CAISL
Carlucci American International School of Lisbon

GRADE ENVIRONMENTAL SCIENCE - IB ENVIRONMENTAL SYSTEMS AND SOCIETY Y1

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SKILLS AND EXPECTATIONS

By the end of grade 11 students taking Environmental Science/Environmental Systems and Societies are expected to:

- Develop a testable hypothesis/research question, design and conduct an investigation identifying ethical and safety implication of the research;
- Identify variables, organize and present quantitative and qualitative results, looking for trends and discrepancies.

OTHER SKILLS AND EXPECTATIONS

MATH SKILLS

- Students are required to identify different types of variables (dependent, independent and controlled) and describe how they will be measured, identifying units and uncertainties associated with data collection equipment.
- Students are expected to process collected data by calculating indices, averages, standard deviations. Other statistical techniques can be also applied (Chi squared, regressions, t-test) but are not specifically required.
- Students must present data considering accuracy of raw data, precision of the equipment's used, scientific notation and significant figures.

SCIENCE NOTEBOOK

- Notebooks are an independent responsibility of the student.
- Students are expected to keep an organized notebook with notes from class, work done at home and data collected during labs.

SCIENTIFIC WRITING

- Students will write Laboratory Reports about experiments conducted in class, related to the subject content, which will include but is not limited to the following requirements:
  - Conduct independent background research to sustain their findings.
  - Include in-text citations for research.
  - Use reliable sources, correctly cited in MLA format.
  - Provide a bibliography created with NoodleTools.
  - Submit personal investigation/Internal Assessment via Turnitin.
    (Additional information about research parameters is available on the CAISL website).

INFORMATION TECHNOLOGY

- Students are expected to use digital measurement tools (probes) in order to collect data, and make appropriate use of data collection software (Logger Pro).
- Students are expected to master the use of Excel to manipulate and interpret collected data.

SAFETY EXPECTATIONS

Students will be expected to learn and to follow the expectations for safe and appropriate practices during laboratory activity, as shown on the "Science Laboratory Safety" document.

ASSESSMENTS

For students to receive a credit towards their High School Diploma, they must demonstrate proficiency on:

- Summative assessments set by the class teacher which may take the form of:
    - Quizzes which assess both knowledge and skill acquisition in the subjects' subtopics.
    - Tests which assess both knowledge and skill acquisition in the subjects' topics.
    - In-class projects.
    - Lab reports.
    - First steps of their personal investigation by placing a hypothesis, research an appropriate background information to support their hypothesis, and research/create a procedure to test their hypothesis.
    - An exam at the end of the 1st year which covers all content and skill acquisition to that point.

Students who are pursuing the IB Diploma in addition to the High School Diploma must complete both years of the program. During the first year they must demonstrate proficiency on:

- Summative assessments set by the class teacher which may take the form of:
    - Quizzes which assess both knowledge and skill acquisition in the subjects' subtopics.
    - Tests which assess both knowledge and skill acquisition in the subjects' topics.
    - In-class projects.
    - Lab reports.
    - First steps of their internal assessment by designing a research question, research an appropriate background information to support their research question, and research/create a procedure to test their research question.
    - An exam at the end of the 1st year which covers all content and skill acquisition to that point.

While there are no internal assessments sent to the IB nor external exams set by the IB during the 1st year of the program, much of the work done will be revised or adapted early in Year 2 to be evaluated by the IB.

PERFORMANCE INDICATORS

Foundations of environmental systems and societies/Foundations of Environmental Science

Environmental Value Systems

Describe, identify and discuss the main environmental value systems (EVS´s) and recognize how; historical events, among other influences, affect the development of EVSs and environmental movements.

Defend how an EVS might be considered as a system in the sense that it may be influenced by education, experience, culture and media (inputs), and involves a set of interrelated premises, values and arguments that can generate consistent decisions and evaluations (outputs).

Understand that scientific research is encouraged in order to form policies and to understand how systems can be controlled, manipulated or changed to solve resource depletion and other problems.

Explain how different EVSs ascribe different intrinsic value to components of the biosphere.

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.

Systems and Models

Understand how a systems approach can help in the study of complex environmental issues.

Recognize up to what point the use of systems and models simplifies interactions but may provide a more holistic view without reducing issues to single processes.

Construct a system diagram or a model from a given set of information.

Evaluate the use of models as a tool in a given situation, for example, climate change predictions.

Energy and Equilibria

Understand how the laws of thermodynamics govern the flow of energy in a system and the ability to do work in ecological systems.

Recognize that systems can exist in alternative stable states or as equilibria between which there are tipping points and evaluate the possible consequences of these tipping points.

Realize that destabilizing positive feedback mechanisms will drive systems toward these tipping points, whereas stabilizing negative feedback mechanisms will resist such changes.

Discuss resilience in a variety of systems.

Sustainability

Discuss how all systems can be viewed through the lens of sustainability and understand the goal of sustainable development (to meet the needs of the present without compromising the ability of future generations to meet their own needs).

Use environmental indicators and ecological footprints to assess sustainability.

Understand how environmental impact assessments (EIAs) play an important role in sustainable development and evaluate its use.

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

Discuss the value of ecosystem services to a society and how environmental indicators can be used to evaluate the progress of a project to increase sustainability.

Humans and Pollution

Recognize that pollution is a highly diverse phenomenon of human disturbance in ecosystems and that pollution management strategies can (and should) be applied at different levels.

Construct systems diagrams to show the impact of pollutants.

Evaluate the effectiveness of each of the three different levels of intervention in pollution management.

Evaluate the uses of DDT.

Ecosystems and ecology

Species and Populations

Understand that a species interacts with its abiotic and biotic environments, and its niche is described by these interactions.

Recognize and explain how populations change and respond to interactions with the environment.

Be familiar with the fact that any system has a carrying capacity for a given species.

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

Explain population growth curves in terms of numbers and rates.

Communities and Ecosystems

Understand that the interactions of species with their environment result in energy and nutrient flows.

Identify how photosynthesis and respiration play a significant role in the flow of energy in communities.

Explain how the feeding relationships of species in a system can be modelled using food chains, food webs and ecological pyramids.

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 and 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.

Flows of Energy and Matter

Recognize that ecosystems are linked together by energy and matter flows and that the Sun's energy drives these flows, and humans are impacting the flows of energy and matter both locally and globally.

Analyze quantitative models of flows of energy and matter and 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 GPP, NPP, GSP and NSP from given data.

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

Biomes, Zonation, and Succession

Understand that climate determines the type of biome in a given area, although individual ecosystems may vary due to many local abiotic and biotic factors.

Debate how succession leads to climax communities that may vary due to random events and interactions over time and describe the process of succession in a given example.

Recognize how ecosystem stability, succession and biodiversity are intrinsically linked.

Explain the distributions, structure, biodiversity and relative productivity of contrasting biomes analyzing data and discussing the impact of climate change on many of them.

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

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

Interpret models or graphs related to succession and zonation.

Investigating Ecosystems

Understand that 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.

Recognize that ecosystems can be better understood through the investigation and quantification of their components.

- Design and carry out ecological investigations evaluating sampling strategies and the methods to measure at least three abiotic factors in an ecosystem.
- Construct simple identification keys for up to eight species.
- 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 and for measuring or estimating populations of motile and non-motile organisms.
- Calculate and interpret data for species richness and diversity.
- Draw graphs to illustrate species diversity in a community over time.

Biodiversity and conservation

An Introduction to Biodiversity

- Understand that biodiversity can be identified in a variety of forms, including species diversity, habitat diversity and genetic diversity.
- Recognize that the ability to both understand and quantify biodiversity is important to conservation efforts.
- Comment on the relative values of biodiversity data and discuss the usefulness of providing numerical values of species diversity to understand the nature of biological communities and the conservation of biodiversity.

Origins of Biodiversity

- Reflect on the belief that evolution is a gradual change in the genetic character of populations over many generations, achieved largely through the mechanism of natural selection.
- Understand that environmental change poses new challenges to species, which drives the evolution of diversity.
- Recognize and identify major mass extinction events in the geological past and discuss the possible causes.
- Explain how plate activity has influenced evolution and biodiversity.

Threats to Biodiversity

- Understand that while global biodiversity is difficult to quantify, it is decreasing rapidly due to human activity.
- Recognize that the classification of species according to a conservation status can provide a useful tool in the conservation of biodiversity.
- Discuss the case histories of three different species: one that has become extinct due to human activity, another that is critically endangered, and a third species whose conservation status has been improved by intervention.
- Describe the threats to biodiversity from human activity in a given natural area of biological significance or conservation area.
- Discuss the conflict between exploitation, sustainable development and conservation in tropical biomes.

Conservation of Biodiversity

- Understand that the impact of losing biodiversity drives conservation efforts.
- Discuss how the variety of arguments given for the conservation of biodiversity will depend on EVSs.
- Identify various approaches to the conservation of biodiversity, each with associated strengths and limitations.
- Explain the criteria used to design and manage protected areas evaluating the success of a given protected area.
- Evaluate different approaches to protecting biodiversity.

Water and aquatic food production systems and societies

Introduction to Water Systems

- Understand that the hydrological cycle is a system of water flows and storages that may be disrupted by human activity.
- Recognize that the ocean circulatory system (ocean conveyor belt) influences the climate and global distribution of water (matter and energy).
- Discuss human impacts on the hydrological cycle.
- Construct and analyze a hydrological cycle diagram.

Access to Fresh Water

- Understand that he supplies of freshwater resources are inequitably available and unevenly distributed, which can lead to conflict and concerns over water security.
- Discuss how freshwater resources can be sustainably managed using a variety of different approaches.
- Evaluate the strategies that can be used to meet an increasing demand for fresh water.
- Discuss, with reference to case studies, how shared freshwater resources have given rise to international conflict.

Aquatic Food Production Systems

- Recognize that aquatic systems provide a source of food production and their unsustainable use can lead to environmental degradation and collapse of wild fisheries.
- Understand that aquaculture provides potential for increased food production.
- Discuss, with reference to a case study, the controversial harvesting of a named species.
- Evaluate strategies that can be used to avoid unsustainable fishing.

Water Pollution

- Understand that water pollution, both groundwater and surface water, is a major global problem, the effects of which influence human and other biological systems.
- Analyze water pollution data and management strategies.
- Explain the process and impacts of eutrophication and evaluate the uses of indicator species and biotic indices in measuring aquatic pollution.