Marietta City Schools

2025–2026 District Unit Planner

IB Biology Y2 Ecosystems: Interactions and Interdependence Unit 4 Planner

Teacher(s)	IB Biology PLC	**Subject group and course**	Group 4/IB Biology Y2 SL		
Course part and topic	Unit 4: Ecosystems: Interactions and Interdependence **B4.1**.1-4.1.8, **B4.2**.1-4.2.13, **C4.1**.1-4.1.18, **C4.2**.1-4.2.22	**SL or HL/Year 1 or 2**	SL Y2	**Dates**	6 weeks

Unit description and texts	**DP assessment(s) for unit**
In this unit students will investigate the movement of matter and energy through ecosystems. More specifically ecosystem's structure, nutrient cycling, community ecology and climate change. In addition, the role humans play in the changing environment will be evaluated. 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:** • **B4.1.4 Use transect data to correlate the distribution of plant or animal species with an abiotic variable from a natural or semi-natural habitat.** • **B4.2.8 Students should examine models or digital collections of skulls to infer diet from the anatomical features. Examples may include *Homo sapiens* (humans), *Homo floresiensis* and *Paranthropus robustus*** • **C4.1.3 Random quadrat sampling to estimate population size for sessile organisms (plants and animals) - number counts suitable - standard deviation of the mean** • **C4.1.4 Capture–mark–release–recapture and the Lincoln index to estimate population size for motile organisms** • **C4.1.7 Population Growth Curves - test the growth of a population against the model of exponential growth using a graph with a logarithmic scale for size of population on the vertical axis and a non-logarithmic scale for time on the horizontal axis** • **C4.1.8 Modelling of the sigmoid population growth curve-collect data**

	regarding population growth. Yeast and duckweed are recommended but other organisms that proliferate under experimental conditions could be used ● **C4.1.15 Use of the chi-squared test for association between (presence/absence) two species- several sampling sites, exploring the differences or similarities in distribution (interspecific competition)** ● **C4.2.11 Construction of energy pyramids -use research data from specific ecosystems to represent energy transfer and energy losses between trophic levels in food chains**

INQUIRY: Establishing the purpose of the unit

Unit Statement of Inquiry: In recent years, the underlying biochemical unity of all plants, animals and microbes has become increasingly apparent.

Core Ideas: Adaptation to the Environment, Ecological Niches, Populations and Communities, Transfers of Energy and Matter

Phenomenon: *Plasmodium falciparum* is a protozoan parasite that has adapted to live and reproduce in mosquitoes and humans.

Crosscutting Concepts-
- Energy and Matter: Flows, Cycles, and Conservation
- Stability and Change of Systems
- Patterns
- Scale, Proportion, and Quantity

SEP:
- Developing and Using Models
- Obtaining, Evaluating, and Communicating information
- Analyzing and Interpreting Data
- Planning and Carrying out Investigations

ACTION: teaching and learning through inquiry

<table>
<tr>
<th>Content/skills/concepts—essential understandings
U = Understandings NOS = Nature of Science
A = Applications S = Skills</th>
<th>Learning process
Check the boxes for any pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.</th>
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B4.1 Adaptation to environment Form and function—Ecosystems

B4.1.1—Habitat as the place in which a community, species, population or organism lives
A description of the habitat of a species can include both geographical and physical locations, and the type of ecosystem.

B4.1.2—Adaptations of organisms to the abiotic environment of their habitat
Include a grass species adapted to sand dunes and a tree species adapted to mangrove swamps.

B4.1.3—Abiotic variables affecting species distribution
Include examples of abiotic variables for both plants and animals. Students should understand that the adaptations of a species give it a range of tolerance.

B4.1.4—Range of tolerance of a limiting factor
Application of skills: Students should use transect data to correlate the distribution of plant or animal species with an abiotic variable. Students should collect this data themselves from a natural or seminatural habitat. Semi-natural habitats have been influenced by humans but are dominated by wild rather than cultivated species. Sensors could be used to measure abiotic variables such as temperature, light intensity and soil pH.

B4.1.5—Conditions required for coral reef formation
Coral reefs are used here as an example of a marine ecosystem. Factors should include water depth, pH, salinity, clarity and temperature.

B4.1.6—Abiotic factors as the determinants of terrestrial biome distribution
Students should understand that, for any given temperature and rainfall pattern, one natural ecosystem type is likely to develop. Illustrate this using a graph showing the distribution of biomes with these two climatic variables on the horizontal and vertical axes.

B4.1.7—Biomes as groups of ecosystems with similar communities due to similar abiotic conditions and convergent evolution
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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.

All review items will be flipped Schoology lessons with connections to Unit materials in class.
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Students should be familiar with the climate conditions that characterize the tropical forest, temperate forest, taiga, grassland, tundra and hot desert biomes. **B4.1.8—Adaptations to life in hot deserts and tropical rainforest** Include examples of adaptations in named species of plants and animals. **LQ-** **• What are the properties of the components of biological systems?** **• Is light essential for life?** **B4.2 Ecological niches Form and function—Ecosystems** **GQ-** **• What are the advantages of specialized modes of nutrition to living organisms?** **• How are the adaptations of a species related to its niche in an ecosystem?** **B4.2.1—Ecological niche as the role of a species in an ecosystem** Include the biotic and abiotic interactions that influence growth, survival and reproduction, including how a species obtains food. **B4.2.2—Differences between organisms that are obligate anaerobes, facultative anaerobes and obligate aerobes** Limit to the tolerance of these groups of organisms to the presence or absence of oxygen gas in their environment. **B4.2.3—Photosynthesis as the mode of nutrition in plants, algae and several groups of photosynthetic prokaryotes** Details of different types of photosynthesis in prokaryotes are not required. **B4.2.4—Holozoic nutrition in animals** Students should understand that all animals are heterotrophic. In holozoic nutrition food is ingested, digested internally, absorbed and assimilated. **B4.2.5—Mixotrophic nutrition in some protists** Euglena is a well-known freshwater example of a protist that is both autotrophic and heterotrophic, but many other mixotrophic species are part of oceanic plankton. Students should understand that some mixotrophs are obligate and others are facultative.	

B4.2.6—Saprotrophic nutrition in some fungi and bacteria Fungi and bacteria with this mode of heterotrophic nutrition can be referred to as decomposers. **B4.2.7—Diversity of nutrition in archaea** Students should understand that archaea are one of the three domains of life and appreciate that they aremetabolically very diverse. Archaea species use either light, oxidation of inorganic chemicals or oxidation of carbon compounds to provide energy for ATP production. Students are not required to name examples. **B4.2.8—Relationship between dentition and the diet of omnivorous and herbivorous representative members of the family Hominidae** **Application of skills: Students should examine models or digital collections of skulls to infer diet from the anatomical features. Examples may include *Homo sapiens* (humans), *Homo floresiensis* and *Paranthropus robustus*.** **NOS: Deductions can be made from theories. In this example, observation of living mammals led to theories relating dentition to herbivorous or carnivorous diets. These theories allowed the diet of extinct organisms to be deduced.** **B4.2.9—Adaptations of herbivores for feeding on plants and of plants for resisting herbivory** **For herbivore adaptations, include piercing and chewing mouthparts of leaf-eating insects. Plants resist herbivory using thorns and other physical structures. Plants also produce toxic secondary compounds in seeds and leaves. Some animals have metabolic adaptations for detoxifying these toxins.** **B4.2.10—Adaptations of predators for finding, catching and killing prey and of prey animals for resisting predation** Students should be aware of chemical, physical and behavioural adaptations in predators and prey. **B4.2.11—Adaptations of plant form for harvesting light** Include examples from forest ecosystems to illustrate how plants in forests use different strategies to reach light sources, including trees that reach the canopy, lianas, epiphytes growing on branches of trees, strangler epiphytes, shade-tolerant shrubs and herbs growing on the forest floor. **B4.2.12—Fundamental and realized niches** Students should appreciate that fundamental niche is the potential of a species based on adaptations and tolerance limits and that realized niche is the actual extent of a species niche when in competition with other species.	

B4.2.13—Competitive exclusion and the uniqueness of ecological niches Include elimination of one of the competing species or the restriction of both to a part of their fundamental niche as possible outcomes of competition between two species. **C4.1 Populations and Communities Interaction and Interdependence - Ecosystems** **GQ-** **• How do interactions between organisms regulate sizes of populations in a community?** **• What interactions within a community make its populations interdependent?** **C4.1.1—Populations as interacting groups of organisms of the same species living in an area** **Students should understand that members of a population normally breed and that reproductive isolation is used to distinguish one population of a species from another.** **C4.1.2—Estimation of population size by random sampling** **Students should understand reasons for estimating population size, rather than counting every individual, and the need for randomness in sampling procedures.** **NOS: Students should be aware that random sampling, instead of measuring an entire population, inevitably results in sampling error. In this case the difference between the estimate of population size and the true size of the whole population is the sampling error.** **C4.1.3—Random quadrat sampling to estimate population size for sessile organisms** Both sessile animals and plants, where the numbers of individuals can be counted, are suitable. **Application of skills: Students should understand what is indicated by the standard deviation of a mean. Students do not need to memorize the formula used to calculate this. In this example, the standard deviation of the mean number of individuals per quadrat could be determined using a calculator to give a measure of the variation and how evenly the population is spread.** **C4.1.4—Capture–mark–release–recapture and the Lincoln index to estimate population size for motile organisms** **Application of skills: Students should use the Lincoln index to estimate population size. Population size estimate = M × NR, where M is the number of individuals caught and marked initially, N is the total number of individuals recaptured and R is the number of marked individuals recaptured. Students should understand the assumptions made when using this method.**	

C4.1.5—Carrying capacity and competition for limited resources A simple definition of carrying capacity is sufficient, with some examples of resources that may limit carrying capacity. **C4.1.6—Negative feedback control of population size by density-dependent factors** Numbers of individuals in a population may fluctuate due to density-independent factors, but densitydependent factors tend to push the population back towards the carrying capacity. In addition to competition for limited resources, include the increased risk of predation and the transfer of pathogens or pests in dense populations. **C4.1.7—Population growth curves** Students should study at least one case study in an ecosystem. Students should understand reasons for exponential growth in the initial phases. A lag phase is not expected as a part of sigmoid population growth. **NOS: The curve represents an idealized graphical model. Students should recognize that models are often simplifications of complex systems.** **Application of skills: Students should test the growth of a population against the model of exponential growth using a graph with a logarithmic scale for size of population on the vertical axis and a nonlogarithmic scale for time on the horizontal axis.** **C4.1.8—Modelling of the sigmoid population growth curve** **Application of skills: Students should collect data regarding population growth. Yeast and duckweed are recommended but other organisms that proliferate under experimental conditions could be used.** **C4.1.9—Competition versus cooperation in intraspecific relationships** Include reasons for intraspecific competition within a population. Also include a range of real examples of competition and cooperation. **C4.1.10—A community as all of the interacting organisms in an ecosystem** Communities comprise all the populations in an area including plants, animals, fungi and bacteria. **C4.1.11—Herbivory, predation, interspecific competition, mutualism, parasitism and pathogenicity as categories of interspecific relationship within communities** Include each type of ecological interaction using at least one example.	

C4.1.12—Mutualism as an interspecific relationship that benefits both species Include these examples: root nodules in Fabaceae (legume family), mycorrhizae in Orchidaceae (orchid family) and zooxanthellae in hard corals. In each case include the benefits to both organisms. Note: When students are referring to organisms in an examination, either the common name or the scientific name is acceptable. **C4.1.13—Resource competition between endemic and invasive species** Choose one local example to illustrate competitive advantage over endemic species in resource acquisition as the basis for an introduced species becoming invasive. **C4.1.14—Tests for interspecific competition** Interspecific competition is indicated but not proven if one species is more successful in the absence of another. Students should appreciate the range of possible approaches to research: laboratory experiments, field observations by random sampling and field manipulation by removal of one species. **NOS: Students should recognize that hypotheses can be tested by both experiments and observations and should understand the difference between them.** **C4.1.15—Use of the chi-squared test for association between two species** **Application of skills: Students should be able to apply chi-squared tests on the presence/absence of two species in several sampling sites, exploring the differences or similarities in distribution. This may provide evidence for interspecific competition.** **C4.1.16—Predator–prey relationships as an example of density-dependent control of animal populations** Include a real case study. **C4.1.17—Top-down and bottom-up control of populations in communities** Students should understand that both of these types of control are possible, but one or the other is likely to be dominant in a community. **C4.1.18—Allelopathy and secretion of antibiotics** These two processes are similar in that a chemical substance is released into the environment to deter potential competitors. Include one specific example of each—where possible, choose a local example. **LQ-** **• What are the benefits of models in studying biology?**	

• **What factors can limit capacity in biological systems?** **C4.2 Transfers of Energy and Matter - Interactions and Interdependence - Ecosystems** **GQ-** • **What is the reason matter can be recycled in ecosystems but energy cannot?** • **How is the energy that is lost by each group of organisms in an ecosystem replaced?** **C4.2.1—Ecosystems as open systems in which both energy and matter can enter and exit** Students should know that in closed systems only energy is able to pass in and out. **C4.2.2—Sunlight as the principal source of energy that sustains most ecosystems** Include exceptions such as ecosystems in caves and below the levels of light penetration in oceans. **NOS: Laws in science are generalized principles, or rules of thumb, formulated to describe patterns observed in nature. Unlike theories, they do not offer explanations, but describe phenomena. Like theories, they can be used to make predictions. Students should be able to outline the features of useful generalizations.** **C4.2.3—Flow of chemical energy through food chains** Students should appreciate that chemical energy passes to a consumer as it feeds on an organism that is the previous stage in a food chain. **C4.2.4—Construction of food chains and food webs to represent feeding relationships in a community** Represent relationships in a local community if possible. Arrows indicate the direction of transfer of energy and biomass. **C4.2.5—Supply of energy to decomposers as carbon compounds in organic matter coming from dead organisms** Include faeces, dead parts of organisms and dead whole organisms. **C4.2.6—Autotrophs as organisms that use external energy sources to synthesize carbon compounds from simple inorganic substances** Students should understand that energy is required for carbon fixation and for the anabolic reactions that build macromolecules. **C4.2.7—Use of light as the external energy source in photoautotrophs and oxidation reactions as the**	

energy source in chemoautotrophs Students should understand that oxidation reactions release energy, so they are useful in living organisms. Include iron-oxidizing bacteria as an example of a chemoautotroph. **C4.2.8—Heterotrophs as organisms that use carbon compounds obtained from other organisms to synthesize the carbon compounds that they require** Students should appreciate that complex carbon compounds such as proteins and nucleic acids are digested either externally or internally and are then assimilated by constructing the carbon compounds that are required. **C4.2.9—Release of energy in both autotrophs and heterotrophs by oxidation of carbon compounds in cell respiration** Students are not required to be familiar with photoheterotrophs. **C4.2.10—Classification of organisms into trophic levels** Use the terms "producer", "primary consumer", "secondary consumer" and "tertiary consumer". Students should appreciate that many organisms have a varied diet and occupy different trophic levels in different food chains. **C4.2.11—Construction of energy pyramids** **Application of skills: Students should use research data from specific ecosystems to represent energy transfer and energy losses between trophic levels in food chains.** **C4.2.12—Reductions in energy availability at each successive stage in food chains due to large energy losses between trophic levels** Decomposers and detritus feeders are not usually considered to be part of food chains. However, students should understand the role of these organisms in energy transformations in food chains. Consider the causes of energy loss. **C4.2.13—Heat loss to the environment in both autotrophs and heterotrophs due to conversion of chemical energy to heat in cell respiration** Include the idea that energy transfers are not 100% efficient so heat is produced both when ATP is produced in cell respiration and when it is used in cells. **C4.2.14—Restrictions on the number of trophic levels in ecosystems due to energy losses** At each successive stage in food chains there are fewer organisms or smaller organisms. There is therefore less biomass, but the energy content per unit mass is not reduced. **C4.2.15—Primary production as accumulation of carbon compounds in biomass by autotrophs**	

The units should be mass (of carbon) per unit area per unit time and are usually g m^{-2} yr^{-1}. Students should understand that biomes vary in their capacity to accumulate biomass. Biomass accumulates when autotrophs and heterotrophs grow or reproduce. **C4.2.16—Secondary production as accumulation of carbon compounds in biomass by heterotrophs** Students should understand that, due to loss of biomass when carbon compounds are converted to carbon dioxide and water in cell respiration, secondary production is lower than primary production in an ecosystem. **C4.2.17—Constructing carbon cycle diagrams** Students should illustrate with a diagram how carbon is recycled in ecosystems by photosynthesis, feeding and respiration. **C4.2.18—Ecosystems as carbon sinks and carbon sources** If photosynthesis exceeds respiration there is a net uptake of carbon dioxide and if respiration exceeds photosynthesis there is a net release of carbon dioxide. **C4.2.19—Release of carbon dioxide into the atmosphere during combustion of biomass, peat, coal, oil and natural gas** Students should appreciate that these carbon sinks vary in date of formation and that combustion following lightning strikes sometimes happens naturally but that human activities have greatly increased combustion rates. **C4.2.20—Analysis of the Keeling Curve in terms of photosynthesis, respiration and combustion** Include analysis of both the annual fluctuations and the long-term trend. **C4.2.21—Dependence of aerobic respiration on atmospheric oxygen produced by photosynthesis, and of photosynthesis on atmospheric carbon dioxide produced by respiration** The fluxes involved per year are huge, so this is a major interaction between autotrophs and heterotrophs. **C4.2.22—Recycling of all chemical elements required by living organisms in ecosystems** Students should appreciate that all elements used by living organisms, not just carbon, are recycled and that decomposers play a key role. Students are not required to know details of the nitrogen cycle and other nutrient cycles. **LQ-** **• What are the direct and indirect consequences of rising carbon dioxide levels in the atmosphere?** **• How does the transformation of energy from one form to another make biological processes possible?**	

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: What challenges are raised by the communication of scientific knowledge? The challenge of interpreting writing from the past is to attempt to understand the perspective of the time. Scientists often have a deep understanding of the causes of issues of global concern. Thay can appropriately influence the actions of citizens if they provide clear information about research findings. However, popular media coverage of science has a publication bias toward stories that describe something novel, especially if it can capture the public's attention. The libnguistic relativity hypothesis argues that the words we use have	☐ 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.

	an impact on our perception of the world. The strategy of choosing a term that can affect perception has helped popularize the use of plastic in the ocean (The Great Pacific Garbage Patch). Activity: Analyze changes in the frequency of use terms: Google search for greenhouse effect, climate change, global warning, global heating, climate crisis, and climate emergency. Search for synonyms.	

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