Topic #2 Ecosystems and Ecology

Content Area: **Science**
Course(s): **IB Environmental Sciences and Societies, SL**
Time Period: **First Marking Period**
Length: **25 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

In Topic 2 students study ecosystems and ecology. By understanding relationships between species and populations, communities and ecosystems, flows of energy and matter, biomes, zonation and succession, and investigating ecosystems students will gain a deeper understanding of how humans fit into and affect the world's ecosystems

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?

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

Enduring Understanding

- A species interacts with its abiotic and biotic environments, and its niche is described by these interactions.
- Populations change and respond to interactions with the environment.
- Any system has a carrying capacity for a given species.
- The interactions of species with their environment result in energy and nutrient flows.
- Photosynthesis and respiration play a significant role in the flow of energy in communities.
- The feeding relationships of species in a system can be modelled using food chains, food webs, and ecological pyramids.
- Climate determines the type of biome in a given area, although individual ecosystems may vary due to many local abiotic and biotic factors.
- Succession leads to climax communities that may vary due to random events and interactions over time. This leads to a pattern of alternative stable states for a given ecosystem.
- Ecosystem stability, succession and biodiversity are intrinsically linked.
- The description and investigation of ecosystems allows for comparisons to be made between different ecosystems and for them to be monitored, modelled and evaluated over time, measuring both natural change and human impacts.
- Ecosystems can be better understood through the investigation and quantification of their components.

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

Varying the population size of species will only affect the others that are directly connected through a food chain
Green plants are the only producers of carbohydrates in ecosystems
Organisms higher in a food web eat everything that is lower in the food web
Plants take in food from the outside environment, and/or plants get their food from the soil via roots

Students will be able to…

• Interpret graphical representations or models of factors that affect an organism's niche. Examples include predator–prey relationships, competition, and organism abundance over time.

• Explain population growth curves in terms of numbers and rates.

• Construct models of feeding relationships—such as food chains, food webs and ecological pyramids—from given data.

• Explain the transfer and transformation of energy as it flows through an ecosystem.

• Analyze the efficiency of energy transfers through a system.

• Construct system diagrams representing photosynthesis and respiration.

• Explain the relevance of the Laws of Thermodynamics to the flow of energy through ecosystems.

• Explain the impact of a persistent or non-biodegradable pollutant in an ecosystem.

• Analyze quantitative models of flows of energy and matter.

• Construct a quantitative model of the flows of energy or matter for given data.

• Analyze the efficiency of energy transfers through a system.

• Calculate the values of both GPP and NPP from given data.

• Calculate the values of both GSP and NSP from given data.

• Discuss human impacts on energy flows and on the carbon and nitrogen cycles.

• Explain the distributions, structure, biodiversity, and relative productivity of contrasting biomes.

• Analyze data for a range of biomes.

• Discuss the impact of climate change on biomes.

• Describe the process of succession in a given example.

• Explain the general patterns of change in communities undergoing succession.

• Discuss the factors which could lead to alternative stable states in an ecosystem.

• Discuss the link between ecosystem stability, succession, diversity, and human activity.

• Distinguish the roles of r and K selected species in succession.

• Interpret models or graphs related to succession and zonation.

• Design and carry out ecological investigations.

• Construct simple identification keys for up to eight species.

• Evaluate sampling strategies.

• Evaluate methods to measure at least three abiotic factors in an ecosystem.

• Evaluate methods to investigate the change along an environmental gradient and the effect of a human impact in an ecosystem.

• Evaluate methods for estimating biomass at different trophic levels in an ecosystem.

• Evaluate methods for measuring or estimating populations of motile and nonmotile organisms.

• Calculate and interpret data for species richness and diversity.

• Draw graphs to illustrate species diversity in a community over time or between communities.

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

Topic 2: Ecosystems and ecology

2.1 Species and populations

2.2 Communities and ecosystems

2.3 Flows of energy and matter

2.4 Biomes, zonation and succession

2.5 Investigating ecosystems

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

Online Curriculum Center