Year 2, HL Option C Ecology and Conservation

Content Area: **Science**
Course(s): **IB Biology, HL**
Time Period: **Third Marking Period**
Length: **4 Weeks**
Status: **Published**

Unit Overview

Students will learn about the different tolerance of species and how indicator species are essential to the community and ecology of an area. Students will also learn about the risks that are taken to help maintain stable populatins as well as the events that have occured when new species were introduced into communities.

STAGE 1- DESIRED RESULTS

C1 Use models as representations of the real world—zones of stress and limits of tolerance graphs are models of the real world that have predictive power and explain community structure.

C2 Use models as representations of the real world—pyramids of energy model the energy flow through ecosystems.

C3 Assessing risks and benefits associated with scientific research—the use of biological control has associated risk and requires verification by tightly controlled experiments before it is approved.

C4 Scientists collaborate with other agencies—the preservation of species involves international cooperation through intergovernmental and non-governmental organizations.

C5 Avoiding bias—a random number generator helps to ensure population sampling is free from bias.

C6 Assessing risks and benefits of scientific research—agricultural practices can disrupt the phosphorus cycle.

Standards

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

Cross Cutting Concepts

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

Disciplinary Core Ideas

Life Sciences

- LS1C: Organization for Matter and Energy Flow in Organisms
- 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
- LS4C: Adaptation
- LS4D: Biodiversity and Humans

Earth and Space Sciences

- 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

C1 How does community structure show emergent property of an ecosystem?

C2 How are the changes in community structure affected by organisms?

C3 How do human activities impact on ecosystem function?

C4 How do entire communities need to be conserved in order to preserve biodiversity?

C5 What are the dynamic biological processes that impact population density and population growth?

C6 How are soil cycles subject to disruption?

Enduring Understanding

Students will have a deeper understanding of community structure and how communities are being changed due to different biologyical processess that are both natural and human influenced.

Students will know...

C1

- The distribution of species is affected by limiting factors.
- Community structure can be strongly affected by keystone species.
- Each species plays a unique role within a community because of the unique combination of its spatial habitat and interactions with other species.
- Interactions between species in a community can be classified according to their effect.
- Two species cannot survive indefinitely in the same habitat if their niches are identical.

C2

- Most species occupy different trophic levels in multiple food chains.
- A food web shows all the possible food chains in a community.
- The percentage of ingested energy converted to biomass is dependent on the respiration rate.
- The type of stable ecosystem that will emerge in an area is predictable based on climate.

- In closed ecosystems energy but not matter is exchanged with the surroundings.
- Disturbance influences the structure and rate of change within ecosystems.

C3

- Introduced alien species can escape into local ecosystems and become invasive.
- Competitive exclusion and the absence of predators can lead to reduction in the numbers of endemic species when alien species become invasive.
- Pollutants become concentrated in the tissues of organisms at higher trophic levels by biomagnification.
- Macroplastic and microplastic debris has accumulated in marine environments.

C4

- An indicator species is an organism used to assess a specific environmental condition.
- Relative numbers of indicator species can be used to calculate the value of a biotic index.
- *In situ* conservation may require active management of nature reserves or national parks.
- *Ex situ* conservation is the preservation of species outside their natural habitats.
- Biogeographic factors affect species diversity.
- Richness and evenness are components of biodiversity.

C5

- Sampling techniques are used to estimate population size.
- The exponential growth pattern occurs in an ideal, unlimited environment.
- Population growth slows as a population reaches the carrying capacity of the environment.
- The phases shown in the sigmoid curve can be explained by relative rates of natality, mortality, immigration and emigration.
- Limiting factors can be top down or bottom up.

C6

- Nitrogen-fixing bacteria convert atmospheric nitrogen to ammonia.
- *Rhizobium* associates with roots in a mutualistic relationship.
- In the absence of oxygen denitrifying bacteria reduce nitrate in the soil.
- Phosphorus can be added to the phosphorus cycle by application of fertilizer or removed by the harvesting of agricultural crops.
- The rate of turnover in the phosphorus cycle is much lower than the nitrogen cycle.
- Availability of phosphate may become limiting to agriculture in the future.
- Leaching of mineral nutrients from agricultural land into rivers causes eutrophication and leads to increased biochemical oxygen demand.

Students will be able to...

C1

- Explain the distribution of one animal and one plant species to illustrate limits of tolerance and zones of stress.
- Examine local examples to illustrate the range of ways in which species can interact within a community.
- Analyze the symbiotic relationship between *Zooxanthellae* and reef-building coral reef species.

C2

- Complete the conversion ratio in sustainable food production practices.
- Analyze one example of how humans interfere with nutrient cycling.

C3

- Examine the study of the introduction of cane toads in Australia and one other local example of the introduction of an alien species.
- Discuss the trade-off between control of the malarial parasite and DDT pollution.
- Examine a case study of the impact of marine plastic debris on Laysan albatrosses and one other named species.

C4

- Examine a case study of the captive breeding and reintroduction of an endangered animal species.
- Analyze the impact of biogeographic factors on diversity limited to island size and edge effects.

C5

- Evaluate the methods used to estimate the size of commercial stock of marine resources.
- Explain the use of the capture-mark-release-recapture method to estimate the population size of an animal species.
- Discuss the effect of natality, mortality, immigration and emigration on population size.
- Analyze the effect of population size, age and reproductive status on sustainable fishing practices.
- Explain the bottom-up control of algal blooms by shortage of nutrients and top-down control by herbivory.

C6

- Analyze the impact of waterlogging on the nitrogen cycle.
- Assess the use of insectivorous plants as an adaptation for low nitrogen availability in waterlogged soils.

STAGE 2- EVIDENCE OF LEARNING

Formative Assessment

- Debriefing
- Hand Signals
- Index Card Summaries
- Journal Entry
- Observation
- Questions & Answers
- Quiz

Authentic Assessments

C1

- Skill: Analysis of a data set that illustrates the distinction between fundamental and realized niche.
- Skill: Use of a transect to correlate the distribution of plant or animal species with an abiotic variable.

C2

- Skill: Comparison of pyramids of energy from different ecosystems.
- Skill: Analysis of a climograph showing the relationship between temperature, rainfall and the type of ecosystem.
- Skill: Construction of Gersmehl diagrams to show the inter-relationships between nutrient stores and flows between taiga, desert and tropical rainforest.
- Skill: Analysis of data showing primary succession.
- Skill: Investigation into the effect of an environmental disturbance on an ecosystem.

C3

- Skill: Analysis of data illustrating the causes and consequences of biomagnification.
- Skill: Evaluation of eradication programmes and biological control as measures to reduce the impact of alien species.

C4

- Skill: Analysis of the biodiversity of two local communities using Simpson's reciprocal index of diversity.

C5

- Skill: Modelling the growth curve using a simple organism such as yeast or species of *Lemna.*

C6

- Skill: Drawing and labelling a diagram of the nitrogen cycle.
- Skill: Assess the nutrient content of a soil sample.

Laboratories will be used for assessment

Quizzes will be given.

Benchmark Assessments

Chapter tests will be given.

STAGE 3- LEARNING PLAN

Instructional Map

Guidance for the implementation of the IB Biology Curriculum

C1 Random samples are taken in studies involving large geographical areas or if limited time is available. Is random sampling a useful tool for scientists despite the potential for sampling bias?

C2 Examples of aspects to investigate in the ecosystem could be species diversity, nutrient cycling, water movement, erosion, leaf area index, among others.

Many developed countries export toxic waste to less developed countries. Is financial compensation a fair exchange for hazardous waste?

C3 Over 100 countries across the globe have agreed to ban the production of CFCs to reduce the depletion of the ozone layer.

C4 The formula for Simpson's reciprocal index of diversity is:

- $D = \frac{N(N-1)}{\Sigma n(n-1)}$

  D = diversity index, N = total number of organisms of all species found and n = number of individuals of a particular species.

C5 The issues around the growing global human population are of international concern regardless of

different growth rates in different countries.

C6 Crop rotations allow the renewal of soil nutrients by allowing an area to remain “fallow”.

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

Modification Strategies

- Cooperative Grouping
- Highlighted Text
- Oral Directions
- Preferential Seating
- Repeated Drill and Practice
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials

Differentiation Strategies

High Preparation

- Group Investigations
- Independent Research / Project
- Leveled Rubrics
- Multiple Intelligence Options
- Multiple Texts
- Varying Graphic Organizers

Low Preparation

- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Open-ended Activities
- Use of Collaboration
- Varied Product Choice
- Work Alone / Together

Horizontal Intergration- Interdisciplinary Connections

See Appendix

Vertical Integration- Discipline Mapping

Previous courses

6th grade – Diversity of life

7th grade – Populations and Ecosystems

8th grade – Human Systems Interactions and Heredity and Adaptations

9th grade – Honors Biology

10th grade – Honors Chemistry

Possible next courses

Honors Physics

Anatomy & Physiology

IB Physics

Zoology

Forensics

Additional Materials

Videos used through McGraw Hill, Crash Course and Howard Hughes Medical Institute.

Current Research articles supplied through Newsela.