Teaching Guide

Topic 7: Climate change and energy production

Topic map

Sub-topic number and name	Learning outcome	Number of lessons (suggested) 1 hour per lesson	Relevant material
7.01 Energy choices and security	Different energy sources vary in sustainability, availability, cost and socio-political implications. Energy security is an important factor in making energy choices.	4	Pages 300–316 Figures 7.01–7.10 Self-assessment questions 7.01.01–7.01.03 Case studies 7.01.01, 7.01.02 End-of-topic question 1
7.02 Climate change – causes and impacts	Climate change is a normal feature of Earth but human activity has influenced recent changes and there is significant debate about this. Climate change has global impacts.	5	Pages 317–335 Figures 7.11–7.22 Self-assessment questions 7.02.01–7.02.05 Case study: 7.02.01 End-of-topic question 2
7.03 Climate change – mitigation and adaptation	Mitigation attempts to reduce the causes of climate change. Adaptation attempts to manage the impacts of climate change.	4	Pages 336–347 Figures 7.23–7.27 Self-assessment questions 7.03.01–7.03.02 Case study 7.03.01 End-of-topic question 3

Sub-topic 7.01: Energy choices and security

Overview

Most students will have a basic knowledge and understanding of energy choices and security, but they are unlikely to know the detail required. They will become aware of the complexity of

energy issues and the fact that choice of energy sources can have impacts on both local and global scales.

Students will evaluate the advantages and disadvantages of different energy sources, discuss the factors that affect choice of energy sources by different societies, discuss factors which affect energy security, and evaluate the energy strategy of a given society.

Suggested activities

Possible starters

Consider the sources of energy used at home, at school/college, and in journeys between home and school. Have there been any changes in these sources of energy over time? What other sources of energy have students come across? What sources of energy have they had no connection with? Discuss and divide the sources of energy into non-renewable and renewable energy.

Key images of the different sources of energy production can do much to clarify areas where students have little or no prior knowledge.

Main lesson content

- Divide students into groups with each group researching the environmental impact (production and emissions) of one energy source, before reporting back to the whole class. Each student could produce a brief energy impact statement for all the sources of energy covered.
- Energy demand – using a series of images to contrast very high energy use in North America with low energy use in Africa. Selected images can be used to illustrate the concept of the energy ladder.
- Special consideration of the issues surrounding nuclear power by considering major incidents such as Three Mile Island, Chernobyl, and Fukushima. How significant is the issue of nuclear waste? A good source of information is: www.teachnuclear.ca/all-things-nuclear
- Energy security – group brainstorming to list reasons why an increasing number of countries are concerned about energy security and what they are doing about it.
- Energy efficiency – what, if anything, have students and their families done to become more energy efficient? Has their school/college implemented energy conservation measures? What could be done at home and at school/college in the future?
- Useful online sources of information and resources are a good source of up-to-date information.
  www.bp.com/statisticalreview – the BP Statistical Review of World Energy is updated annully to present a comprehensive source of information on energy production, consumption, and trends.
  www.geography.org.uk – DVDs from the Geographical Association: (1) *Global Energy Security* (2) *Energy Security: India's Sustainable Solutions* (3) *Climate Change*.

Common misunderstandings and misconceptions

When analysing energy data, some students struggle with the differences between *per capita* energy production and *per capita* consumption. This is because some energy-rich countries (e.g. Nigeria, Venezuela) have big economic problems because the wealth created by oil resources does not appear to have been used wisely and has not trickled down to the general population.

Supporting struggling students

The BBC's GCSE Bitesize website has a useful section on energy resources which includes video clips:
www.bbc.co.uk

Challenging high achievers

High achievers could pursue the general relationship between energy use and economic development by researching data for these two variables for a sample of countries across the economic spectrum and plotting the data on a scatter graph before assessing the strength of the relationship. A statistical technique such as Spearman's Rank Correlation Coefficient could be used to test the relationship between the two variables.

Homework suggestions

Useful and interesting homework assignments might include:

- researching the energy mix of the country in which the student lives
- producing a diagram to illustrate the concept of the energy ladder
- using the energy charting tool at www.bp.com/statisticalreview to undertake tasks set by the teacher.

Cross-references with other sub-topics

1.03 Energy and equilibria, 1.04 Sustainability, 8.02 Resource use in society, 8.04 Human population and carrying capacity.

Sub-topic 7.02: Climate change – causes and impacts

Overview

Students will probably have a reasonable basic knowledge of the causes and impacts of climate change, but are unlikely to have come across detail such as oceanic and atmospheric circulatory systems, and positive and negative feedback mechanisms.

Students will discuss the feedback mechanisms that would be associated with a change in mean global temperature, evaluate contrasting viewpoints on the issue of climate change, and understand that the impacts of climate change are global and require a high level of international cooperation.

Suggested activities

Possible starters

Brainstorm in groups to differentiate between the characteristics of weather and climate.

Project maps of (a) ocean currents and (b) atmospheric circulatory systems onto the screen with labelling deleted to see how many ocean currents and major winds the class can name. Conduct a brief discussion of their possible influence on weather and climate.

Brainstorm the causes and impacts of climate change. Check the relationship between the group's ideas and the requirements of the syllabus.

Selected video clips can stimulate starter activities. For example, www.oxfam.org.uk highlights the impact of climate change on poor people around the world.

Main lesson content

- Analyse graphs of past changes in mean global temperature.
- Discuss and list extreme weather events followed by selected video clips of extreme weather (hurricanes, heatwaves, etc.).
- Interpret graphs illustrating climate change projections.
- Use maps of the world and of continental areas to identify the human populations and environments most at risk.
- Consider the likely impact of climate change upon the country in which students live.
- Useful online sources of information and resources are:
    - www.skeptic.com – a scientific and educational organisation promoting science and critical thinking; many articles concerning climate change
    - www.sciencedaily.com – a good source of articles and videos on climate change
    - www.newscientist.com – articles on all aspects of climate change
    - www.climate.nasa.gov – a detailed source covering the evidence, causes, effects and solutions relating to climate research
    - www.tes.co.uk/teaching-resources/climate-change – the *Times Educational Supplement* (TES) – claims to be the world's largest online network of teachers.

Common misunderstandings and misconceptions

The distinction between weather and climate can cause problems for some students. At a higher level, clearly explaining the differences between negative and positive feedback can be challenging.

Supporting struggling students

Producing clearly labelled diagrams to illustrate feedback mechanisms can overcome the difficulties that some students have with this concept. Careful choice of other illustrative material can also be crucial to students' level of understanding.

www.teachclimatechange.org/ – this website aims to be a comprehensive tool for teaching climate change. The resources are searchable by key stage.

Challenging high achievers

There is plenty for the most able to investigate. The consequences of climate change could be examined in detail, with particular reference to case studies. Investigating examples where the consequences of climate change are seen as beneficial could go well beyond syllabus requirements.

Homework suggestions

To clearly differentiate between weather and climate, students could record the weather at their location for a week and compare this to the climate of the region. The case study of Kiribati in the Elevate materials could provide the basis for a number of homework assignments relating to climate change.

Cross-references with other sub-topics

1.02 Systems and models, 1.03 Threats to biodiversity, 5.02 Terrestrial food production systems and food choices, 6.01 Introduction to the atmosphere, 6.02 Stratospheric ozone, 8.04 Human population carrying capacity.

Sub-topic 7.03: Climate change – mitigation and adaptation

Overview

Students are not likely to have much prior knowledge of this sub-topic. If a reasonable knowledge base is present at the start, it is more likely to be with regard to adaptation rather than mitigation.

Students will discuss mitigation and adaptation strategies to deal with impacts of climate change, evaluate the effectiveness of international climate change talks, understand that the impacts of climate change are global and require global mitigation, and appreciate there is a degree of uncertainty in the extent and effect of climate change.

There is an argument for beginning this sub-topic by considering adaptation before mitigation, as students' prior knowledge is more likely to relate to adaptation.

Suggested activities

Possible starters

Brainstorm adaptation strategies and name any examples students have come across.

Use of key images to illustrate adaptation strategies along with significant examples of their use.

Similar starters can be used with regard to mitigation.

www.climate.gov/teaching/ – includes a cartoon focussing on adapting to climate change.

Main lesson content

- Use video clips and other resources to introduce key strategies such as carbon dioxide removal (CDR) and carbon capture and storage (CCS).
- Debate the concept of adaptive capacity.
- Consider 'time lag' in relation to climate change – even if mitigation strategies drastically reduce future emissions of greenhouse gases, past emissions will continue to have an effect for decades to come.
- Introduce the main international organisations with responsibility for climate change (IPCC, UNFCCC).
- Useful online sources of information and resources are:
    - www.sciencedaily.com – a good source of articles and videos on climate change
    - www.ipcc.ch - The Intergovernmental Panel on Climate Change. Numerous relevant publications, particularly two of the four parts of the IPCC's Fifth Assessment Report:
        Climate Change 2014: Impacts, Adaptation and Vulnerability.
        Climate Change 2014: Mitigation of Climate Change.
    - www.unep.org/climatechange/adaptation/ – includes the barriers and constraints to adaptation efforts for developing countries, ecosystem-based adaptation, and access to adaptation finance.
    - www.climatechangelive.org – resources and lesson plans relating to climate change.

Common misunderstandings and misconceptions

Some students struggle to differentiate between adaptation and mitigation. Higher-level concepts that can cause difficulty are adaptive capacity and time lag.

Supporting struggling students

The BBC's GCSE Bitesize website has a useful section on climate change which includes video clips:
www.bbc.co.uk

Challenging high achievers

There are many areas of interest for high achievers to explore. The possibilities of geoengineering could be an attractive option.

Homework suggestions

Students might be asked to research an example of climate adaptation and give a brief presentation in the following lesson. The range of examples covered could make an effective classroom display. At the end of this sub-topic, preparing for a test of all the key terms covered in the topic would be a useful homework assignment.

Cross-references with other sub-topics

1.05 Humans and pollution, 4.02 Access to fresh water, 6.03 Photochemical smog.