

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 4- Topic 4 Water	SL or HL/Year 1 or 2	SL; Year 1	Dates	6 weeks- Semester 2
Unit description and texts		DP assessment(s) for unit			
<p>Topic 4 examines the distribution of Earth’s water and the limited availability of accessible freshwater. It explores the hydrological cycle, water scarcity, and the concept of water footprints. Students analyze causes and impacts of water pollution, including eutrophication and salinization. The topic also evaluates aquatic food production systems and strategies for sustainable water management.</p> <p>Environmental systems and societies guide</p>		<ul style="list-style-type: none"> ● 1 Summative unit assessment ● 2 Formative quizzes ● Bottle water case study ● Colorado river case study ● Tragedy of the commons activity and discussion ● Water pollution impacts on biodiversity 			
<p><u>Statement of Inquiry:</u> Water is a finite resource whose quality and availability are influenced by human management and natural systems.</p> <p><u>Phenomenon:</u> Despite abundant rainfall, millions globally lack access to clean drinking water.</p> <p><u>Crosscutting Concepts:</u></p> <ul style="list-style-type: none"> ● Systems and system models ● Cause and effect ● Stability and change <p><u>Core Ideas:</u> 4.1 Introduction to Water Systems</p>					

- Most of Earth's water is saltwater; accessible freshwater is limited and unevenly distributed.
- The **hydrological cycle** transfers water between atmosphere, land, and oceans.
- Drainage basins (watersheds) are key units for managing freshwater systems.
- River discharge varies due to climate, geology, and human activity.

4.2 Access to Fresh Water

- Water scarcity can be physical (not enough water) or economic (lack of infrastructure).
- Water stress is measured using per capita availability and withdrawal rates.
- Water footprints show direct and indirect water use (agriculture = largest use).
- Sustainable management balances environmental, social, and economic needs.

4.3 Aquatic Food Production Systems

- Fisheries and aquaculture supply a major portion of global protein.
- Overfishing reduces fish stocks and disrupts food webs.
- Aquaculture can increase food supply but may cause pollution and habitat loss.
- Sustainability depends on management practices and trophic level efficiency.

4.4 Water Pollution

- Pollution sources include agricultural runoff, sewage, industry, and thermal discharge.
- Eutrophication results from excess nutrients, leading to algal blooms and oxygen depletion.
- Bioaccumulation and biomagnification increase toxin concentration up food chains.
- Water quality is assessed using physical, chemical, and biological indicators.

SEPs:

- Developing & Using Models
- Analyzing & interpreting data
- Use mathematics and computational thinking
- Engage in Argument from Evidence

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 systems thinking to water and aquatic environments**
Students can explain how changes in one part of the system (e.g., pollution, overfishing, climate change) affect the entire hydrological or aquatic system.
- **Evaluate human impacts using evidence**
Students can analyze data on water scarcity, water quality, and fisheries to assess environmental and societal consequences.
- **Make and justify sustainability-based decisions**
Students can compare management strategies and defend solutions using environmental, social, and economic reasoning.

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:

Guiding Questions for Topic 4 Subtopics

4.1 Water Systems

- How do water systems support life on Earth, and how do they interact with other systems, such as the carbon cycle?
- How do human activities alter the natural flow of water systems, and what are the potential ecological consequences of these changes?
- In what ways can water systems be managed to ensure long-term sustainability, and what role do different stakeholders (governments, NGOs, communities) play in this process?

4.2 Water access, use and security

- What issues of water equity exist, and how can they be addressed?
- How do human populations affect the water cycle, and how does this impact water security?

4.3 Aquatic food production systems

- How are our diets impacted by our values and perspectives?
- To what extent are aquatic food systems sustainable?

4.4 Water Pollution

- What factors regulate population size and distribution?
- How do models of population growth (exponential vs logistic) help predict ecological outcomes under different environmental pressures?

Objectives / Understandings for Topic 4

4.1 Water Systems

- 4.1.1 Movements of water in the hydrosphere are driven by solar radiation and gravity.
- 4.1.2 The global hydrological cycle operates as a system with stores and flows
- 4.1.3 The main stores in the hydrological cycle are the oceans (96.5%), glaciers and ice caps (1.7%), groundwater (1.7%), surface freshwater (0.02%), atmosphere (0.001%), organisms (0.0001%).
- 4.1.4 Flows in the hydrological cycle include transpiration, sublimation, evaporation, condensation, advection, precipitation, melting, freezing, surface run-off, infiltration, percolation, streamflow and

Learning experiences and strategies/planning for self-supporting learning:

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

groundwater flow.

- 4.1.5 Human activities, such as agriculture, deforestation and urbanization, can alter these flows and stores.
- 4.1.6 The steady state of any water body can be demonstrated through flow diagrams of inputs and outputs.

4.2 Water access, use and security

- 4.2.1 Water security is having access to sufficient amounts of safe drinking water.
- 4.2.2 Social, cultural, economic and political factors all have an impact on the availability of, and equitable access to, the freshwater required for human well-being.
- 4.2.3 Human societies undergoing population growth or economic development must increase the supply of water or the efficiency of its utilization.
- 4.2.4 Water supplies can be increased by constructing dams, reservoirs, rainwater catchment systems, desalination plants and enhancement of natural wetlands.
- 4.2.5 Water scarcity refers to the limited availability of water to human societies.
- 4.2.6 Water conservation techniques can be applied at a domestic level.
- 4.2.7 Water conservation strategies can be applied at an industrial level in food production systems.
- 4.2.8 Mitigation strategies exist to address water scarcity

4.3 Aquatic food production systems

- 4.3.1 Phytoplankton and macrophytes provide energy for freshwater and marine food webs.
- 4.3.2 Humans consume organisms from freshwater and marine environments.
- 4.3.3 Demand for foods from freshwater and marine environments is increasing due to the growth in human population and changes in dietary preferences.
- 4.3.4 The increasing global demand for seafood has encouraged use of unsustainable harvesting practices and overexploitation.
- 4.3.5 Overexploitation has led to the collapse of fisheries.
- 4.3.6 The maximum sustainable yield (MSY) is the highest possible annual catch that can be sustained over time, so it should be used to set caps on fishing quotas.

- 4.3.7 Climate change and ocean acidification are having impacts on ecosystems and may cause collapse of some populations in freshwater or marine ecosystems.
- 4.3.8 Unsustainable exploitation of freshwater and marine ecosystems can be mitigated through policy legislation addressing the fishing industry and changes in consumer behaviour.
- 4.3.9 Marine protected areas (MPAs) can be used to support aquatic food chains and maintain sustainable yields.
- 4.3.10 Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. The industry is expanding to increase food supplies and support economic development, but there are associated environmental impacts.

4.4 Water Pollution

- 4.4.1 Water pollution has multiple sources and has major impacts on marine and freshwater systems.
- 4.4.2 Plastic debris is accumulating in marine environments. Management is needed to remove plastics from the supply chain and to clear up existing pollution.
- 4.4.3 Water quality is the measurement of chemical, physical and biological characteristics of water. Water quality is variable and is often measured using a water quality index. Monitoring water quality can inform management strategies for reducing water pollution.
- 4.4.4 Biochemical oxygen demand (BOD) is a measure of the amount of dissolved oxygen required by microorganisms to decompose organic material in water.
- 4.4.5 Eutrophication occurs when lakes, estuaries and coastal waters receive inputs of mineral nutrients, especially nitrates and phosphates, often causing excessive growth of phytoplankton.
- 4.4.6 Eutrophication leads to a sequence of impacts and changes to the aquatic system.
- 4.4.7 Eutrophication can substantially impact ecosystem services.
- 4.4.8 Eutrophication can be addressed at three different levels of management.

Students will develop the following skills:

Data Analysis & Interpretation

- Analyze graphs and datasets (river discharge, water stress index, fish stock trends, dissolved oxygen levels).

- Interpret water quality indicators (BOD, nitrates, turbidity, pH).
- Draw evidence-based conclusions from quantitative and qualitative data.

Systems Thinking

- Trace flows of water, nutrients, and energy through aquatic systems.
- Identify feedback loops (e.g., eutrophication, overfishing impacts).
- Explain how environmental, social, and economic systems interact.

Application of Sustainability Concepts

- Apply ideas like resilience, carrying capacity, ecological footprint, and equity to water issues.
- Connect water systems to food security, climate change, and biodiversity.

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. Critical Thinking Skills

- Analyzing water scarcity data and pollution indicators
- Evaluating sustainability of fisheries, aquaculture, and water management strategies
- Weighing environmental, social, and economic trade-offs
- Making evidence-based judgments about solutions

2. Research Skills

- Interpreting primary and secondary data (water quality, fish stocks, water footprints)
- Selecting and using relevant case studies
- Citing credible environmental sources
- Synthesizing information to support arguments

Language and learning <i>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.</i>	TOK connections <i>Check the boxes for any explicit TOK connections made during the unit</i>	CAS connections <i>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.</i>														
<p>Explicit Language and Learning Connections Made During Topic 1</p> <p>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:</p> <p>Key Vocabulary and Conceptual Terms:</p> <ul style="list-style-type: none"> • 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. 	<p>Theory of Knowledge (TOK) Connections for Topic 1</p> <p>Topic 1 is deeply connected to TOK through the exploration of perspectives, ethics, and the production of knowledge about environmental systems.</p> <p>TOK Knowledge Questions (KQs) Relevant to Topic 1:</p> <ul style="list-style-type: none"> • 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? <p>Relevant Areas of Knowledge (AOKs):</p> <ul style="list-style-type: none"> • Natural Sciences: 	<p>Explicit Learning and Language Connections Made During Topic 1</p> <table border="1" data-bbox="1415 555 2145 1279"> <thead> <tr> <th>Learning Connection</th> <th>Explanation</th> </tr> </thead> <tbody> <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> </tbody> </table>	Learning Connection	Explanation	Systems Thinking in Sciences and Geography	Supports understanding of feedback, scale, and modeling environmental processes.	Ethical Reasoning in TOK and Philosophy	Connects to moral implications of sustainability and environmental justice.	Critical Literacy in Language and Social Studies	Enhances skills in interpreting environmental texts, media, and value positions.	Quantitative Reasoning in Math and Science	Needed for modeling systems, analyzing surveys, and calculating ecological data.	Cultural and Political Awareness in Civics	Explores governance, stakeholder roles, and worldview formation.	Personal Reflection and Communication Skills (ATL)	Encourages articulation of values, persuasive writing, and respectful dialogue.
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- **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

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