

O Level Biology (5090)

Unit 7: Organisms and the Environment

Recommended Prior Knowledge

Students should have a knowledge of the different forms of energy, of plant nutrition, respiration and transpiration. A knowledge of the great diversity of life and habitats would be helpful.

Context

This Unit, whilst considering some of the fundamental topics of biology also takes a broader view of the subject and investigates some of the ethical issues raised by human interference with the environment.

Outline

Energy flow is traced through biological systems and the carbon and nitrogen cycles are considered in some detail. There is a reference to parasitism in the shape of the transmission and control of malaria, but control measures employed lead into a consideration of the human effect on the ecosystem in a wider sense – deforestation, pollution and damage to habitats leading to a need for conservation.

AO	Learning outcomes	Suggested activities and further guidance	Online resources	Other resources
15(a)	State that the Sun is the principle source of energy input into biological systems.	Stress that it is light energy from the Sun which is important in photosynthesis, but enzymes controlling all metabolic reactions rely also on its heat energy to provide a suitable temperature for their operation.		Textbooks Ian J. Burton – Topic 17 The Relationship between Organisms and the Environment Mary Jones – Unit 16 Organisms and Environment M. & G. Jones – 15 Living organisms and their environment
15(b)	Describe the non-cyclical nature of energy flow.	Once energy is released by organisms it is lost and can be replaced only by further input, directly or indirectly, from the Sun.		

15(c)	Define the following terms and establish the relationship of each in food webs: producer, consumer, herbivore, carnivore, decomposer, food chain.	<p>Students may be able to suggest food chains in various different habitats.</p> <p>Students should be provided with a food chain of at least three organisms, starting with a producer, and write each of the specified words underneath the appropriate component of the food chain provided.</p>	<p>Food chains and terminology: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/foodchains/foodchains1.shtml</p>	
15(d)	Describe energy losses between trophic levels and infer the advantages of short food chains.	<p>In Unit 8(d) of unit 4 students considered the use of energy for different processes in a body thus there is always less energy available to each successive level in a food chain or web.</p> <p>Use the suggested online resource to review the ways in which energy may be lost between trophic levels. Students may make a bullet-point list of these and explain why food chains are commonly limited in length.</p> <p>The efficiency of food production in terms of placing humans as primary consumers and of reducing energy losses through factory farming may be discussed with reference to named examples generated by students.</p>	<p>Energy transfer: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/foodchains/foodchains2.shtml</p>	
15(e)	Describe and interpret pyramids of numbers and of biomass.	<p>It should be explained why pyramids of biomass (which are of typical pyramid shape) provide a more accurate representation of energy relationships between organisms in a food chain or food web than pyramids of numbers (many of which are not the typical pyramid shape).</p> <p>Students may draw and explain pyramids of number and biomass for food chains introduced earlier in the unit. They may link the shape of biomass pyramids to the knowledge gained in 15(d).</p> <p>Students may draw pyramids to scale using graph paper if numbers and/or biomasses are given.</p>	<p>Pyramids of biomass: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/foodchains/foodchains3.shtml</p>	

15(f)	Describe and state the importance of the carbon cycle.	<p>This outcome stresses the fact that life is carbon-based and is an opportunity to consolidate topics covered in Units 2, 3 and 4.</p> <p>Students may list and then arrange into a sequence all the processes they have studied which involve carbon compounds. The cyclical nature of these processes should become apparent.</p> <p>Students may be asked to trace the fate of an atom of carbon after it has entered a plant in a CO₂ molecule during photosynthesis, thus building up their own carbon cycles. These may then combined to provide (perhaps with a few additions/adjustments) the definitive version for distribution.</p> <p>The suggested online resources may be used to provide additional stimuli and assistance during or following the above activities.</p>	<p>The carbon cycle info and diag.: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/foodchains/foodchains5.shtml</p> <p>Carbon cycle animated video: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/foodchains/foodchainact.shtml</p>	
15(g)	Describe the nitrogen cycle in making available nitrogen for plant and animal protein, including the role of bacteria in nitrogen fixation, decomposition and nitrification (details of denitrification and the names of individual bacteria are not required).	<p>Students may attempt to brainstorm the nitrogen cycle in a similar way to the carbon cycle. Cross reference with decomposition considered in 14(b) of Unit 6.</p> <p>Students tend to find this cycle difficult to understand and remember. It is therefore wise to avoid unnecessary detail. The suggested online resources present the topic at an appropriate level.</p> <p>Students may use the talking explanation of the nitrogen cycle to write a set of bullet-point notes to explain each step – <u>underlining</u> the different types of bacteria involved.</p> <p>Distinguish carefully between the terms ‘nitrogen fixation’ and ‘nitrification’. Reference should be made to bacteria in the root nodules of leguminous plants as well as to those which are free-living.</p>	<p>Simple nitrogen cycle diagrams: http://www.s-cool.co.uk/gcse/biology/environment/cycling-through-nature.html#nitrogen-cycle</p> <p>Talking explanation and animation of the nitrogen cycle: http://www.nodvin.net/snhu/SCI219/demos/Chapter_3/Chapter_03/Present/animations/32_2_1a.html</p> <p>Photograph of root nodules: http://blog.lib.umn.edu/denis036/thisweekinevolution/AlfalfaNodules5.jpg</p>	

15(h)	Understand the role of the mosquito as a vector of disease.	<p>Indicate how the lifestyle of the mosquito makes it a successful vector of a wide variety of diseases. Stress that the mosquito is the carrier (vector) of the pathogen but does not itself cause malaria. Ways in which control of the mosquito vector is achieved should be considered here.</p> <p>Students may use the suggested online resources to research the lifestyle and control of the mosquito vector and present their findings in the form of a poster, fact sheet or brief presentation to the class.</p> <p>It is possible for some students to research and summarise 15(h) whilst others do so for 15(i). Students may subsequently share their findings.</p>	<p>Mosquito vector and control: http://www.cdc.gov/malaria/about/biology/mosquitoes/index.html</p> <p>World Health Organisation malaria fact sheet: http://www.who.int/mediacentre/factsheets/fs094/en/index.html</p>	<p>Textbook M. & G. Jones - 13 Health, disease and medicine</p>
15(i)	Describe the malaria pathogen as an example of a parasite and describe the transmission and control of the malarial pathogen (details of the life cycle of the pathogen are not required).	<p>Control of the pathogen both before and after it has entered the body should be considered here.</p> <p>As above, students may use the suggested online resources to research the lifestyle and control of the mosquito vector and present their findings in the form of a poster, fact sheet or brief presentation to the class.</p>	See suggested resources listed above.	
15(j)	Describe the effects of humans on the ecosystem with emphasis on examples of international importance (tropical rain forests, oceans and important rivers).	<p>Action which affects large areas in one part of the world may have consequences in another (e.g. global warming, scarcity or contamination of fish supplies). Loss of habitats leads to extinction of species and to loss of possible benefits from those species (e.g. drugs). Action taken in one region near a river can cause flooding and devastation hundreds of miles away.</p> <p>Students may be divided into three groups with each group studying in depth, using the suggested online resources, one example of the effects of humans on the ecosystem. Students may present their findings in the form of a report or presentation to exchange with others.</p>	<p>Tropical rain forests: http://environment.nationalgeographic.com/environment/habitats/rainforest-threats/</p> <p>Oceans: http://www.protectplanetocan.org/introduction/introduction.html</p> <p>Rivers: http://www.internationalrivers.org/</p>	<p>Textbooks Mary Jones – Unit 17 Human Effects on Ecosystems</p> <p>Ian J. Burton – Topic 18 – The Effects of Human Activity on the Ecosystem</p> <p>M. & G. Jones – 16 Humans and the environment</p>

15(k)	Describe the consequences of deforestation in terms of its effects on soil stability, climate and local human populations.	<p>The removal of trees removes the binding effect their roots have on the soil as well as the protection their canopies provide from sun, wind and rain. The humus their dead leaves provide is also lost. Local populations may lose homes and livelihoods. Climate changes are usually experienced at greater distances from the site of deforestation.</p> <p>Students may use the list of points outlined above and the suggested online resource to produce a 'spider diagram' showing the consequences of deforestation.</p>	<p>Deforestation: http://www.bbc.co.uk/dna/h2g2/A3556848</p>	
15(l)	<p>Evaluate the effects of:</p> <p>water pollution by sewage, by inorganic waste and by nitrogen containing fertilisers;</p> <p>air pollution by greenhouse gases (carbon dioxide and methane), contributing to global warming;</p> <p>air pollution by acidic gases (sulphur dioxide and oxides of nitrogen), contributing to acid rain;</p> <p>pollution due to insecticides.</p>	<p>Students should be made aware of the damage being caused to the planet by the stated forms of pollution and that it is when the materials mentioned are used or released in excess that problems occur.</p> <p>Eutrophication should be considered as an effect of water pollution by sewage and N₂ fertilisers, as should the build up along food chains of insecticides which cannot be metabolised.</p> <p>Ensure that there is a clear distinction in students' minds between the use of fertilisers and the use of insecticides.</p> <p>Students may produce a set of flow charts to list the steps involved in the processes of eutrophication, global warming and the production of acid rain.</p> <p>Students may produce a poster or information leaflet describing the effects of the stated forms of pollution.</p> <p>The distinction between 'causes' and 'consequences' may be clearly made by asking students to list these in two columns of a table for each form of pollution.</p>	<p>Water pollution: http://www.water-pollution.org.uk/</p> <p>Combustion products: http://www.bbc.co.uk/schools/gcsebitesize/science/21c/atmosphere/chemicalreactionsrev2.shtml</p> <p>Greenhouse effect animation: http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/</p> <p>Acid rain: http://www.supergreenme.com/green-environment-eco:Acid-Rain</p>	

15(m)	Discuss reasons for conservation of species with reference to maintenance of biodiversity, management of fisheries and management of timber production.	<p>Many of the points relevant here will have been considered in 15(j) and (k) above. The concept of sustainable management of fish (via 'quotas') and timber supplies should be promoted.</p> <p>Students may research specific examples of species or ecosystems which are actively being conserved, the methods by which this is being achieved and the reasons why their conservation is important. Students may present their findings in a variety of formats.</p>	<p>Species conservation: http://www.admwebstudios.co.uk/Biodiversity3.htm#preserve</p>	
15(n)	Discuss reasons for recycling materials, with reference to named examples.	<p>Depletion of the planet's resources is of concern. Deforestation for paper production may be reduced by paper recycling and energy may be saved by recycling glass. Recycling metal (from cans to cars) saves both energy and reduces the need to mine the ore.</p> <p>The suggested online resource may be used by students to research the topic further. Students may produce a poster or information leaflet, for use in their school or community, to promote the benefits of recycling.</p>	<p>Metal, paper, plastic and glass recycling: http://www.thriftyfun.com/tf42552953.tip.html</p>	