

# Topic #7 Climate Change and Energy Production

Content Area: **Science**  
 Course(s): **IB Environmental Sciences and Societies, SL**  
 Time Period: **Fourth Marking Period**  
 Length: **13 hours**  
 Status: **Published**

## Unit Overview

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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

This topic includes all the different energy sources available to societies that vary in their sustainability, availability, cost, and socio-political implications, energy security, how our energy needs and lifestyles have affected the climate and ways to prevent, reverse, and mitigate those effects.

## STAGE 1- DESIRED RESULTS

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## Science and Engineering Practices

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- 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

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## Cross Cutting Concepts

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- 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

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## Disciplinary Core Ideas

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## Physical Sciences

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- 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**

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- 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**

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- 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**

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- ETS1A: Defining and Delimiting an Engineering Problem
- ETS1B: Developing Possible Solutions
- ETS1C: Optimizing the Design Solution

## **Essential Questions**

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Which strengths and weaknesses of the systems' approach and of the use of models have been revealed through this topic?

To what extent have the solutions emerging from this topic been directed at preventing environmental impacts, limiting the extent of the environmental impacts or restoring systems in which environmental impacts have already occurred?

What value systems are at play in the causes and approaches to resolving the issues addressed in this topic?

How does your personal value system compare with the others you have encountered in the context of issues raised in this topic?

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

In which ways might the solutions explored in this topic alter your predictions for the state of human societies and the biosphere decades from now?

## **Enduring Understanding**

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- There is a range of different energy sources available to societies that vary in their sustainability, availability, cost, and socio-political implications.
- The choice of energy sources is controversial and complex. Energy security is an important factor in making energy choices.
- 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.

- Mitigation attempts to reduce the causes of climate change.
- Adaptation attempts to manage the impacts of climate change.

### **Students will know...**

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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**

Fossil fuels have been around since the origins of Earth and are not connected to organic life or photosynthesis

Human activities alone are what cause the greenhouse effect

The atmosphere is large and small amounts of carbon dioxide or a few degrees of temperature change can't make much difference

Carbon is destroyed when fossil fuels are burned. Carbon released from combustion and other human activities doesn't really have any adverse impact on the climate system

If warming is occurring, it is the result of a natural cycle we can't do anything about

Energy is truly lost in many energy transformations

Energy is confined to some particular origin, such as what we get from food or what the electric company sells

### **Students will be able to...**

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- Evaluate the advantages and disadvantages of different energy sources.
- Discuss the factors that affect the choice of energy sources adopted by different societies.
- Discuss the factors which affect energy security.
- Evaluate the energy strategy of a given society.
- Discuss the feedback mechanisms that would be associated with a change in mean global temperature.
- Evaluate contrasting viewpoints on the issue of climate change.
- Discuss mitigation and adaptation strategies to deal with impacts of climate change.
- Evaluate the effectiveness of international climate change talks.

## **STAGE 2- EVIDENCE OF LEARNING**

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### **Formative Assessment**

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- 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**

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- 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**

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IB test questions, essays, and case studies.

## **STAGE 3- LEARNING PLAN**

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### **Instructional Map**

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4th marking period

Topic 7: Climate change and energy production

7.1 Energy choices and security

7.2 Climate change—causes and impacts

7.3 Climate change—mitigation and adaptation

### **Modification/Differentiation of Instruction**

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#### 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, guided 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**

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- 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 Assignment
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials
- Use of Audio Resources

## **Differentiation Strategies**

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### **High Preparation**

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- 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**

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- 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**

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See Appendix

## **Vertical Integration- Discipline Mapping**

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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, Disciplinary Core Ideas, and Crosscutting 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 required 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**

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Kognity (website)

Online Curriculum Center (an IB site)