Summary

Topic 1 - Foundations of environmental systems and societies

Subject	Year	Start date	Duration
Environmental Systems & Societies	IB1, IB2	Week 1, September	4 weeks 16 hours

Course Part

Core

Description

This topic may be particularly appropriate for considering big questions A, C, D and E

Curriculum

Aims

Acquire the knowledge and understandings of environmental systems at a variety of scales

Apply the knowledge, methodologies and skills to analyse environmental systems and issues at a variety of scales

Appreciate the dynamic interconnectedness between environmental systems and societies

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

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

Develop awareness of the diversity of environmental value systems

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

Engage with the controversies that surround a variety of environmental issues

Create innovative solutions to environmental issues by engaging actively in local and global contexts

Objectives

Demonstrate knowledge and understanding of relevant

facts and concepts

methodologies and techniques

values and attitudes

Apply this knowledge and understanding in the analysis of

explanations, concepts and theories

data and models

case studies in unfamiliar contexts

arguments and value systems

Evaluate, justify and synthesise, as appropriate

explanations, theories and models

arguments and proposed solutions

methods of fieldwork and investigation

cultural viewpoints and value systems

Engage with investigations of environmental and societal issues at the local and global level through

evaluating the political, economic and social contexts of issues

selecting and applying the appropriate research and practical skills necessary to carry out investigations

suggesting collaborative and innovative solutions that demonstrate awareness and respect for the cultural differences and value systems of others

Syllabus Content

Topic 1: Foundations of environmental systems and societies

1.1 Environmental value systems

Significant ideas:

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.

Knowledge and understanding:

Significant historical influences on the development of the environmental movement have come from literature, the media, major environmental disasters, international agreements and technological developments.

An EVS is a worldview or paradigm that shapes the way an individual, or group of people, perceives and evaluates environmental issues, influenced by cultural, religious, economic and socio-political contexts.

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).

There is a spectrum of EVSs, from ecocentric through anthropocentric to technocentric value systems.

An ecocentric viewpoint integrates social, spiritual and environmental dimensions into a holistic ideal. It puts ecology and nature as central to humanity and emphasizes a less materialistic approach to life with greater self-sufficiency of societies. An ecocentric viewpoint prioritizes biorights, emphasizes the importance of education and encourages self-restraint in human behaviour.

An anthropocentric viewpoint argues that humans must sustainably manage the global system. This might be through the use of taxes, environmental regulation and legislation. Debate would be encouraged to reach a consensual, pragmatic approach to solving environmental problems.

A technocentric viewpoint argues that technological developments can provide solutions to environmental problems. This is a consequence of a largely optimistic view of the role humans can play in improving the lot of humanity. Scientific research is encouraged in order to form policies and to understand how systems can be controlled, manipulated or changed to solve resource depletion. A pro-growth agenda is deemed necessary for society's improvement.

There are extremes at either end of this spectrum (for example, deep ecologists - ecocentric to cornucopian–technocentric), but in practice, EVSs vary greatly depending on cultures and time periods, and they rarely fit simply or perfectly into any classification.

Different EVSs ascribe different intrinsic value to components of the biosphere.

Applications and skills:

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.

1.2 Systems and models

Significant ideas:

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.

Knowledge and understanding:

A systems approach is a way of visualizing a complex set of interactions which may be ecological or societal.

These interactions produce the emergent properties of the system.

The concept of a system can be applied at a range of scales.

A system is comprised of storages and flows.

The flows provide inputs and outputs of energy and matter.

The flows are processes that may be either transfers (a change in location) or transformations (a change in the chemical nature, a change in state or a change in energy).

In system diagrams, storages are usually represented as rectangular boxes and flows as arrows, with the direction of each arrow indicating the direction of each flow. The size of the boxes and the arrows may be representative of the size/magnitude of the storage or flow.

An open system exchanges both energy and matter across its boundary while a closed system exchanges only energy across its boundary.

An isolated system is a hypothetical concept in which neither energy nor matter is exchanged across the boundary.

Ecosystems are open systems; closed systems only exist experimentally, although the global geochemical cycles approximate to closed systems.

A model is a simplified version of reality and can be used to understand how a system works and to predict how it will respond to change.

A model inevitably involves some approximation and therefore loss of accuracy.

Applications and skills:

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.

1.3 Energy and equilibria

Significant ideas:

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 towards these tipping points, whereas stabilizing negative feedback mechanisms will resist such changes.

Knowledge and understanding:

The first law of thermodynamics is the principle of conservation of energy, which states that energy in an isolated system can be transformed but cannot be created or destroyed.

The principle of conservation of energy can be modelled by the energy transformations along food chains and energy production systems.

The second law of thermodynamics states that the entropy of a system increases over time. Entropy is a measure of the amount of disorder in a system. An increase in entropy arising from energy transformations reduces the energy available to do work.

The second law of thermodynamics explains the inefficiency and decrease in available energy along a food chain and energy generation systems.

As an open system, an ecosystem will normally exist in a stable equilibrium, either in a steady-state equilibrium or in one developing over time (for example, succession), and maintained by stabilizing negative feedback loops.

Negative feedback loops (stabilizing) occur when the output of a process inhibits or reverses the operation of the same process in such a way as to reduce change - it counteracts deviation.

Positive feedback loops (destabilizing) will tend to amplify changes and drive the system toward a tipping point where a new equilibrium is adopted.

The resilience of a system, ecological or social, refers to its tendency to avoid such tipping points and maintain stability.

Diversity and the size of storages within systems can contribute to their resilience and affect their speed of response to change (time lags).

Humans can affect the resilience of systems through reducing these storages and diversity.

The delays involved in feedback loops make it difficult to predict tipping points and add to the complexity of modelling systems.

Applications and skills:

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.

1.4 Sustainability

Significant ideas:

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.

Knowledge and understanding:

Sustainability is the use and management of resources that allows full natural replacement of the resources exploited and full recovery of the ecosystems affected by their extraction and use.

Natural capital is a term used for natural resources that can produce a sustainable natural income of goods or services.

Natural income is the yield obtained from natural resources.

Ecosystems may provide life-supporting services such as water replenishment, flood and erosion protection, and goods such as timber, fisheries, and agricultural crops.

Factors such as biodiversity, pollution, population or climate may be used quantitatively as environmental indicators of sustainability. These factors can be applied on a range of scales, from local to global. The Millennium Ecosystem Assessment (MA) gave a scientific appraisal of the condition and trends in the world's ecosystems and the services they provide using environmental indicators, as well as the scientific basis for action to conserve and use them sustainably.

EIAs incorporate baseline studies before a development project is undertaken. They assess the environmental, social and economic impacts of the project, predicting and evaluating possible impacts and suggesting mitigation strategies for the project. They are usually followed by an audit and continued monitoring. Each country or region has different guidance on the use of EIAs.

EIAs provide decision-makers with information in order to consider the environmental impact of a project. There is not necessarily a requirement to implement an EIA's proposals, and many socio-economic factors may influence the decisions made.

Criticisms of EIAs include: the lack of a standard practice or training for practitioners, the lack of a clear definition of system boundaries and the lack of inclusion of indirect impacts.

An ecological footprint (EF) is the area of land and water required to sustainably provide all resources at the rate at which they are being consumed by a given population. If the EF is greater than the area available to the population, this is an indication of unsustainability.

Applications and skills:

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.

1.5 Humans and pollution

Significant ideas:

Pollution is a highly diverse phenomenon of human disturbance in ecosystems.

Pollution management strategies can be applied at different levels.

Knowledge and understanding:

Pollution is the addition of a substance or an agent to an environment through human activity, at a rate greater than that at which it can be rendered harmless by the environment, and which has an appreciable effect on the organisms in the environment.

Pollutants may be in the form of organic or inorganic substances, light, sound or thermal energy, biological agents or invasive species, and may derive from a wide range of human activities including the combustion of fossil fuels.

Pollution may be non-point or point source, persistent or biodegradable, acute or chronic.

Pollutants may be primary (active on emission) or secondary (arising from primary pollutants undergoing physical or chemical change).

Dichlorodiphenyltrichloroethane (DDT) exemplifies a conflict between the utility of a “pollutant” and its effect on the environment.

Applications and skills:

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.

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will

  ask students to formulate a reasoned argument to support their opinion or conclusion

  give students time to think through their answers before asking them for a response

  reward a new personal understanding, solution or approach to an issue

  ask open questions

  set students a task which required higher-order thinking skills (such as analysis or evaluation)

  build on a specific prior task

  help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)

  require students to take an unfamiliar viewpoint into account when formulating arguments

  ask questions that required the use of knowledge from a different subject from the one you are teaching

  include a reflection activity

  make a link to TOK

Social

- In this unit, we will

  have students work in small groups

  allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity

  have students peer assess their group performance or process

  support students in resolving a conflict in a team

  give a group assessment task

  give students feedback on how they worked as a group

  have students discuss their understanding of a text or idea among themselves and come up with a shared understanding

  provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance

  encourage students to consider alternative points of view or to take the perspective of others

  provide opportunities for students to make decisions

Communication

- In this unit, we will

  ask students to explain their understanding of a text or idea to each other

  construct a task around the use of different vocabulary and examples when speaking to different audiences

  have students give an oral presentation without reading from their notes

  ask students to monitor and check the quality of their writing

  construct a task so that students practise their listening skills

  assess or give feedback on speaking or writing concisely

  provide opportunities for students to read and understand different types of texts

  encourage or require students to plan a response before they begin

  ask students to formulate arguments clearly and coherently

  encourage all students to contribute to discussions

Developing IB Learners

Learner Profile

Inquirers

Knowledgeable

Thinkers

Communicators

Principled

Open-minded

Caring

Risk-takers (Courageous)

Balanced

Reflective