Marietta City Schools

2025-2026 District Unit Planner

Teacher(s)	IB ESS Y1- Glazebrook PLC: Glazebrook	**Subject group and course**	Environmental Systems and Society (ESS)		
Course part and topic	Unit 2- Topic 2: Ecology	**SL or HL/Year 1 or 2**	SL; Year 1	**Dates**	12 weeks- Semester 1

Unit description and texts	**DP assessment(s) for unit**
Topic 2 focuses on the study of ecological systems at multiple scales—from individuals and populations to communities and ecosystems. Students explore how energy flows and matter cycles within systems, how organisms interact, and how human activities disrupt these dynamics. The topic emphasizes ecological modelling, population dynamics, trophic interactions, and human impacts on ecosystems. Through this, students develop a systems-based understanding of how ecological processes sustain life and how societies influence them. **Environmental systems and societies guide**	● 2 Summative unit assessments ● 3 Formative quizzes ● Midterm ● Lincoln index to estimate population size ● Carrying capacity/limiting factor activity ● Bioaccumulation simulation and modeling ● Deforestation and impacts of biogeochemical cycles research ● Succession investigation

Statement of Inquiry:
Ecosystems are dynamic systems whose stability depends on energy flow, species interactions, and responses to disturbance.

Phenomenon:
Coral reefs, once vibrant ecosystems, are increasingly experiencing bleaching events and biodiversity collapse.

Crosscutting Concepts:
- Systems and system models
- Energy and matter
- Stability and change
- Structure and function

Core Ideas:
2.1 Individuals, Populations, Communities, and Ecosystems

- Populations consist of individuals of the same species living in the same area at the same time.
- Communities are groups of populations interacting within an ecosystem.
- Ecosystems include both biotic communities and abiotic components.
- Abiotic factors (e.g., light, temperature) and biotic factors (e.g., competition, predation) influence distribution.

2.2 Species Interactions

- Organisms interact in ways that include predation, competition, mutualism, parasitism, and commensalism.
- A species' ecological niche includes its habitat, role, and interactions.
- Keystone species play a critical role in maintaining ecosystem structure.

2.3 Energy in Ecosystems

- Energy flows through ecosystems from producers to consumers and decomposers.
- Food chains and food webs show energy transfer.
- Energy decreases at each trophic level due to loss as heat (10% rule).

2.4 Biogeochemical Cycles

- Water, carbon, nitrogen, and phosphorus cycle through ecosystems.
- Key processes include evaporation, photosynthesis, nitrogen fixation, and decomposition.
- Human activity (e.g., deforestation, agriculture) disrupts natural cycles.

2.5 Succession and Ecosystem Stability

- Succession is a natural process of ecological change over time.
- Primary succession starts from bare substrate; secondary follows disturbance.
- Biodiversity, productivity, and resilience increase with succession.
- Human activities can interrupt or redirect succession (e.g., agriculture, grazing).

<u>SEPs:</u>

- Asking Questions and Defining Problems
- Developing & Using Models
- Analyzing & interpreting data
- Use mathematics and computational thinking
- Constructing Explanations
- Obtaining, evaluating and communicating information

INQUIRY: establishing the purpose of the unit

Transfer goals ***List here one to three big, overarching, long-term goals for this unit. Transfer goals are the major goals that ask students to "transfer" or apply their knowledge, skills, and concepts at the end of the unit under new/different circumstances, and on their own without scaffolding from the teacher.***
SWBAT: At the end of this unit, students should be able to independently and effectively: ● **Apply ecological concepts** (such as food webs, productivity, and carrying capacity) to novel environmental issues and predict outcomes of human or natural disturbances. ● **Use systems thinking** to connect ecological processes with broader sustainability challenges, recognizing interactions between human societies and natural systems. ● **Evaluate and propose solutions** to ecological problems (e.g., habitat loss, pollution, invasive species) that balance ecological integrity with human needs, applying knowledge independently to new contexts.

ACTION: teaching and learning through inquiry

Content/skills/concepts—essential understandings	**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:	Learning experiences and strategies/planning for self-supporting learning:
Guiding Questions for Topic 1 Subtopics **2.1 Individuals, Populations, Communities, and Ecosystems** ● How can natural systems be modelled, and can these models be used to predict the effects of human disturbance? **2.2 Energy Flow and Productivity** ● How does energy flow through ecosystems, and what limits the number of trophic levels? ● How can ecological pyramids and productivity measurements be used to evaluate ecosystem health? **2.3 Matter Cycles and Pollution** ● How do matter cycles (carbon, nitrogen, water) sustain ecosystems, and how do human actions disrupt them? ● In what ways do pollutants like microplastics, heavy metals, and persistent organic pollutants alter ecological balance? **2.4 Population Dynamics** ● What factors regulate population size and distribution? ● How do models of population growth (exponential vs logistic) help predict ecological outcomes under different environmental pressures? **2.5 Succession and Ecosystem Change** ● How do ecosystems respond to change over time, both naturally and as a result of human activity? ● What role does ecological succession play in maintaining biodiversity and resilience? **Objectives / Understandings for Topic 2** **2.1 Individuals and populations, communities and ecosystems**	**Study Skills** ● Teach study reading & Cornell notes ● Independent reading outside of class **Small group/pair work** ● Jigsaw summaries ● Flexible grouping **Writing/Diagram-ing** ● In-Class Practice **Interdisciplinary learning** The course is interdisciplinary by nature. Other/s: **Accommodations:** ● *SWD/504 – Accommodations Provided* ● *ELL – Reading & Vocabulary Support* ● *Intervention Support* ● *Extensions – Enrichment Tasks and Project*

• 2.1.1 The biosphere is an ecological system composed of individuals, populations, communities, ecosystems. • 2.1.2 An individual organism is a member of a species. • 2.1.3 Classification of organisms allows for efficient identification and prediction of characteristics. • 2.1.4 Taxonomists use a variety of tools to identify an organism. • 2.1.5 A population is a group of organisms of the same species living in the same area at the same time, and which are capable of interbreeding. • 2.1.6 Factors that determine the distribution of a population can be abiotic or biotic. • 2.1.7 Temperature, sunlight, pH, salinity, dissolved oxygen and soil texture are examples of many abiotic factors that affect species distributions in ecosystems. • 2.1.8 A niche describes the particular set of abiotic and biotic conditions and resources upon which an organism or a population depends. • 2.1.9 Populations interact in ecosystems by herbivory, predation, parasitism, mutualism, disease and competition, with ecological, behavioural and evolutionary consequences. • 2.1.10 Carrying capacity is the average size of a population determined by competition for limited resources. • 2.1.11 Population size is regulated by density-dependent factors and negative feedback mechanisms. • 2.1.12 Population growth can either be exponential or limited by carrying capacity. • 2.1.13 Limiting factors on the growth of human populations have increasingly been eliminated, resulting in consequences for sustainability of ecosystems. • 2.1.14 Carrying capacity cannot be easily assessed for human populations. • 2.1.15 Population abundance can be estimated using random sampling, systematic sampling or transect sampling. • 2.1.16 Random quadrat sampling can be used to estimate population size for non-mobile organisms. • 2.1.17 Capture–mark–release–recapture and the Lincoln index can be used to estimate population size for mobile organisms. • 2.1.18 A community is a collection of interacting populations within the ecosystem. • 2.1.19 Habitat is the location in which a community, species, population or organism lives. • 2.1.20 Ecosystems are open systems in which both energy and matter can enter and exit. • 2.1.21 Sustainability is a natural property of ecosystems.	

● 2.1.22 Human activity can lead to tipping points in ecosystem stability. ● 2.1.23 Keystone species have a role in the sustainability of ecosystems. ● 2.1.24 The planetary boundaries model indicates that changes to biosphere integrity have passed a critical threshold. ● 2.1.25 To avoid critical tipping points, loss of biosphere integrity needs to be reversed. **2.2 Energy and biomass in ecosystems** ● 2.2.1 Ecosystems are sustained by supplies of energy and matter. ● 2.2.2 The first law of thermodynamics states that as energy flows through ecosystems, it can be transformed from one form to another but cannot be created or destroyed. ● 2.2.3 Photosynthesis and cell respiration or cellular respiration transform energy and matter in ecosystems. ● 2.2.4 Photosynthesis is the conversion of light energy to chemical energy in the form of glucose, some of which can be stored as biomass by autotrophs. ● 2.2.5 Producers form the first trophic level in a food chain. ● 2.2.6 Cell respiration or cellular respiration releases energy from glucose by converting it into a chemical form that can easily be used in carrying out active processes within living cells. ● 2.2.7 Some of the chemical energy released during cell respiration or cellular respiration is transformed into heat. ● 2.2.8 The second law of thermodynamics states that energy transformations in ecosystems are inefficient. ● 2.2.9 Consumers gain chemical energy from carbon (organic) compounds obtained from other organisms. Consumers have diverse strategies for obtaining energy-containing carbon compounds. ● 2.2.10 Because producers in ecosystems make their own carbon compounds by photosynthesis, they are at the start of food chains. Consumers obtain carbon compounds from producers or other consumers, so form the subsequent trophic levels. ● 2.2.11 Carbon compounds and the energy they contain are passed from one organism to the next in a food chain. The stages in a food chain are called trophic levels. ● 2.2.12 There are losses of energy and organic matter as food is transferred along a food chain. ● 2.2.13 Gross productivity (GP) is the total gain in biomass by an organism. Net productivity (NP) is the amount remaining after losses due to cell respiration or cellular respiration.	

- 2.2.14 The number of trophic levels in ecosystems is limited due to energy losses.
- 2.2.15 Food webs show the complexity of trophic relationships in communities.
- 2.2.16 Biomass of a trophic level can be measured by collecting and drying samples.
- 2.2.17 Ecological pyramids are used to represent relative numbers, biomass or energy of trophic levels in an ecosystem.
- 2.2.18 Pollutants that are non-biodegradable, such as polychlorinated biphenyl (PCB), dichlorodiphenyltrichloroethane (DDT) and mercury, cause changes to ecosystems through the processes of bioaccumulation and biomagnification.
- 2.2.19 Non-biodegradable pollutants are absorbed within microplastics, which increases their transmission in the food chain.
- 2.2.20 Human activities, such as burning fossil fuels, deforestation, urbanization and agriculture, have impacts on flows of energy and transfers of matter in ecosystems.

2.3 Biogeochemical cycles

- 2.3.1 Biogeochemical cycles ensure chemical elements continue to be available to living organism
- 2.3.2 Biogeochemical cycles have stores, sinks and sources.
- 2.3.3 Organisms, crude oil and natural gas contain organic stores of carbon. Inorganic stores can be found in the atmosphere, soils and oceans.
- 2.3.4 Carbon flows between stores in ecosystems by photosynthesis, feeding, defecation, cell respiration or cellular respiration, death and decomposition.
- 2.3.5 Carbon sequestration is the process of capturing gaseous and atmospheric carbon dioxide and storing it in a solid or liquid form.
- 2.3.6 Ecosystems can act as stores, sinks or sources of carbon.
- 2.3.7 Fossil fuels are stores of carbon with unlimited residence times. They were formed when ecosystems acted as carbon sinks in past eras and become carbon sources when burned.
- 2.3.8 Agricultural systems can act as carbon stores, sources and sinks, depending on the techniques used.
- 2.3.9 Carbon dioxide is absorbed into the oceans by dissolving and is released as a gas when it comes out of a solution.
- 2.3.10 Increases in concentrations of dissolved carbon dioxide cause ocean acidification, harming marine animals.

● 2.3.11 Measures are required to alleviate the effects of human activities on the carbon cycle. **2.4 Climate and biomes** ● 2.4.1 Climate describes atmospheric conditions over relatively long periods of time, whereas weather describes the conditions in the atmosphere over a short period of time. ● 2.4.2 A biome is a group of comparable ecosystems that have developed in similar climatic conditions, wherever they occur. ● 2.4.3 Abiotic factors are the determinants of terrestrial biome distribution. ● 2.4.4 Biomes can be grouped into various different types that include freshwater, marine, forest, grassland, desert and tundra. Each of these classes has characteristic abiotic limiting factors, productivity and diversity. They may be further classed into many subcategories (for example, temperate forests, tropical rainforests and boreal forests). ● 2.4.5 The tricellular model of atmospheric circulation explains the behaviour of atmospheric systems and the distribution of precipitation and temperature at different latitudes. It also explains how these factors influence the structure and relative productivity of different terrestrial biomes. ● 2.4.6 The oceans absorb solar radiation and ocean currents distribute the resulting heat around the world. ● 2.4.7 Global warming is leading to changing climates and shifts in biomes. **2.5 Zonation, succession and change in ecosystems** ● 2.5.1 Zonation refers to changes in community along an environmental gradient. ● 2.5.2 Transects can be used to measure biotic and abiotic factors along an environmental gradient in order to determine the variables that affect the distribution of species. ● 2.5.3 Succession is the replacement of one community by another in an area over time due to changes in biotic and abiotic variables. ● 2.5.4 Each seral community (sere) in a succession causes changes in environmental conditions that allow the next community to replace it through competition until a stable climax community is reached ● 2.5.5 Primary successions happen on newly formed substratum where there is no soil or preexisting community, such as rock newly formed by volcanism, moraines revealed by retreating glaciers, wind-blown sand or waterborne silt. ● 2.5.6 Secondary successions happen on bare soil where there has been a pre-existing community, such as a field where agriculture has ceased or a forest after an intense firestorm.	

• 2.5.7 Energy flow, productivity, species diversity, soil depth and nutrient cycling change over time during succession. • 2.5.8 An ecosystem's capacity to tolerate disturbances and maintain equilibrium depends on its diversity and resilience. Students will develop the following skills: **Critical Thinking & Evaluation** • Analyze environmental value systems (EVS) and how they influence decision-making. • Evaluate the influence of historical events, media, science, and politics on environmental movements. **Systems Thinking** • Create and interpret systems diagrams with flows, storages, feedback loops, and tipping points. **Communication & Collaboration** • Engage in respectful debates, discussions, and group activities around environmental perspectives. • Design and carry out effective surveys/questionnaires to gather and analyze values and perspectives. **Data Literacy** • Select and apply statistical tools (e.g., correlation, behavior-over-time graphs) to analyze survey results or system behaviors. **Ethical Reasoning** • Examine and justify ethical positions on environmental issues and decisions using a variety of worldviews.	

Formative assessment:

Each subtopic will be assessed using topic quizzes.. Students will also complete individual and group assignments to demonstrate understanding of and practice with concepts, content, and skills.

Summative assessment:

Summative Case-study assessments will mirror criteria described by the IB program. Unit test will mirror the IB exam students will take at the end of the year**.**

Differentiation:

- ***Just-in-time reteaching from formative quizzes at the start of most class sessions***
- ***Scaffold learning*** *- teaching study skills and writing strategies as well as content*
- ***Extend learning*** *- authentic science writing & documentaries for advanced reading*

Details: Growth will be monitored using formative assessments by instructor. Remediation/ extension will be conducted through homework activities and investigations conducted in class. One on one tutoring offered to assist students needing additional assistance with material.

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.

1. Communication skills

- Exchanging thoughts, messages and information effectively through interaction
- Reading, writing and using language to gather and communicate information

2. Research skills

- Finding, interpreting, judging and creating information
- Interacting with media to use and create ideas and information

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.*
Explicit Language and Learning Connections Made During Topic 1 Topic 1 is rich in interdisciplinary vocabulary and conceptual language that helps students make connections across subjects and develop holistic environmental literacy. These connections include: **Key Vocabulary and Conceptual Terms:** ● **Levels of Organization**: biosphere, ecosystem, community, population, species, niche (fundamental vs. realized). ● **Population Dynamics**: carrying capacity, limiting factors, exponential growth, logistic growth, r-strategists, K-strategists. ● **Energy Flow & Productivity**: trophic level, food chain, food web, gross productivity (GP), net productivity (NP), ecological pyramids, second law of thermodynamics. ● **Cycles & Matter**: carbon cycle, nitrogen cycle, water cycle, nutrient cycling.	**Theory of Knowledge (TOK) Connections for Topic 1** Topic 1 is deeply connected to TOK through the exploration of perspectives, ethics, and the production of knowledge about environmental systems. **TOK Knowledge Questions (KQs) Relevant to Topic 1:** ● To what extent do models (e.g., population growth, food webs) represent reality in ecology? ● How do different cultures value ecosystems, and how does this shape what is considered "knowledge" about sustainability? ● What role does uncertainty play in ecological predictions? ● To what degree should ethical considerations guide ecological research? **Relevant Areas of Knowledge (AOKs):** ● **Natural Sciences**:	**Explicit Learning and Language Connections Made During Topic 1** <table><tr><th>Learning Connection</th><th>Explanation</th></tr><tr><td>Systems Thinking in Sciences and Geography</td><td>Supports understanding of feedback, scale, and modeling environmental processes.</td></tr><tr><td>Ethical Reasoning in TOK and Philosophy</td><td>Connects to moral implications of sustainability and environmental justice.</td></tr><tr><td>Critical Literacy in Language and Social Studies</td><td>Enhances skills in interpreting environmental texts, media, and value positions.</td></tr><tr><td>Quantitative Reasoning in Math and Science</td><td>Needed for modeling systems, analyzing surveys, and calculating ecological data.</td></tr><tr><td>Cultural and Political Awareness in Civics</td><td>Explores governance, stakeholder roles, and worldview formation.</td></tr><tr><td>Personal Reflection and Communication Skills (ATL)</td><td>Encourages articulation of values, persuasive writing, and respectful dialogue.</td></tr></table>

• **Pollution & Human Impact**: bioaccumulation, biomagnification, non-biodegradable pollutants, microplastics, deforestation, ecosystem resilience. • **Succession & Change**: seral stage, pioneer species, climax community, primary succession, secondary succession, resilience, stability. **Interdisciplinary Learning Links:** • **Biology**: Cellular respiration, photosynthesis, adaptations, genetic variation, population biology. • **Chemistry**: Biogeochemical cycles, pollutants (DDT, PCBs, mercury), chemical transformations in ecosystems. • **Mathematics**: Lincoln Index (population estimation), logistic vs. exponential growth curves, percentage calculations for energy transfer, data analysis from sampling. • **Geography**: Biomes, land-use change, deforestation, human impacts on ecosystems, mapping succession/zonation.	Ecological models, data collection, population studies. • **Human Sciences**: Human impacts on ecosystems, social/economic drivers of deforestation. • **Ethics**: Moral responsibility in managing ecological resources and biodiversity. **TOK Concepts Featured:** • Evidence, Certainty, Truth, Interpretation, Power, Justification, Explanation, Objectivity, Perspective, Culture, Values, Responsibility **Example TOK Activities:** • **Data reliability debate**: Students compare Lincoln Index field data vs. secondary population data; discuss knowledge claims about accuracy. • **Succession thought experiment**: Compare ecological succession in nature vs. human-managed systems (farmlands, urban restoration).	

● **Economics**: Ecosystem services, sustainable resource use, costs of deforestation, evaluating policies for conservation. ● **Ethics/Philosophy**: Debates on ecological responsibility, environmental ethics, indigenous vs. industrialized value systems. **Literacy/Language Connections:** **Academic Language Development**: ● Building discipline-specific vocabulary lists (e.g., bioaccumulation, trophic level, succession). ● Sentence frames for CER writing: *"The data suggests that… This is because… Therefore, we can conclude that…"* **Reading Strategies**: ● Simplified articles for ESOL learners on biomes and pollution. ● Higher-level scientific journal excerpts for advanced learners on ecosystem resilience and succession. **Writing Skills**:	● **Case study discussion**: Bioaccumulation (DDT, mercury) — debate whether banning a chemical reflects scientific certainty, precaution, or ethical responsibility. ● **Cultural lens analysis**: Compare indigenous vs. industrialized perspectives on carrying capacity and resource use.	

● Lab reports (Lincoln Index, succession investigation) emphasizing precise use of terminology. ● Research essays (deforestation & cycles) integrating secondary sources with scientific argumentation. **Oral Language Practice**: ● Structured debates (e.g., "Should governments prioritize economic development or biodiversity conservation?"). ● Peer-to-peer teaching of key terms using diagrams and models. **Visual Literacy**: ● Reading/constructing food webs, pyramids, population graphs, and zonation/succession diagrams.		

Resources *List and attach (if applicable) any resources used in this unit*
● Oxford Environmental Systems and Societies ISBN 978-0-19-833256-5 ● Biozone Environmental Science Student Workbook ISBN 978-1-927173-55-8 ● Hodder Education Environmental Systems and Societies Study and Revision Guide ISBN 978-1-471-89973-7 ● IB ESS Schoology Group

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*