

Key Concepts GCSE Topic 3 Ecosystems, biodiversity and management

Detailed Content	Core Knowledge & Understanding	Keywords
<p>Distributions and characteristics of the world's large-scale ecosystems (tropical, temperate and boreal forests, tropical and temperate grasslands, deserts and tundra).</p>	<p>An ecosystem is a community of plants and animals which interact with each other and their non-living environment. The non-living environment includes rocks, soil, air and water. A biome is a large-scale ecosystem.</p> <p>Biome characteristics</p> <p>Tropical forests (rainforests)</p> <ul style="list-style-type: none"> - found in low-lying areas near the equator - Central and South America, parts of Central Africa and Asia - hot, humid, wet climate (equatorial) - huge variety of plants and animals (around half of all the world's species) - mostly hardwood trees <p>Temperate forests (deciduous forests)</p> <ul style="list-style-type: none"> - found across Europe and USA - mild, wet climate (temperate maritime) - deciduous trees that lose their leaves in winter <p>Boreal forests (coniferous or taiga forests)</p> <ul style="list-style-type: none"> - found in Scandinavia, Russia and Canada - cool, moderate rainfall climate (cool temperate) - evergreen trees with needle-like leaves <p>Tropical grasslands (savanna)</p> <ul style="list-style-type: none"> - found in Central Africa, northern Australia, central South America - hot and dry climate (semi-arid) - two distinct seams (dry and wet) - grasses, scrub and occasional trees <p>Temperate grasslands</p> <ul style="list-style-type: none"> - found in Puszta in Hungary, the Veldt in South America, the Pampas in Argentina & the Prairies in USA - mild with moderate rainfall (temperate continental) - grass - trees and large bushes are scarce <p>Hot desert</p> <ul style="list-style-type: none"> - found on western coasts of continents and North Africa (Sahara) - dry, hot climate (desert, arid) - very little vegetation - area on the edge of the desert is called desert scrub <p>Tundra</p> <ul style="list-style-type: none"> - found surrounding the North and South poles - extremely cold and dry climate - limited plants and animals 	<p>Ecosystem Interact Living Non-living Biome Characteristics Humid Temperate Deciduous Maritime Continental Boreal Coniferous Taiga Evergreen Arid Semi-arid Scrub Vegetation</p>

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<p>The role of climate and local factors (soils and altitude) in influencing the distribution of different large-scale ecosystems</p>	<p>Large scale influences Climate (temperature, precipitation and sunshine hours) is the main factor influencing the distribution of ecosystems. Climate is determined by the latitude of a place (curvature of the Earth determining the uneven distribution of solar radiation), continentality (how far away a place is from the coast, places closer to the coast of a continent have cooler and wetter climates) and ocean currents (the global movement of warmer water from near the equator to the Poles and vice versa) Small scale influences At higher altitudes (height above sea level) places are colder, so fewer plants grow there, which limits the number of animal species and means there is not much organic matter, making soils thin or non-existent. More nutrient-rich soils can support more plants. Acidity, drainage and thickness of soils also influence plant growth. Peat soils are very acidic, so only acid-tolerant plants such as conifers can grow in these soils Clay soils are sticky, so water can't flow through easily making it hard for plants that need well-drained soils to grow Thin soils (mountain tops) do not have enough nutrients for large trees to grow</p>	<p>Influences Temperature Precipitation Sunshine hours Latitude Solar radiation Continentality Ocean currents Altitude Nutrients Organic Biotic Abiotic Resources Exploited</p>
<p>How the biosphere provides resources for people (food, medicine, building materials and fuel resources) but is also increasingly exploited commercially for energy, water and mineral resources.</p>	<p>The biosphere includes all parts of the Earth that are occupied by living organisms (plants, animals, bacteria, fungi, soils and water) and provides lots of resources: Food - Cereals, fruit, vegetables and livestock Medicine - lots of plants have medicinal purposes including plants from the tropical forests have created over 7,000 drugs e.g. quinine to treat malaria Building materials - trees for timber, clay for bricks, rocks (e.g. slate) for other building materials Fuel - wood, dried grass and dried animal dung to burn, animal fat in tundra areas as oil, fossil fuels The biosphere is also exploited for commercial gain (profit) Energy - large areas of forest cut down (deforestation) for growing of crops to make biofuels, or for coal mines, oil fields or power stations. Drilling for oil or gas in the tundra damages the biosphere and pipelines cause the permafrost to melt. Flooding to build HEP dams. Fracking can pollute the air and contaminate the groundwater Water - increasing global population leading to increase demand on water for washing, irrigation and sanitation. Over-exploitation of lakes, rivers and aquifers mean plants and animals no longer have enough water to survive Minerals - mining for minerals such as gold and iron increases deforestation and toxic chemicals in soils, rivers and lakes. Open-cast mining on the surface reduces habitats for plants and animals</p>	<p>Deforestation Commercial Biosphere Permafrost Fossil fuels Biosphere Minerals Aquifers</p>

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<p>Distribution and characteristics of the UK's main terrestrial ecosystems (moorlands, heaths, woodlands, wetlands).</p>	<p>The UK has 5 main terrestrial (land-based) ecosystems:</p> <p>Heaths</p> <ul style="list-style-type: none"> - found in lowland areas, below 1000m e.g the New Forest - high rainfall - open landscapes with poor, acidic soils - dry, sandy soils in south & east of UK, wet and peaty soils in north & west - habitats for lots of insects and rare plants <p>Moorlands</p> <ul style="list-style-type: none"> - found in highland areas, above 1000m e.g. Scotland, northern England & Wales - high rainfall - open landscapes with, thin poor, acidic soils - habitats for animals and birds, used for grazing sheep <p>Deciduous woodlands</p> <ul style="list-style-type: none"> - most native woodlands in the UK are deciduous woodlands e.g. oak, ash and beech - often have thick, fertile soils as fallen leaves decompose - habitats for animals and birds e.g. badgers, foxes and grey squirrels <p>Coniferous woodlands</p> <ul style="list-style-type: none"> - found in many areas of the UK e.g. Scotland e.g. Scots pine and evergreen trees - many coniferous woodlands are commercial plantations <p>Wetlands</p> <ul style="list-style-type: none"> - found where soils are waterlogged for most of the year e.g. marshes, fens and bogs - also found in places which flood seasonally e.g. Somerset levels - anaerobic soils (the water stops oxygen getting into the soil) - vegetation in bogs decomposes very slowly forming peat - habitats for mammals e.g. otters and water voles, birds e.g. bittern and snipe and insects, dragonflies and damselflies 	<p>Heath Moorlands Deciduous woodlands Coniferous woodlands Wetlands Acidic soils Habitats Native Non-native Evergreen Waterlogged Decomposes Anaerobic Peat</p>

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<p>Importance of marine ecosystems to the UK as a resource and how human activities are degrading them</p>	<p>The UK has a range of important ecosystems around its coast including salt marshes, estuaries, cold-water coral reefs and deep-sea habitats</p> <p>Resources</p> <p>Recreation - leisure activities such as swimming, fishing and boating through tourism</p> <p>Energy - oil exploration and drilling off-shore, natural gas exploitation, renewable energy such as wind, wave and tidal</p> <p>Fishing - source of food and jobs through the fishing catching and processing, marine ecosystems provide feeding and breeding grounds for many fish species</p> <p>Degradation (damaging)</p> <p>Pollution</p> <ul style="list-style-type: none"> - plastic waste is eaten by marine animals - industrial waster can kill marine organisms - run-off from farmlands can lead to eutrophication causing excess algae to grow, reducing the oxygen and light to the seabed <p>Damage to the seabed</p> <ul style="list-style-type: none"> - dredging)clearing mud from the sea floor reduces nutrients, damages sea plants and habitats - fishing with trawl nets damages seabed habitats e.g. coral reefs - infrastructure such as wind farms and oil platforms can damage the seabed and harm seabed organisms <p>Fishing</p> <ul style="list-style-type: none"> - Overfishing is the result of catching more fish than is required and leads to fish species being caught faster than they can be replaced through breeding, causing numbers to decline - Knock-on effect of overfishing is lack of food for birds and seals and they can get trapped in fishing nets <p>Named Example - Looe Bay, Cornwall</p> <p>Resources</p> <ul style="list-style-type: none"> - seagrass (NOT seaweed) can help remove carbon from that atmosphere (carbon sink) (10% of all ocean carbon storage) - important habitat for many species including, cuttlefish, seahorses and stalked jellyfish - production of oxygen - sometimes referred to as the 'lungs of the sea' <p>Threats</p> <ul style="list-style-type: none"> - Wasting disease - wiped out much of the UK seagrass beds boating anchorage rips up large sections of the sea floor - climate change increases storm frequency and intensity damaging seagrass beds, rising sea levels reducing light intake and reducing size and density of seagrass beds - sewerage outflow reduces light penetration to seagrass beds as the change in nutrients increases plankton on the surface 	<p>Salt marshes Estuaries Cold water coral reefs Habitats Recreation Degradation Eutrophication</p>

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<p>Why rainforests have very high biodiversity and how plants (stratified layers, buttress roots, drip tips) and animals (strong limbs, modified wings and beaks, camouflage) are adapted to that environment</p>	<p>Biodiversity is the variety of organisms living in a particular area, both plants and animals. Rainforests have extremely high biodiversity because:</p> <ul style="list-style-type: none"> - rainforests have been around for a very long time, with little climate change, allowing animals and plants to evolve - layered structure provides lots of different habitats allowing animals and plants to adapt - they are stable environments as the climate is hot and wet all year round <p>The stratified layers of the rainforest</p> <p>Emergents - tallest trees which poke out of the main canopy, branches and leaves only at the top where they can get the most sunlight, buttress roots above the ground to support them, keep them stable and get nutrients from the top layer of the soil, thick waxy leaves with drip-tips to allow water to run-off leaving no standing water for fungi and bacteria to grow on the trees - 30m to 40m tall</p> <p>Main canopy - a continuous layer of trees, with only leaves at the top, creating a dense shade to the rest of the forest - 20m to 30m tall</p> <p>Undercanopy - younger trees yet to reach their full height, struggle to find a break in the main canopy to reach sunlight - 10m to 20m tall</p> <p>Shrub layer and forest floor - nearest the ground where sunlight is blocked by the canopies above, shrubs have large broad leaves to absorb as much sunlight as they can, forest floor mainly contains leaf litter which decomposes quickly - 0m to 10m tall</p> <p>Animal adaptations</p> <ul style="list-style-type: none"> - strong limbs to remain high in the canopy and climb and leap from tree to tree to find food e.g. howler monkeys - camouflage to hide from predators e.g. leaf insects - modified beaks to suit their diet e.g. macaws have strong, short beaks to open nuts and toucans have long, light beaks to reach for fruit and insects - modified wings for flying in the undercanopy e.g. harpy eagle has short, pointy wings to avoid getting tangled in the dense undercanopy 	<p>Stratified Emergents Canopy Run-off Main canopy Undercanopy Shrub layer Forest floor Adaptations Camouflage Modified</p>
<p>Examples of goods and services provided by tropical rainforest ecosystems (food stuffs, medicines, timber and recreation).</p>	<p>Food - from wild animals e.g. meat for people who live there and products such as coca, coffee, bananas and sugar originally came from rainforest ecosystems</p> <p>Medicines - many medicines are adapted from the highly biodiverse rainforest, e.g. Madagascar periwinkle is used to make medicines to fight cancer</p> <p>Timber - many types of hardwood e.g. mahogany used for building and paper</p> <p>Recreation - tourism is a growing business in the rainforests, including ecotourism, where visitors stay in sustainable lodges e.g. Ecuador</p>	<p>Ecotourism Sustainable</p>
<p>How climate change presents a threat to the structure, functioning and biodiversity of tropical rainforests.</p>	<p>Climate change means temperatures are increasing, rainfall is decreasing, droughts are more frequent and longer lasting and there is a greater risk of wildfires. The impacts of climate change are:</p> <p>Structure - drier conditions will cause plants to grow more slowly or die or become extinct</p> <p>Functioning - fruit producing plants will have their usual cycle interrupted or changed leading to a change in the food web and food chains, leaf litter will decompose more slowly so there will be fewer nutrients available for plants</p> <p>Biodiversity - interdependence of plants and animals in the rainforests will lead to a reduction in productivity of rainforests with drier hotter conditions, leaving plants and animals vulnerable to extinction</p>	<p>Structure Functioning Food webs Food chains Biodiversity</p>

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<p>Economic and social causes of deforestation (conversion to agriculture, resource extraction, population pressure).</p>	<p>Agriculture - subsistence farmers grow food for themselves and their families and clear small areas of forests, whereas commercial farms like cattle ranches or palm oil or soya plantations clear vast areas of forest</p> <p>Resource extraction - trees are felled to make furniture and for construction, needing road building to move the materials resulting in more tree clearance, minerals such as gold, copper, iron and oil are mined and extracted resulting in contamination of groundwater supplies and destruction of habitats</p> <p>Population pressure - population increase results in more land needed for settlements and more trees being used for cooking or to burn to make charcoal.</p> <p>Case Study - Ecuador</p> <p>Political and economic primary causes - Government sanctioned oil extraction from 1960's by PetroAmazonas (TNC) was expected to increase GDP but each oil well needs around 2 hectares of forest to be cut down, waste products were pumped to the surface to mix with waste water creating toxic soil, liquid leeches through the soil into rivers leading to no fish, destroying the food chain.</p> <p>Political and economic secondary causes - creation of roads through the rainforest led to barriers for movement of animals reducing breeding spaces, population increase of 'colonists' (described as neo-colonial environmentalism) into the rainforest who removed the smaller trees for building and using 'slash and burn' techniques for small-scale farming, leading to nutrient-poor soil commercial loggers removed larger trees, often illegally, poor soil led to large-scale cattle ranchers rearing beef for sale in in Europe and the US. Palm oil plantations (cash crop) - in many products used world-wide but are not native to the rainforest and so require very large areas of rainforest to be cleared, reducing biodiversity (monoculture) (130 000 hectares cleared for palm oil production) and using pesticides to control plagues, which further leeches into the water system.</p> <p>Oil has increased Ecuadorian economy but more than 80% of indigenous people in the oil producing areas live below the poverty line.</p>	<p>Subsistence farmers Commercial farmers Contamination Extraction Leeching Slash and burn Colonists Neo-colonial environmentalism Loggers Cattle ranchers Palm oil Plantations Cash crop Native Non-native Monoculture Pesticides Herbicides</p>
<p>Political and economic factors (governance, commodity value and ecotourism) that have contributed to the sustainable management of a rainforest in a named region</p>	<p>Political sustainable management - Case Study - Ecuador</p> <p>- Government policies - creation of Yasuni National Park - proposed the international community pay Ecuador 3.6 billion US\$ to leave the oil and it's carbon emissions in the ground which would be used to help indigenous communities and reforest the area but limited economic response from other governments and oil extraction began in 2014. Following decline in oil prices Ecuadorian government sanctioned Fruta Del Norte to mine for gold in attempt to reduce poverty. Signed global agreements such as the Paris Agreement to limit CO² emissions.</p> <p>- Large-scale NGOs - RAMSAR sites - Limoncocha National Park and Nature Reserve attracts 10,000 tourists a year allowing protection of endangered species, protecting the forest against development, protecting biodiversity and local communities</p> <p>- Small-scale NGO's - Sumak Allpa - conservation and protection of, for example, Woolley monkeys and red-tailed Boa Constrictor funded by private individuals, or NGOs like the WWF</p> <p>- Economic policies - Yachana Lodge - sustainably built log cabins using solar panels to generate electricity and rainwater collections for showers and toilets, tourists are confined to guided trails</p> <p>- Economic policies - microfinance - small scale loans to assist individuals to start up sustainable logging and agriculture businesses</p> <p>- Education policies - Yachana Foundation - runs residential training courses for local communities providing further employment opportunities, training courses in sustainable crop management and Forest Stewardship courses in sustainable logging</p>	<p>Conservation</p>

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<p>Abiotic and biotic characteristics of the deciduous woodland ecosystem (climate, soil, water, plants, animals and humans)</p>	<p>Abiotic Climate - temperate - no extremes of temperature or rainfall - 4 seasons - average summer temperature 15-17° C, winter is cooler but usually above freezing, leading to long growing season, rainfall quite high, about 1000mm a year Soil - fallen leaves decompose quite quickly forming thin layer of organic matter (humus) enriching the soil, earthworms and other decomposers mix humus with minerals from bedrock to create thick, rich soil called brown earth Water - rains all year round supplying numerous streams, rivers and lakes Biotic Plants - deciduous woodlands dominated by tall, broad-leaved trees - leaf loss in autumn, stratified layers Animals - stratified layers provide a variety of habitats for birds, insects and small mammals, larger animals such as foxes and rabbits burrow in the ground under the trees Humans - Ancient woodlands used by humans for wood fuel, nuts, fruit, tree sap, timber and recreation</p>	<p>Humus Brown earth</p>
<p>The interdependence of biotic and abiotic characteristics (climate, soil, water, plants, animals and humans) and the nutrient cycle (Gersmehl model).</p>	<p>Interdependence of biotic components abiotic components in an ecosystem means they are closely related - if one component changes, the others are affected Climate - plants grow during growing season (spring and summer) providing some protection from wind and heavy rainfall Soil - deep root systems hold the soil together to reduce erosion, decomposition is rapid in autumn Water - protection from dense vegetation reduces surface run-off from heavy rains Plants - canopy is not continuous so light able to pass through to lower layers Animals - decomposers and detritivores mix nutrients in the soil Humans - manage woodlands and have access for their livestock, e.g. New Forest ponies eat bracken meaning other species can grow The Gersmehl model shows the inputs, transfers, stores and outputs of nutrients of ecosystems The deciduous rainforest nutrient cycle Inputs/outputs Precipitation - moderate - significant levels of rainfall all year round but mainly in autumn and winter Run-off - moderate - think soil can absorb the high levels of rainfall Leaching - high - rapid leaching due to high levels of precipitation Weathering - low - weathered bedrock provide nutrients Transfers Fallout - high - in autumn Decay - high - decomposition due to high levels of leaf litter and decomposers in the soil Uptake - moderate - vast root networks take up more nutrients during spring & summer Stores - small in soil due to leaching & productivity but high in biomass - 4 layers of the forest Biomass - high - long, slow growing season with several layers and many species Litter - moderate - highest in autumn - decomposes over winter Soil - moderate - higher leaf litter in autumn but leaching gradually brings minerals down through the soil Food chains and food webs Plants and animals can be classed as producers or consumers. A producer uses sunlight energy to produce food e.g. a banana tree, whereas a consumer gets its energy by eating other organisms - it eats producers or other consumers e.g. insects and foxes</p>	<p>Decomposers Detritivores bedrock Leaf litter</p>

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<p>Why deciduous woodlands have moderate biodiversity and how plants (leaf size and structure, water conservation in winter) and animals (migration, hibernation and food storage) are adapted to that environment.</p>	<p>Biodiversity is the variety of organisms living in a particular area, both plants and animals. Deciduous forests have moderate biodiversity because:</p> <ul style="list-style-type: none"> - lower food production levels in the winter - smaller size ecosystem so less space for plant and animal species - higher latitude = lower temperatures and fewer sunlight hours <p>The stratified layers of the deciduous forests</p> <p>Main canopy - a mainly continuous layer of trees with broad, flat leaves to capture sunlight, leaves drop in autumn and winter to conserve water and energy when their is limited opportunities for photosynthesis - 20m to 30m tall</p> <p>Shrub layer - dominated by plants that can survive with less sunlight such as hazel, some climbing plants such as honeysuckle and ivy climb towards the canopy using taller trees - 5m to 20m tall</p> <p>Herb layer - limited sunlight can get through the dense canopy so shade-tolerant plants such as ferns and mosses grow here, some plants, such as bluebells, grow in early spring while there is limited canopy cover - 0m to 5m</p> <p>Forest floor - decomposing leaves and branches cover the top soil allowing humus to develop, packed with nutrients</p> <p>Animal adaptations</p> <p>Migration - many birds migrate south to warmer temperatures e.g. the swallow leaves in September to spend the winter in Central Africa</p> <p>Hibernation - some animals, such as hedgehogs, dormice and bats, insects such as wasps, bumblebees and ladybirds, reptiles such as adders and grass snakes, and amphibians such as frogs, toads and newts all spend the winter in a deep sleep, reducing their metabolic rate to limit energy usage</p> <p>Food storage - red squirrels store nuts in piles on the forest floor while grey squirrels bury their nuts (they can't always remember where they have left them)</p>	<p>Herb layer Migration Hibernation Food storage Metabolic rate</p>
<p>Examples of goods and services provided by deciduous woodlands ecosystems (timber, fuel, conservation and recreation).</p>	<p>Timber - deciduous trees provide hardwood which is good for construction</p> <p>Fuel - humans use wood or make charcoal for fuel</p> <p>Conservation - ancient woodlands are home to rare or endangered species so are protected</p> <p>Recreation - woodlands are enjoyed for recreation such as walking, mountain-biking, zip wires and horse-riding</p>	
<p>How climate change presents a threat to both the structure, function and biodiversity of the deciduous woodland ecosystem.</p>	<p>Deciduous forests are less vulnerable to climate change as the changes in temperate climates are less extreme.</p> <p>Structure - more extreme weather events e.g. drought or storms could lead to strong winds knocking down trees, trees growing more slowly without enough water, loss of habitats</p> <p>Function - changes in temperature may make hibernation periods too short before there is enough food, high rainfall could lead to increased leaching of nutrients from the soil</p> <p>Biodiversity - increase in damaging insects due to change in temperature and migration on invasive (non-native) pests and bacteria could lead to loss of existing species</p>	

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<p>Economic and social causes of deforestation (urbanisation and population growth, timber extraction and agricultural change).</p>	<p>Urbanisation - woodlands cleared to make space for houses and roads Population growth - increase in demand for timber for houses and other wood products Timber extraction - slow-growing deciduous trees take a long time to replace once they have been cut down, often replaced with cheaper, faster-growing coniferous trees Agricultural change - woodlands and hedgerows cleared to make space for large-scale machinery for farming Case Study - The New Forest The New Forest is a National Park in Hampshire, south east England, awarded status in 2005. About 175,000 people live in the area and up to 15 million people visit the area annually. Social causes of deforestation Increasing population numbers in the UK means that more land is required for housing. The government need to build around 240,000 homes a year to cope with demand. Forests are cleared in order to accommodate this Increasing urbanisation in the UK has led to forested areas being converted for additional land use including the expansion of cities to create jobs for people Traffic congestion is an increasing problem and so areas of woodland are cleared to make carriageways wider Economic causes of deforestation Tourists can damage plants by trampling, footpaths are eroded by walking, cycling, horse-riding and car parking on verges and risk of starting fires with barbeques Timber is extracted from both softwood (coniferous) and hardwood (deciduous) trees. Non-native conifers are easier and faster growing which means a faster profit. Over 40% of the New Forest is privately owned and not managed. Pesticides and herbicides used to control weeds in agricultural areas damages edges of woodlands</p>	<p>Urbanisation Traffic congestion Tourism</p>
<p>Different approaches to the sustainable use and management of deciduous woodlands in a named region</p>	<p>Sustainable Management - Case Study - The New Forest Controlled tree felling- trees are selectively cleared and replaced by other deciduous species in higher numbers Limit pesticide use to prevent damage to plant and animal species National Park Authority set up to raise awareness through campaigns Landowners funded to plant trees, encourages better use of the land Sustainable transport schemes – electric scooters, bikes and tour buses Green leaf tourism – limits tourists numbers, ensures hotels operate in a 'greener' way, promotes use of local products Restrict logging April-August to protect nesting birds</p>	<p>Tree felling Green Leaf tourism</p>