# Topic #1 Foundations of Environmental Systems and Societies

Content Area: **Science**
Course(s): **IB Environmental Sciences and Societies, SL**
Time Period: **First Marking Period**
Length: **16 hours**
Status: **Published**

## Unit Overview

The aims of the ESS course are to enable students to:

1. acquire the knowledge and understandings of environmental systems at a variety of scales

2. apply the knowledge, methodologies, and skills to analyze environmental systems and issues at a variety of scales

3. appreciate the dynamic interconnectedness between environmental systems and societies

4. value the combination of personal, local, and global perspectives in making informed decisions and taking responsible actions on environmental issues

5. be critically aware that resources are finite, and that these could be inequitably distributed and exploited, and that management of these inequities is the key to sustainability

6. develop awareness of the diversity of environmental value systems

7. develop critical awareness that environmental problems are caused and solved by decisions made by individuals and societies that are based on different areas of knowledge

8. engage with the controversies that surround a variety of environmental issues

9. create innovative solutions to environmental issues by engaging actively in local and global contexts

Unit 1 explores the foundations of environmental systems and societies by studying environmental value systems,  systems and models, energy and equilibria, sustainability, humans, and pollution

## STAGE 1- DESIRED RESULTS

## 2020 New Jersey Student Learning Standards- Science

## Science and Engineering Practices

- Analyzing and Interpreting Data
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Developing and Using Models
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information
- Planning and Carrying Out Information
- Using Mathematics and Computational Thinking

## Cross Cutting Concepts

- Cause and Effect
- Energy and Matter
- Influence of Engineering, Technology, and Science on Society and the Natural World
- Interdependence of Science, Engineering, and Technology
- Patterns
- Scale, Proportion, and Quantity
- Stability and Change
- Structure and Functions
- Systems and System Models

## Disciplinary Core Ideas

## Physical Sciences

- PS1A: Structure and Properties of Matter
- PS1B: Chemical Reactions
- PS1C: Nuclear Processes
- PS2A: Forces and Motion
- PS2B: Types of Interaction

- PS3A: Definitions of Energy
- PS3B: Conservation of Energy and Energy Transfer
- PS3C: Relationship Between Energy and Forces
- PS3D: Energy in Chemical Processes and Everyday Life
- PS4A: Wave Properties
- PS4B: Electromagnetic Radiation
- PS4C: Information Technologies and Instrumentation

## Life Sciences

- LS1A: Structure and Functions
- LS1B: Growth and Development of Organisms
- LS1C: Organization for Matter and Energy Flow in Organisms
- LS1D: Information Processing
- LS2A: Interdependent Relationships in Ecosystems
- LS2B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2C: Ecosystems Dynamics, Functioning, and Resilience
- LS2D: Social Interactions and Group Behavior
- LS3A: Inheritance of Traits
- LS3B: Variation of traits
- LS4A: Evidence of Common Ancestry and Diversity
- LS4B: Natural Selection
- LS4C: Adaptation
- LS4D: Biodiversity and Humans

## Earth and Space Sciences

- ESS1A: The Universe and its Stars
- ESS1B: Earth and the Solar System
- ESS1C: The History of Planet Earth
- ESS2A: Earth Materials and Systems
- ESS2B: Plate Tectonics and Large-Scale Systems
- ESS2C: The Role of Water in Earth's Surface Processes
- ESS2D: Weather and Climate
- ESS2E: Biogeology
- ESS3A: Natural Resources
- ESS3B: Natural Hazards
- ESS3C: Human Impacts on Earth Systems

- ESS3D: Global Climate Change

## Engineering. Technology. and Applications of Science

- ETS1A: Defining and Delimiting an Engineering Problem
- ETS1B: Developing Possible Solutioins
- ETS1C: Optimizing the Design Solution

## Essential Questions

Which strengths and weaknesses of the systems, approach and of the use of models have been revealed through this topic?

What value systems are at play in the causes and approaches to resolving the issues addressed in this topic?

How does your personal value system compare with the others you have encountered in the context of issues raised in this topic?

How are the issues addressed in this topic relevant to sustainability or sustainable development?

## Enduring Understanding

- Historical events, among other influences, affect the development of environmental value systems (EVSs) and environmental movements.
- There is a wide spectrum of EVSs, each with its own premises and implications.
- A systems' approach can help in the study of complex environmental issues.
- The use of systems and models simplifies interactions, but may provide a more holistic view without reducing issues to single processes.
- The laws of thermodynamics govern the flow of energy in a system and the ability to do work.
- Systems can exist in alternative stable states or as equilibria between which there are tipping points.
- Destabilizing positive feedback mechanisms will drive systems toward these tipping points, whereas stabilizing negative feedback mechanisms will resist such changes.
- All systems can be viewed through the lens of sustainability.
- Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Environmental indicators and ecological footprints can be used to assess sustainability.
- Environmental impact assessments (EIAs) play an important role in sustainable development.
- Pollution is a highly diverse phenomenon of human disturbance in ecosystems.
- Pollution management strategies can be applied at different levels.

## Students will know...

Abiotic factor, Biochemical oxygen demand (BOD), Biodegradable, Biodiversity, Biomass, Biome Biosphere , Biotic factor, Carrying capacity Climax community, Community, Competition, Correlation, Crude birth rate, Crude death rate, Demographic transition, Diversity, Genetic Diversity Habitat Diversity, Diversity index, Species Diversity, Doubling time, Ecological footprint, Ecosystem, Entropy, Environmental impact assessment (EIA), Equilibrium, Eutrophication, Evolution, Feedback, Feedback, negative Feedback, positive, Fertility, Gaia, Global warming, GNP,Greenhouse gases, Habitat, Halogenated, organic gases, Isolation, *K*-strategist, Latitude, LEDC, MEDC, Model, Mutualism, Natural capital, Natural capital, non-renewable, Natural capital, renewable, Natural capital, replenishable, Natural increase, rate of, Niche Parasitism, Plate tectonics, Pollution, Pollution, non-point source Pollution, point source, Population Productivity, gross (GP), Productivity, gross primary (GPP), Productivity-gross secondary (GSP), Productivity-net (NP) , Productivity-net primary (NPP), Productivity-net secondary (NSP), Productivity, primary Productivity, secondary, *r*-strategist, Sere Smog, Society, Soil, Soil profile, Speciation Species, Stable equilibrium, Standing crop, Steady-state equilibrium, Succession, Sustainability, System, System-closed System-isolated, System-open, Trophic level, Zonation

Predictable misconceptions

Students are not limited to the provided EVS examples, a personal EVS may blend aspects of different EVS's.

Some people object to the concept of “natural capital” because they say it reduces nature to the status of a commodity to be marketed at its exchange value.

## Students will be able to...

• Discuss the view that the environment can have its own intrinsic value.

• Evaluate the implications of two contrasting EVSs in the context of given environmental issues.

• Justify, using examples and evidence, how historical influences have shaped the development of the modern environmental movement.

• Explain the implications of the laws of thermodynamics to ecological systems.

• Discuss resilience in a variety of systems.

• Evaluate the possible consequences of tipping points.

• Explain the relationship between natural capital, natural income, and sustainability.

• Discuss the value of ecosystem services to a society.

• Discuss how environmental indicators such as MA can be used to evaluate the progress of a project to

increase sustainability.

• Evaluate the use of EIAs.

• Explain the relationship between EFs and sustainability.

• Construct systems diagrams to show the impact of pollutants.

• Evaluate the effectiveness of each of the three different levels of intervention, with reference to figure 3.

• Evaluate the uses of DDT.

## STAGE 2- EVIDENCE OF LEARNING

## Formative Assessment

- 3- Minute Pause
- A-B-C Summaries
- Analogy Prompt
- Choral Response
- Debriefing
- Exit Card / Ticket
- Hand Signals
- Idea Spinner
- Index Card Summaries
- Inside-Outside Circle Discussion (Fishbowl)
- Journal Entry
- Misconception Check
- Observation
- One Minute Essay
- One Word Summary
- Portfolio Check
- Questions & Answers
- Quiz
- Self-Assessment
- Student Conference
- Think-Pair-Share

- Web or Concept Map

## Authentic Assessments

• Values and attitude surveys or questionnaires

• Interviews

• Issues-based inquiries to inform decision-making

• Observational fieldwork (natural experiments)

• Field manipulation experiments

• Ecosystem modelling (including mesocosms or bottle experiments)

• Laboratory work

• Models of sustainability

• Use of systems diagrams or other valid holistic modelling approaches

• Elements of environmental impact assessments

• Secondary demographic, development, and environmental data

• Collection of both qualitative and quantitative data

## Benchmark Assessments

IB test questions/essays and case studies.

## STAGE 3- LEARNING PLAN

## Instructional Map

Marking Period 1

Topic 1: Foundations of environmental systems and societies

1.1 Environmental value systems

1.2 Systems and models

1.3 Energy and equilibria

1.4 Sustainability

1.5 Humans and pollution

## Modification/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products

- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

**504 Plans**

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support

- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

**DI** = ppt/air mac, co-operative learning ( mixed ability)

**ESL students**: speaking, reading, writing, peer tutoring

**SPEDs**: restating, reading aloud, quided questions, additional problems and teacher's observations

Rephrase/Clarify/Repeat Directions

Study Guides

Extended Time on Tests / Assignments

Modify Tests / Assignments

Visual Aides

Word Bank

Use a Calculator

Repeated Drill and Practice

Teacher Notes

Preferential Seating

Oral Directions

Use of Additional Reference Materials

Break Down Assignments into Smaller Tasks

**Academic Ability**

1. Struggling: Think--Pair-- Share with gifted students.

2. Gifted: Think-- Pair-- Share with struggling students

## Modification Strategies

- Cooperative Grouping
- Extended Time
- Frequent Breaks
- Highlighted Text
- Interactive Notebook
- Modified Test
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Re-direct
- Repeated Drill and Practice
- Shortened Assisgnment
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials
- Use of Audio Resources

## Differentiation Strategies

## High Preparation

- Alternative Assessments
- Choice Boards
- Games and Tournaments
- Group Investigations
- Guided Reading
- Independent Research / Project
- Interest Groups
- Learning Contracts
- Leveled Rubrics
- Literature Circles
- Multiple Intelligence Options
- Multiple Texts
- Personal Agendas
- Project Based Learning (PBL)
- Stations / Centers
- Think-Tac-Toe
- Tiered Activities / Assignments
- Varying Graphic Organizers

## Low Preparation

- Choice of Book / Activity
- Cubing Activities
- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Goal Setting With Student
- Homework Options
- Jigsaw
- Mini Workshops to Re-teach or Extend Skills
- Open-ended Activities
- Think-Pair-Share by Readiness, Interest, or Learning Style
- Use of Collaboration

- Use of Reading Buddies
- Varied Journal Prompts
- Varied Product Choice
- Varied Supplemental Materials
- Work Alone / Together

## Horizontal Intergration- Interdisciplinary Connections

See Appendix

## Vertical Integration- Discipline Mapping

Students will have been exposed to the Performance Expectations for Life Sciences and Engineering Design outlined in the Next Generation Science Standards (NGSS) starting in 1st grade through Chemistry, which is offered during the sophomore year of High School. Science classes are designed around the Performance Expectations, Science and Engineering Practices, Discplinary Core Ideas, and Croscutting Concepts in the NGSS. In grade 6, students complete a unit on "Diversity of Life". This leads into "Populations and Ecosystems" in grade 7. In grade 8 students study "Human System Interactions" and Heredity and Adaptations." In grade 9 students study Biology, a full year recquired course, Following Biology in 9th grade students will take Chemistry. After students will be able to chose from Physics, Anatomy and Physiology, Human Impact on the Environment, Forensics and Zoology, IB Environmental Systems and Societies, IB Biology, Physics or Chemistry.

## Additional Materials

Kognity (website)

Online Curriculum Center (an IB site)