, and storage of germplasm in seed or tissue banks. A4.2.8—Selection of evolutionarily distinct and globally endangered species for conservation prioritization in the EDGE of Existence program Students should understand the rationale behind focusing conservation efforts on evolutionarily distinct and globally endangered species (EDGE). **NOS: Issues such as which species should be prioritized for conservation efforts have complex ethical, environmental, political, social, cultural, and economic implications and therefore need to be debated.** LQ- • In what ways is diversity a property of life at all levels of biological organization? • How does variation contribute to the stability of ecological communities? **Review D1.1 DNA Replication, D1.2 Protein Synthesis, D1.3 Mutation and Gene Editing D2.2 Gene Expression** GQ- • How is new DNA produced? • How has knowledge of DNA replication enabled applications in biotechnology? D1.1.1—DNA replication as the production of exact copies of DNA with identical base sequences Students should appreciate that DNA replication is required for reproduction and for growth and tissue replacement in multicellular organisms. D1.1.2—Semi-conservative nature of DNA replication and role of complementary base pairing Students should understand how these processes allow a high degree of accuracy in copying base sequences. D1.1.3—Role of helicase and DNA polymerase in DNA replication Limit to the role of helicase in unwinding and breaking hydrogen bonds between DNA strands and the	

general role of DNA polymerase. D1.1.4—Polymerase chain reaction and gel electrophoresis as tools for amplifying and separating DNA Students should understand the use of primers, temperature changes and Taq polymerase in the polymerase chain reaction (PCR) and the basis of separation of DNA fragments in gel electrophoresis. D1.1.5—Applications of polymerase chain reaction and gel electrophoresis Students should appreciate the broad range of applications, including DNA profiling for paternity and forensic investigations. **NOS: Reliability is enhanced by increasing the number of measurements in an experiment or test. In DNA profiling, increasing the number of markers used reduces the probability of a false match.** GQ- • How does a cell produce a sequence of amino acids from a sequence of DNA bases? • How is the reliability of protein synthesis ensured? D1.2.1—Transcription as the synthesis of RNA using a DNA template Students should understand the roles of RNA polymerase in this process. D1.2.2—Role of hydrogen bonding and complementary base pairing in transcription Include the pairing of adenine (A) on the DNA template strand with uracil (U) on the RNA strand. D1.2.3—Stability of DNA templates Single DNA strands can be used as a template for transcribing a base sequence, without the DNA base sequence changing. In somatic cells that do not divide, such sequences must be conserved throughout the life of a cell. D1.2.4—Transcription as a process required for the expression of genes Limit to understanding that not all genes in a cell are expressed at any given time and that transcription, being the first stage of gene expression is a key stage at which expression of a gene can be switched on and off. D1.2.5—Translation as the synthesis of polypeptides from mRNA The base sequence of mRNA is translated into the amino acid sequence of a polypeptide. D1.2.6—Roles of mRNA, ribosomes, and tRNA in translation Students should know that mRNA binds to the small subunit of the ribosome and that two tRNAs can bind	

simultaneously to the large subunit. D1.2.7—Complementary base pairing between tRNA and mRNA Include the terms “codon” and “anticodon”. D1.2.8—Features of the genetic code Students should understand the reasons for a triplet code. Students should use and understand the terms “degeneracy” and “universality”. D1.2.9—Using the genetic code expressed as a table of mRNA codons Students should be able to deduce the sequence of amino acids coded by an mRNA strand. D1.2.10—Stepwise movement of the ribosome along mRNA and linkage of amino acids by peptide bonding to the growing polypeptide chain Focus on elongation of the polypeptide, rather than on initiation and termination. D1.2.11—Mutations that change protein structure Include an example of a point mutation affecting protein structure. GQ- How do gene mutations occur? • What are the consequences of gene mutation? 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 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 risks. One possible impact is that, without expert interpretation, this information could be problematic.** GQ- • How is gene expression changed in a cell? • How can patterns of gene expression be conserved through inheritance? 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 periods of time, from minutes up to days, before being broken down by nucleases. D2.2.4—Epigenesis is 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, remains in place during mitosis or meiosis. D2.2.8—Examples of environmental effects on gene expression in cells and organisms Include the 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.	
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.	**Formative assessment:** ✓ 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	**Summative assessment:** ✓ 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 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	✓ Personal and Shared Knowledge ❏ Ways of Knowing ❏ Areas of Knowledge ✓ The Knowledge Framework Details: The discovery of the Archaeopteryx fossil in the 1860s was considered evidence of Charles Darwin's theory of evolution because it had features of both birds and reptiles. The fossil, which was about the size of a magpie, had feathers, and wings, and walked and perched like a bird, but also had a long bony tail, teeth instead of a beak, and three claws on each wing. Some say the fossil showed how birds evolved from dinosaurs, and it became a key piece of evidence for the origin of birds and the transitional fossils debate. However, the discovery of several small, feathered dinosaurs in recent years has raised questions about Archaeopteryx's position in the evolutionary tree of birds. In 2011, one study concluded that Archaeopteryx was actually a dinosaur, not a bird. https://www.newscientist.com/article/2183633-dinosaur-fossil-may-be-a-whole-new-species-of-t	☐ 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) - The course enables students, through the overarching theme of the NOS, to: ● Acquire and apply a body of knowledge, methods, tools, and techniques that characterize science ● Develop the ability to analyze, evaluate, and synthesize scientific information and claims ● Develop an appreciation of the possibilities and limitations of science ● Develop the ability to communicate and collaborate effectively ● Develop awareness of the ethical, environmental, economic, cultural, and social impact of science.

Resources
MCS Science Resources ● Textbook Pearson Biology for the IB Diploma Standard and Higher Level ● 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

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