INTERNATIONAL BACCALAUREATE

Environmental Systems and Societies

SCHEME OF WORK

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# COURSE INFORMATION

## AIMS

The systems approach provides the core methodology of the ESS course. It is complemented by other influences, such as economic, historical, cultural, socio-political and scientific factors, to provide a holistic perspective on environmental issues. During the course, students will look at examples on a variety of scales, from local to global, and in an international context.

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 analyse 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.

## OBJECTIVES

These objectives reflect how the aims of the ESS course will be assessed. It is the intention of this course that students, in the context of environmental systems and related issues, are able to fulfill the following assessment objectives.

1. Demonstrate knowledge and understanding of relevant:
	* facts and concepts
	* methodologies and techniques
	* values and attitudes.
2. 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.
3. Evaluate, justify and synthesize, as appropriate:
	* explanations, theories and models
	* arguments and proposed solutions
	* methods of fieldwork and investigation
	* cultural viewpoints and value systems
4. 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.

## MODE OF TEACHING

Students will be taught over 2 academic years, with 3 hours of teaching per week, as well as homework/private study time.

The tuition will involve the following

* Tutorial lessons
* Laboratory based activities
* Field work
* Group-based and peer learning
* Presentation giving
* Self-study\*

\*Self-study will make up a more substantial part of the work than most students are familiar with and students are expected to develop these skills as the course progresses.

## ASSESSMENT

### External Assessments

Final grades on the ESS course are based on two examination papers and the Individual Investigation (more commonly known as the “Internal Assessment” or “IA”). The individual investigation is marked internally but may be sent for external moderation. Students should approach the Individual Investigation with the same level of commitment and motivation with which they would prepare for an examination.

The assessment breakdown is as follows:

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| **Assessment Component** | **Weighting (%)** | **Approx. Weighting of Objectives in each Component (%)** | **Duration (hours)** |
| 1 and 2 | 3 |
| **Paper 1 (case study)** | 25 | 50 | 50 | 1 |
| **Paper 2 (short answers and structured essays)** | 50 | 50 | 50 | 2 |
| **Internal assessment (individual investigation)** | 25 | Covers objectives 1, 2, 3 and 4 | 10 |

### Individual Investigation for Internal Assessment (“The IA”)

The Individual Investigation for Internal Assessment (commonly referred to as the Internal Assessment or “IA”) is based on a student’s own individual research and data collection and requires about 10 hours of class time (the process of writing up is in addition to these 10 hours). The purpose is to focus on a particular aspect of an ESS issue and to apply the results to a broader environmental and/or societal context. The investigation is recorded as a written report. The report should be 1,500 to 2,250 words long. Students should be made aware that external moderators will not read beyond 2,250 words and teachers will only mark up to this limit.

The internal assessment will be assessed on the following criteria:

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| **Identifying the context** | **Planning** | **Results, analysis and conclusion** | **Discussion and evaluation** | **Applications** | **Communication** | **Total** |
| **6 (20%)** | 6 (20%) | 6 (20%) | 6 (20%) | 3 (10%) | 3 (10%) | 30 (100%) |

### Ongoing Assessment

In addition to examinations, students will be assessed regularly throughout the term as part of the assessment policy of the faculty and school. The compiled results of these assessments will be reported as part of the school reporting system.

The results of these assessment tasks are compiled to create grades showing student attainment and this is communicated to parents/guardians.

## A NOTE ON STANDARD LEVEL vs HIGHER LEVEL

Environmental Systems and Societies is a Standard Level course: there is no option to study it at Higher Level. It must not be assumed that this is therefore an “easy option” on the IB Diploma Programme. The course is multidisciplinary and is comprised of subject knowledge that will be entirely unfamiliar in some aspects of the course to many students. The course is appropriately challenging, and therefore very rewarding, but must be approached with a conscientious attitude as with any course on the IB Diploma Programme.

# TEACHING SCHEDULE

### Schedule – Term One

|  |  |
| --- | --- |
| WEEK | CHAPTER |
| 1 | 1.2 Systems and Models |
| 2 | 1.2 Systems and Models |
| 3 | 1.1 Environmental Value Systems |
| 4 | 1.3 Energy and Equilibria |
| 5 | 8.2 Resource Use in Society |
| 6 | 8.4 Human Systems and Resource Use |
| 7 | 8.4 Human Systems and Resource Use |
| MID-TERM BREAK |
| 8 | 1.4 Sustainability |
| 9 | 1.5 What is Pollution |
| 10 | 2.1 Species and Populations |
| 11 | 2.2 Communities and Ecosystems |
| 12 | 2.2 Communities and Ecosystems |
| 13 | 2.3 Flows of Energy and Matter |
| 14 | 2.3 Flows of Energy and Matter |
| 15 | FLEXI |

### Schedule – Term Two

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| --- | --- |
| WEEK/DATE | CHAPTER |
| 1 | 2.4 Biomes, Zonation and Succession |
| 2 | 2.4 Biomes, Zonation and Succession |
| 3 | 2.4 Biomes, Zonation and Succession |
| 4 | 2.5 Investigating Ecosystems |
| 5 | 2.5 Investigating Ecosystems |
| 6 | 2.5 Investigating Ecosystems |
| MID-TERM BREAK |
| 7 | 5.1 Introduction to Soil Systems |
| 8 | 5.1 Introduction to Soil Systems |
| 9 | 5.2 Terrestrial Food Production Systems and Food Choices |
| 10 | 5.2 Terrestrial Food Production Systems and Food Choices |
| 11 | 5.3 Soil Degradation and Conservation |
| 12 | 5.3 Soil Degradation and Conservation |
| 13 | 8.1 Human Population Dynamics |
| 14 | 8.1 Human Population Dynamics |

### Schedule – Term Three

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| --- | --- |
| WEEK/DATE | CHAPTER |
| 1 | 8.3 Solid Domestic Waste |
| 2 | 3.1 An Introduction to Biodiversity |
| 3 | 3.2 Origins of Biodiversity |
| 4 | 3.3 Threats to Biodiversity |
| MID-TERM BREAK |
| 5 | 3.3 Threats to Biodiversity |
| 6 | 3.4 Conservation of Biodiversity |
| 7 | 3.4 Conservation of Biodiversity |
| 8 | IA Preparation |
| 9 | IA Preparation / End of Year events |

## Year 2

### Schedule – Term Four

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| WEEK | CHAPTER |
| 1 | 4.1 Introduction to Water Systems |
| 2 | 4.2 Access to Freshwater |
| 3 | 4.2 Access to Freshwater |
| 4 | 4.3 Aquatic Food Production Systems |
| 5 | IAs |
| 6 | IAs |
| 7 | IAs |
| MID-TERM BREAK |
| 8 | 4.3 Aquatic Food Production Systems |
| 9 | 4.4 Water Pollution |
| 10 | 4.4 Water Pollution |
| 11 | 6.1 Introduction to the Atmosphere |
| 12 | 6.2 Stratospheric Ozone |
| 13 | 6.3 Photochemical Smog |
| 14 | 6.4 Acid Deposition |
| 15 | 6.4 Acid Deposition |

### Schedule – Term Five

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| --- | --- |
| WEEK/DATE | CHAPTER |
| 1 | 7.1 Energy Choices and Security |
| 2 | 7.2 Climate Change - Causes and Impacts |
| 3 | 7.2 Climate Change - Causes and Impacts |
| 4 | MOCK EXAMS |
| 5 | MOCK EXAMS |
| 6 | 7.3 Climate Change – Mitigation and Adaptation |
| MID-TERM BREAK |
| 7 | MOCK REVIEW |
| 8 | Revision |
| 9 | Revision |
| 10 | Revision |
| 11 | Revision |
| 12 | Revision |
| 13 | Revision |
| 14 | Revision |

# MEDIUM-TERM PLAN

*NOTE: The topic outlines are in numerical order, not order of teaching.*

*Stated teaching hours does not include any practical activities.*

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| **TOPIC** | **1.1 - Systems and Models** | TEACHING HOURS | 3 |
| 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.
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| SCHEDULE |
| 1 | What is an EVS? |
| 2 | Influences on EVSs |
| 3 | Your EVS |

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| **TOPIC** | **1.2 Systems and Models** | TEACHING HOURS | 4 |
| 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.
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| SCHEDULE |
| 1 | The systems approach |
| 2 | Systems diagrams |
| 3 | Models |
| 4 | Gaia hypothesis |

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| **TOPIC** | **1.3 Energy and Equilibria** | TEACHING HOURS | 3 |
| 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.
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| SCHEDULE |
| 1 | Energy in an ecosystem |
| 2 | Positive and negative feedback |
| 3 | Equilibrium, resilience and tipping points |

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| **TOPIC** | **1.4 Sustainability** | TEACHING HOURS | 3 |
| 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.
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| SCHEDULE |
| 1 | Sustainability |
| 2 | The Millennium Ecosystems Assessment |
| 3 | Environmental impact assessments |

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| **TOPIC** | **1.5 Humans and Pollution** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * Pollution is a highly diverse phenomenon of human disturbance in ecosystems.
* Pollution management strategies can be applied at different levels.
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| SCHEDULE |
| 1 | What is pollution? |
| 2 | DDT |
| 3 | Pollution management strategies |

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| **TOPIC** | **2.1 Species and Populations** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * 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.
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| SCHEDULE |
| 1 | Niches |
| 2 | Population dynamics: biotic and abiotic factors |
| 3 | Carrying capacity / S and J curves |

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| **TOPIC** | **2.2 Communities and Ecosystems** | TEACHING HOURS | 5 |
| SIGNIFICANT IDEAS * 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.
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| SCHEDULE |
| 1 | Respiration and photosynthesis |
| 2 | Food chains, webs and feeding relationships |
| 3 | Ecological pyramids |
| 4 | Productivity pyramids and limitations to good chain length |
| 5 | Bioaccumulation and biomagnification |

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| **TOPIC** | **2.3 Flows of Energy and Matter** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * Ecosystems are linked together by energy and matter flows.
* The Sun’s energy drives these flows, and humans are impacting the flows of energy and matter both locally and globally.
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| SCHEDULE |
| 1 | Energy flow through an ecosystem |
| 2 | Productivity |
| 3 | The carbon cycle |
| 4 | The nitrogen cycle |

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| **TOPIC** | **2.4 Biomes, Zonation and Succession** | TEACHING HOURS | 6 |
| SIGNIFICANT IDEAS * 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.
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| SCHEDULE |
| 1 | Climate and the tricellular model |
| 2 | Biomes |
| 3 | Climate change and biome shift |
| 4 | Zonation |
| 5 | Primary succession / r and k strategists |
| 6 | Humans and succession: secondary succession and plagioclimax |

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| **TOPIC** | **2.5 Investigating Ecosystems** | TEACHING HOURS | 6 |
| SIGNIFICANT IDEAS * 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.
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| SCHEDULE |
| 1 | Ecological keys |
| 2 | Sampling strategies / “How many samples?” |
| 3 | Measuring abiotic factors in ecosystems |
| 4 | Using quadrats (theory) |
| 5 | The Lincoln index |
| 6 | Simpson’s diversity index |

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| **TOPIC** | **3.1 An Introduction to Biodiversity** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * Biodiversity can be identified in a variety of forms including species diversity, habitat diversity and genetic diversity.
* The ability to both understand and quantify biodiversity is important to conservation efforts.
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| SCHEDULE |
| 1 | Types of biodiversity |
| 2 | Biodiversity indices |
| 3 | Biodiversity hotspots |

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| **TOPIC** | **3.2 Origins of Biodiversity** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * Evolution is a gradual change in the genetic character of populations over many generations achieved largely through the mechanism of natural selection.
* Environmental change gives new challenges to species, which drives evolution diversity.
* There have been major mass extinction events in the geological past.
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| SCHEDULE |
| 1 | Natural selection |
| 2 | Isolation and speciation |
| 3 | Mass extinctions and the sixth mass extinction |

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| **TOPIC** | **3.3 Threats to Biodiversity** | TEACHING HOURS | 5 |
| SIGNIFICANT IDEAS * While global biodiversity is difficult to quantify, it is decreasing rapidly due to human activity.
* Classification of species conservation status can provide a useful tool in conservation of biodiversity.
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| SCHEDULE |
| 1 | Estimating biodiversity |
| 2 | Factors that reduce biodiversity |
| 3 | Tropical ecosystems |
| 4 | The IUCN red list |
| 5 | Endangered species case studies |

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| **TOPIC** | **3.4 Conservation of Biodiversity** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * The impact of losing biodiversity drives conservation efforts.
* The variety of arguments given for the conservation of biodiversity will depend on environmental value systems.
* There are various approaches to the conservation of biodiversity, with associated strengths and limitations.
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| SCHEDULE |
| 1 | Reasons to protect species |
| 2 | How conservation organisations work |
| 3 | International conventions |
| 4 | Approaches to conservation and design of nature reserves |

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| **TOPIC** | **4.1 Introduction to Water Systems** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * The hydrological cycle is a system of water ows and storages that may be disrupted by human activity.
* The ocean circulatory system (ocean conveyor belt) in uences the climate and global distribution of water (matter and energy).
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| SCHEDULE |
| 1 | Water cycle – storages and flows |
| 2 | Human influences on the water cycle |
| 3 | Ocean circulation |

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| **TOPIC** | **4.2 Access to Freshwater** | TEACHING HOURS | 5 |
| SIGNIFICANT IDEAS * The supplies of freshwater resources are inequitably available and unevenly distributed, which can lead to conflict and concerns over water security.
* Freshwater resources can be sustainably managed using a variety of different approaches.
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| SCHEDULE |
| 1 | Distribution and uses of freshwater (including influence of climate change on distribution) |
| 2 | Contamination and unsustainable extraction |
| 3 | Enhancing freshwater supplies |
| 4 | Conflict over water supplies |
| 5 | Conflict on the Nile |

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| **TOPIC** | **4.3 Aquatic Food Production Systems** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * Aquatic systems provide a source of food production.
* Unsustainable use of aquatic ecosystems can lead to environmental degradation and collapse of wild fisheries.
* Aquaculture provides potential for increased food production.
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| SCHEDULE |
| 1 | Aquatic systems  |
| 2 | Wild fishing and maximum sustainable yield |
| 3 | Fish farming |
| 4 | Whaling |

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| **TOPIC** | **4.4 Water Pollution** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * Water pollution, both to groundwater and surface water, is a major global problem, the effects of which influence human and other biological systems.
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| SCHEDULE |
| 1 | Aquatic pollutants including sewage |
| 2 | Eutrophication |
| 3 | Testing for water quality (including biotic indices) |
| 4 | Water pollution management strategies |

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| **TOPIC** | **5.1 Introduction to Soil Systems** | TEACHING HOURS | 2 |
| SIGNIFICANT IDEAS * The soil system is a dynamic ecosystem that has inputs, outputs, storages and flows.
* The quality of soil influences the primary productivity of an area.
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| SCHEDULE |
| 1 | The soil profile |
| 2 | Soil as a system |

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| **TOPIC** | **5.2 Terrestrial Food Production Systems and Food Choices** | TEACHING HOURS | 5 |
| SIGNIFICANT IDEAS * The sustainability of terrestrial food production systems is influenced by sociopolitical, economic and ecological factors.
* Consumers have a role to play through their support of different terrestrial food production systems.
* The supply of food is inequitably available and land suitable for food production is unevenly distributed among societies, and this can lead to conflict and concerns.
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| SCHEDULE |
| 1 | Farming systems and sustainability |
| 2 | Sustainability in food production systems |
| 3 | Food production systems case studies |
| 4 | Food choices in societies |
| 5 | Increasing sustainability in food production |

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| **TOPIC** | **5.3 Soil Degradation and Conservation** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * Fertile soils require significant time to develop through the process of succession.
* Human activities may reduce soil fertility and increase soil erosion.
* Soil conservation strategies exist and may be used to preserve soil fertility and reduce soil erosion.
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| SCHEDULE |
| 1 | Soil succession |
| 2 | Factors reducing soil fertility |
| 3 | Improving soil fertility |
| 4 | Evaluating soil management strategies |

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| **TOPIC** | **6.1 Introduction to the Atmosphere** | TEACHING HOURS | 2 |
| SIGNIFICANT IDEAS * The atmosphere is a dynamic system which is essential to life on Earth.
* The behaviours, structure and composition of the atmosphere influence variations in all ecosystems.
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| SCHEDULE |
| 1 | The atmosphere as a dynamic system |
| 2 | The atmosphere and climate |

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| **TOPIC** | **6.2 Stratospheric Ozone** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * Stratospheric ozone is a key component of the atmospheric system because it protects living systems from the negative effects of ultraviolet radiation from the Sun.
* Human activities have disturbed the dynamic equilibrium of stratospheric ozone formation.
* Pollution management strategies are being employed to conserve stratospheric ozone.
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| SCHEDULE |
| 1 | UV and ozone |
| 2 | Air pollution and ozone |
| 3 | The Montreal protocol |

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| **TOPIC** | **6.3 Photochemical Smog** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * The combustion of fossil fuels produces primary pollutants which may generate secondary pollutants and lead to photochemical smog, whose levels can vary by topography, population density and climate.
* Photochemical smog has significant impacts on societies and living systems.
* Photochemical smog can be reduced by decreasing human reliance on fossil fuels.
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| SCHEDULE |
| 1 | Photochemical smog / tropospheric ozone |
| 2 | Smog / thermal inversions |
| 3 | Pollution management strategies for atmospheric pollution |

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| **TOPIC** | **6.4 Acid Deposition** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * Acid deposition can impact living systems and the built environment.
* The pollution management of acid deposition often involves cross-border issues.
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| SCHEDULE |
| 1 | Acid deposition pollutants |
| 2 | The impacts of acid deposition |
| 3 | Pollution management strategies for acid deposition |
| 4 | The role of international agreements on acid deposition |

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| **TOPIC** | **7.1 Energy Choices and Security** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * There is a range of different energy sources available to societies that vary in their sustainability, availability, cost and sociopolitical implications.
* The choice of energy sources is controversial and complex. Energy security is an important factor in making energy choices.
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| SCHEDULE |
| 1 | Energy sources now and in the future |
| 2 | Evaluating energy sources |
| 3 | Energy security |
| 4 | Evaluating energy security |

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| **TOPIC** | **7.2 Climate Change – Causes and Impacts** | TEACHING HOURS | 5 |
| SIGNIFICANT IDEAS * Climate change has been a normal feature of the Earth’s history, but human activity has contributed to recent changes.
* There has been significant debate about the causes of climate change.
* Climate change causes widespread and significant impacts on a global scale.
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| SCHEDULE |
| 1 | The greenhouse effect and climate change |
| 2 | Feedback in climate |
| 3 | Weather, climate and climate models |
| 4 | The impacts of climate change |
| 5 | The climate change debate |

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| **TOPIC** | **7.3 Climate Change – Mitigation and Adaptation** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * Mitigation attempts to reduce the causes of climate change.
* Adaptation attempts to manage the impacts of climate change.
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| SCHEDULE |
| 1 | Mitigation |
| 2 | Adaptation |
| 3 | International climate change talks |

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| **TOPIC** | **8.1 Human Population Dynamics** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * A variety of models and indicators are employed to quantify human population dynamics.
* Human population growth rates are impacted by a complex range of changing factors.
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| SCHEDULE |
| 1 | Demographic tools for quantifying population dynamics |
| 2 | Global population: Malthus and Boserup |
| 3 | Demographic transition model and age/sex pyramids |
| 4 | Factors affecting population dynamics |

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| **TOPIC** | **8.2 Resource Use in Society** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * The renewability of natural capital has implications for its sustainable use.
* The status and economic value of natural capital is dynamic.
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| SCHEDULE |
| 1 | Natural capital and natural income |
| 2 | (Mis-) management of natural capital |
| 3 | The dynamic nature of natural capital |

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| **TOPIC** | **8.3 Solid Domestic Waste** | TEACHING HOURS | 3 |
| SIGNIFICANT IDEAS * Solid domestic waste (SDW) is increasing as a result of growing human population and consumption.
* Both production and management of solid domestic waste can have significant influence on sustainability.
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| SCHEDULE |
| 1 | Waste: the linear and circular model |
| 2 | Management strategies for solid domestic waste |
| 3 | Evaluating management strategies for SDW |

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| **TOPIC** | **8.4 Human Systems and Resource Use** | TEACHING HOURS | 4 |
| SIGNIFICANT IDEAS * Human carrying capacity is difficult to quantify.
* The ecological footprint is a model that makes it possible to determine whether human populations are living with carrying capacity.
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| SCHEDULE |
| 1 | Human carrying capacity |
| 2 | Ecological footprints |
| 3 | Ecological footprints in MEDCs and LEDCs |
| 4 | How EVSs affect ecological footprints. |