Paper 2 Physical Options

UNIT 1 Tropical environments

Recommended Prior Knowledge As is the case for all of the Advanced Geography Options completion of the core modules is expected. The Tropical environments option builds on the knowledge and understanding gained in compulsory core Units 2 Atmosphere and weather and 3 Rocks and weathering.

Context The focus in this option is on the humid and seasonally humid tropics, i.e. those regions that have high temperatures and high annual rainfall or a seasonal distribution of rainfall.

Outline Study of the physical environment is the starting point with consideration of the climatic characteristics across the humid and seasonally humid tropics which can then lead into discussion of the vegetation, soils and landforms of these areas. Case study material and examples should be included wherever appropriate and **one** case study illustrating some of the problems of sustainable management of **either** the tropical rainforest ecosystem **or** the savanna ecosystem is an essential part of the option.

Resources Geofile online at Nelson Thornes and Geo Factsheets at www.curriculum-press.co.uk are two excellent subscription online resources.

Textbooks referenced below Digby, B ed. (2000) *Global Challenges* Heinemann; Heelas, R (2001) *Tropical Environments: Contrasting Regimes and Challenges* Nelson Thornes; Meg and Jack Gillett (2003) *Physical Environment: A Case Study Approach* Hodder and Stoughton; Guinness, P and Nagle, G (1999) *Advanced Geography: Concepts and Cases* Hodder and Stoughton; Money, DC (2000) *Weather and Climate* Nelson; Nagle, G (2000) *Advanced Geography* Oxford University Press; O'Hare, G (1990) *Soils, Vegetation and Ecosystems* Oliver and Boyd; Warburton, P (2001) *Atmospheric Processes and Human Influences* Collins; Waugh, D (2000) *Geography: An Integrated Approach* Nelson Thornes 3rd edition; Woodfield, J (2000) *Ecosystems and Human Activity* Collins 2nd edition; Geography in Focus (2000) Cook, I, Hordern, B McGahan, H, Ritson, P. Causeway Press.
A recent text is very useful: David Holmes (2006) *Ecosystems and Biodiversity*, Philip Allan Updates

Content	Objectives and suggested teaching activities	Online resources	Other resources
	Introduction The intention is to convey an overview of the option at the outset. Study a world map of the major biomes of which the TRF and savanna are two. Consider latitudinal distribution. Relate to the global climate map and global population distribution. Emphasise the humid tropics/low latitudes and links between the sub-sections of climate, vegetation and soils in the syllabus through these maps. **Exercise:** Give climate data for selected stations e.g. equatorial climate, savanna climate, monsoon climate. Plot data, describe in detail climatic characteristics of each as a lead in to explanation. **Why are the tropics an issue?** Brief, general discussion of wilderness areas, outstanding physical environments, biodiversity, resources, endangered species, the threats posed by indiscriminate exploitation and the need for conservation. Possible development of links to Advanced Human Options Unit 2 Environmental management and 3.3 about tourism.	General: amazonia.com is a comprehensive web site. www.gis.psu.edu/geog121/remote/rondonia_75html www.dpi.inpe.br/Amazoniapg13.html www.worldclimate.com Has a good range of climate data for a selection of stations round the world **June 2003 Q. 2(a)** Good climate data – could be a useful teaching aid.	Any atlas. Nagle p.210 excellent map of world vegetation zones/biomes. Woodfield p.15 Holmes p.4 map and p.5 table of biomes and their characteristics. Heelas p.8 as a starting point. Digby p.38 Heelas pp.12-13

1.1 Tropical climates	The foundations will have been laid at AS through Unit 2 Atmosphere and weather. See SoW 2.2 Earth-atmosphere energy budget and general circulation, etc. **Explanation of climates** Good starting point - **general circulation of the atmosphere**. Focus on the Hadley cell. Formation of ITCZ, low pressure at the Equator, descending air at 30˚ N and S, producing high pressure. Air masses, associated wind belts - trade winds. Migration of thermal equator according to the seasons. Relate to the resultant changing position of pressure and wind belts, on-shore/offshore winds and resultant rainfall. Relationship of earth to sun as it moves to produce seasonal variations in temperature. Ocean currents have an influence. **Examples** **1. West Africa** Aptly demonstrates the change from equatorial to savanna climate with seasonal variation in rainfall. It may be appropriate to introduce the **West African ecocline (vegetation transect)** to demonstrate links between climate, vegetation and human activities. **June 2003 Q. 2(b)** The ecocline would be an ideal example for such a question which asks about the relationship between rainfall and vegetation. **2. Indian sub-continent -** Monsoon climate. Sub-tropical jet stream and relation to surface conditions Well annotated maps can be very useful for both examples and can be used in an examination answer for explanatory purposes.	**June 2007 Q. 1(a)** Convectional heating - essential to tropical climates **Nov 2005 Q. 1(a)** **Nov 2002 Q. 2(a)** specifically about the ITCZ and its influence upon precipitation **November 2003 Q. 1(a)** **June 2002 Q. 1(a)** **June 2008 Q. 1(b)** Emphasise the variation in tropical climates from humid to seasonally humid to arid: they are all tropical climates. **June 2006 Q. 1(a)**	Garrett and Nagle p.411 Waugh p.226 Nagle p.157 Digby p.39 Waugh p.228 Gillett pp.110-111 Fig.1 Digby p.41 Money p.87 Money pp.37-9 Warburton pp.145-154, excellent section. Nagle p.173 has very good diagrams. Waugh pp.239-40

1.2 Tropical ecosystems	**Vegetation** This section needs an introduction to the ecosystem as a concept, and its structure, functioning and development over time. Soil characteristics and formation is also included. Focus on TRFand savanna ecosystems. **Biomass - total mass of living organisms present in an area**. Expressed as mass per unit area measured as dry weight. It is a weight, compared with productivity, which is a rate. **Productivity -** rate of energy production, usually on an annual basis. **Gross Primary Productivity (GPP)** total energy production including respiration. **Net Primary Productivity (NPP)** is the total amount of energy transferred from sunlight into organic matter (photosynthesis) minus the energy lost via respiration. It is expressed as a rate g/m²/yr. Food chain/webs **Trophic levels** – a feeding level within a food chain from which energy is lost. **Biodiversity** a term used to describe the variety of species, both floral and faunal within an ecosystem. Nutrient cycling - Gersmehl diagrams. Plant succession, climax vegetation, plagioclimax, seres, prisere, sub-seres, plagioseres seral stages, sub-climax. **Tropical rainforests** - structure, characteristics, adaptations, nutrient cycling. Relationship to climate/reasons for the nature of the forest/large biomass/high productivity, etc.	**June 2007 Q. 1(b)** **June 2002 Q. 2(a)** **Nov 2003 Q. 1(b)** **June 2008 Q. 2(a) Fig. 1** **June 2002 Q. 1(a**)	Waugh Chapter 11 pp.286-306 Nagle Chapter 10 O'Hare Chapter 4 pp.94-106 Woodfield pp.4-11 Holmes p.6 useful definitions. Holmes p. 8, useful table of comparative GPP NPP biomass data. Food chain/webs Holmes p. 7 diagram of energy flows.

	Could introduce case study material here and consider both human and physical factors which determine the nature of the forest, or it can be done as a separate section after all the theory is covered. Familiarity with secondary succession and how it differs is important. **Savanna -** Characteristics, adaptations of vegetation to seasonal variation of rainfall, nutrient cycling, productivity rates. Comparison with TRF and explanation of differences. Spatial variation of vegetation (ecocline) north to south across the savanna in West Africa to demonstrate the spatial variation in seasonal rainfall. **June 2003 Q. 2(b)** could have been answered very well using the West African ecocline. **Soils** Basic background detail if soils have not been studied previously. Definition of soil, composition, structure. **Factors** which influence soil formation: climate, vegetation, relief, fauna, geology, time. **Soil forming processes** Precipitation-evaporation ratios, leaching and upward capillary action; gleying, ferrallitisation, laterisation, calcification, duricrusts. Soil profiles for tropical soils. Oxisol/latosols/ferrallitic soils. Familiarity with **at least one** tropical soil. Well annotated diagram will fulfil requirements. **November 2002 Q. 1** requires at least one tropical soil profile. **Catena** is a down slope sequence of soils which reflects differences in drainage conditions. The influential factors are slope angle, water table, aspect, vegetation and climate. Rock type is constant.	**June 2006 Q. 2(a)** Fig.1 excellent teaching resource, use as an introduction to this section of work on succession. **June 2006 Q. 1(b)** and **Nov 2005 Q. 1(b)** vegetation structure. Geo Factsheet 25 Energy Flow and Nutrient cycling in Tropical Rainforests **June 2007 Fig. 1** Recommended resource, relationship between soils and human activity.	Woodfield Chapter 2 pp.14-41 Waugh pp.316-318 'The Rain Forest Paradox' *Geography Review* Sept 1998 pp.7-9 Nagle pp.212-3 O'Hare pp.116-122 Heelas pp.67-73, excellent detail on all aspects of the natural environment of the TRF. Holmes Part 3 pp.31-46 Nagle pp.214-5 O'Hare pp.126-7 Garrett and Nagle pp.463-6 Heelas pp.39-45 Holmes Part 2 pp.18-30 Waugh Chapter 10 from p.260 good visual presentation of soils. Heelas pp.65-6 good Nagle pp.193-4, very good on zonal and equatorial soils with good profile diagrams.

	Note See CIE Standards booklet for an excellent candidate response/possible model answer to a question on catenas. There is plenty of information here. Human impact on tropical soils should be covered either here or in the final section of the unit. The question may focus on soils, e.g. **June 2006 Q. 2(b)**	**Nov 2006 Q. 1(b)** focuses on one tropical soil. **June 2004 Q. 2(c)** useful diagram of a catena.	O'Hare p.50, pp.119-120 catena in Belize. Waugh p.276 Nagle p.189 All references have theoretical models of the catena.
1.3 Tropical landforms	The theme of this section of work should emphasise the link between process and form. It will be familiar from AS work. See the AS SoW 3.2 Weathering and rocks and 3.3 Slope processes and development **Weathering processes** **Physical** Exfoliation, dilatation, crystal growth, frost action. **Chemical** Hydrolysis, hydration, carbonation. Reminder of the Peltier diagram. Also latitudinal variation of weathering depths - link to basal surface of weathering. **Nov 2003 Q. 2(a)** Good teaching aid. **Factors influencing weathering rates** Van't Hoff's Law, importance of water, rock structure - joint pattern - increasing surface area and allows ingress of water. Influences both *rate* and *amount* of weathering. **Granite -** characteristics of granite composition and structure. Weathering of granite: hydrolysis. Weathering front-basal surface, joint pattern, corestones, saprolite.		Waugh p.40 Nagle p.40 has a diagram showing the relationship between depth of weathering and climate.

	Evolution of landforms Etchplanation theory: deep weathering; exhumation by stripping - reasons for stripping, i.e. climate change, fluvial activity, vegetation removal, cyclical nature of the stripping. **Pediplanation** - uplift of a pediplain; vertical fluvial incision; pediment formation and role of water in lateral planation of these surfaces and relation to parallel retreat of slopes. Link to Unit 4.2 Processes producing desert landforms. **November 2002 Q. 2(b)** and **June 2003 Q. 1(a)** **Landforms** Pediplains, etchplains: inselbergs, ruwares, bornhardts, koppies/kopjes, tors. Useful teaching aids: **June 2003 Q. 1(a)** diagrams and **November 2003 Q. 2** and **Fig. 1**. Mark schemes for these papers give a good guide to content. **Limestone** characteristics of limestone composition and structure. Joint pattern, bedding planes and vertical joints. Permeability. **Weathering process** Carbonation-solution. **Tropical karst limestone forms** emphasise vertical nature of the weathering to produce scale of these landforms. **Landforms** Cockpit karst, tower karst, mogotes. Good examples: China and Caribbean. **June 2002 Q. 2(b)**	**June 2006 Q. 2(b)** **June 2007 Q. 1(b)** **June 2007 Q. 2(b)** **June 2008 Q. 2(b)** www.geoimages.berkeley.edu Excellent images of landforms.	Cook and Hordern Chapter 8 Nagle pp.38-9, a key source Heelas p.58, passing reference. Waugh p.198, short reference.

1.4 Sustainable management of tropical environments	The big idea in this section is **sustainability** in relation to the functioning of the physical environment and human use of that environment in order to maintain its resources. Carrying capacity, soil erosion, leaching, infertility. Link to human activities. Management strategies. Discussion should include evaluation of the success of the management. Zoning, biosphere reserves, conflicts which arise. **Case study of TRF ecosystem OR savanna ecosystem** **TRF** Deforestation, problems associated within the physical environment: soil erosion, leaching, consequent infertility, breakdown of nutrient cycles, loss of productivity NPP. Changing albedo, implications for global climate change. Therefore extend local effects to global impact. Also forests as carbon sinks, link to atmospheric pollution and climate change. Loss of agricultural potential. Carrying capacity, sustainable population levels, indigenous populations. Human activities: agriculture - sustainable bush fallowing, commercial large scale agriculture – plantations, ranching. Other activities: mining, tourism, ecotourism. Biofuels. It is important that soils are treated as part of the system from the point of view of management. **June 2006 Q. 2(b)**	**Nov 2006 Fig. 1** excellent photograph of an inselberg. Ideal teaching resource - annotate describe and explain evolution. **Nov 2005 Q. 2(a) Fig. 1** **June 2007Q. 2(b)** www.siue.edu/GEOGRAPHY/ONLINE/Gillespie.htm www.istrianet.org Very good on tropical karst after temperate karst scenery. Mentions three films which were shot in tower karst landscapes including two James Bond films and *The Beach*. **June 2006 Q. 2(b)** Rainforest management question is discursive not factual 'Why is it so difficult to manage?' Build into teaching.	Garrett and Nagle p.530 Heelas pp.86-90 theme of sustainability. Digby pp.89-105, very good accessible section. Heelas pp.74-85, case study of Brazil. Woodfield pp.30-7 Gola Forest, Sierra Leone. Woodfield p.30, excellent flow diagram to show effects of deforestation on albedo. Holmes Parts 2, 3 pp.94-115 and Part 8, sustainability and management of biodiversity.

	Optional discussion activity - Food for thought Mature TRF produces as much CO_2 as it absorbs. It is only when the forest is growing that it acts as a sink. Apparently it would be best to chop down all the TRF, use the wood for building and replant so that the TRF regrows, absorbing more CO_2? Scale of human activity scale of climate change that might result - local, global. **Savanna** Rainfall reliability, drought, desert margins - Sahel – use the West African example again. Overpopulation, nomadic pastoralism, indigenous populations, changes to sedentary agriculture, way of life, pressure on the natural environment. Desertification e.g. Sahara margins - Sahel. Possible aspects - Masai, Fulani tribes. Tourism – National Parks and the impact of safaris. Management strategies. Water availability. There is case study material in many textbooks. It might be advisable to study both TRF and savanna if time allows. One could always be set as a research exercise, provided that a guide to the structure is provided by means of side headings. Students may enjoy this sort of task. If structure is not indicated sheaves of undigested internet research may appear. PowerPoint presentations can be a useful method of presentation, in which the whole group can share, provided they are kept short and the technology is available. **Pasoh Forest Malaysia** has all the necessary ingredients of physical environment and human activities which threaten the natural environment and conservation/protection measures/management.	**June 2005 Fig. 1 Q. 2(b)** very useful diagram not widely available. www.nasa.gov Good images www.inpe.br Focus on Brazilian rainforest **June 2005 Q. 2(b)** **November 2002 Q. 2(b)** **June 2003 Q. 1(b)** **November 2003 Q. 2(b)**	Money p.87 Warburton pp. 100-101 Waugh pp.335-338 Case Study 12 Garrett and Nagle pp.524-529, excellent section on desertification, The Challenge of Seasonality in the Tropics. Digby pp.36-48, savanna areas. *Geography Review* November 2003 pp.24-6 'Desertification in Southern Africa' *Geography Review* September 1996 Geo Factsheet 24 The causes of aridity Geo Factsheet 28 Desertification: Causes and Control