Unit 3: Topic 7 People and the Biosphere

What global factors affect biome distribution and characteristics?
A biome is a global scale ecosystem, where all the plants and animals interact perfectly together with their living and non-living environment e.g. Tropical rainforest.

Where are the biomes of the world?
To 'describe the distribution of a place' is to state where something is found and any patterns in it's location and point out areas that don't fit with the general pattern. For example: **Tropical rainforest** found on either side of the equator, about 15 N or 15 S where the climate is wet and hot, conditions perfect for all year round growing plants. There is no tropical rainforest in East Africa even though it is on the equator.

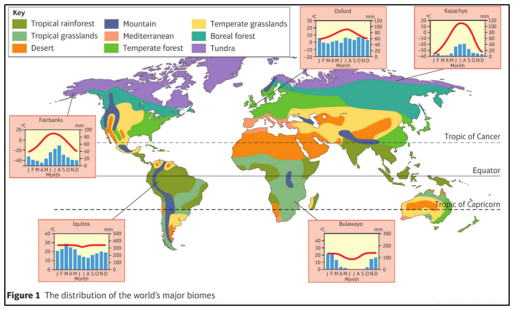


Figure 1 The distribution of the world's major biomes

What are the characteristics of the world's major biomes?
Characteristics are specific features that allow us to identify how one biome differs from another.

Biome	Climate	Vegetation
Tropical rainforests	Hot all year, 25-30℃, rainfall 200-3000mm	Dense forest, layers of trees competing for light
Tropical grasslands	Hot all year, 25-35℃, rainfall 500-1000mm, dry season	Tall grasses, shrubs, trees e.g. baobab
Deserts	Very hot all year 30℃, cool nights, less than 250mm rain	Scarce plants, water storing succulents, spines not leaves e.g. cacti
Temperate grassland	Hot summer 25℃, very cold winter -40℃, 500-900mm rain	Short grasses with very few trees and bushes
Temperate forest	Warm summers 18℃, cool winter 5℃, 1000mm rainfall	Deciduous trees such as oak
Boreal forest	Mild summers, 10-20℃cold winters below0℃, less than 500mm rainfall	Coniferous trees such as pines
Tundra	Below 0℃ most of the year, 10℃ in summer, less than 250mm rainfall	Very few plants mostly lichens and mosses. Trees are rare and stunted

How can we explain the distribution of and characteristics of biomes?

Biome	Reasons for distribution
Tropical rainforests	High temps, high rainfall, on equator, sun overhead all year, Inter tropical convergence zone.
Tropical grasslands	Further from equator, High temps, dry season, sparse tree growth, moist summer, dry winter
Deserts	On the tropics, sinking air, high day temps, cool night temps, low rainfall
Temperate forest/ grassland	High latitudes e.g. UK, low pressure, year round rain, lower sun angle, reduced sunshine hours.
Boreal forest	Northern hemisphere, cold temps, higher pressure, sinking air, low rainfall
Tundra	Low temperatures, short sunlight hours, sinking air , low precipitation, frozen subsoil, strong winds

What local factors affect biomes?
How does altitude affect biomes?
Temperatures fall between 0.5℃ and 1℃ every 100m in height. Hills/ mountains are also exposed to wind. Slopes become steeper and soils become thinner. Forest biomes decrease with altitude and are replaced by grasses then mosses and lichens at the highest altitudes.

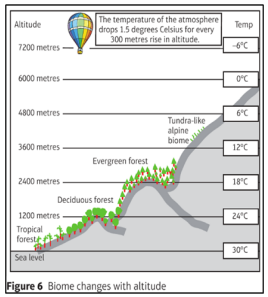


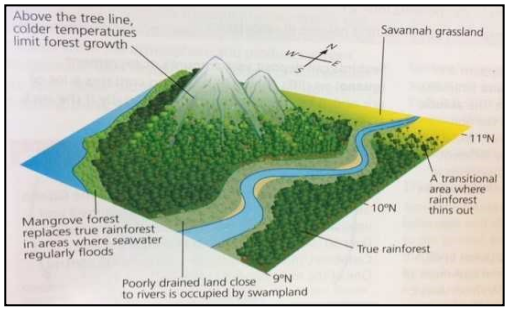
Figure 6 Biome changes with altitude

How does rock type affect biomes?
Some rocks are permeable and soak up water e.g. sandstone whilst others like slate are impermeable and don't let water soak through them. Limestone produces alkaline soils and are dry suitable for beech trees e.g. limestone pavements in Yorkshire

How do soils affect biomes?
Different plants grow better in different types of soil.

Soil type	Characteristics
Sandy soil	Small air gaps, drains well , quite dry, plants need tolerance to drought, barley and root crops
Clay soil	Sticky, few air gaps, poor drainage, puddles from rain, holds nutrients, wheat, beans and grass
Chalky soils	Well drained, grass and barley
Peat	No rock/mineral particles, decayed plants, rich in nutrients, acidic, rough grazing/forestry

How does drainage affect biomes?
Impermeable surfaces lead to waterlogged conditions and can prevent tree from growing with only specially adapted plants able to cope.

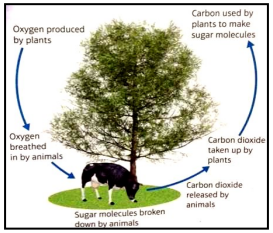


How do biotic and abiotic components of a biome interact?
Biotic components of a biome or ecosystem are all living parts: the flora and fauna, all fungi, bacteria and any other form of life.
Abiotic components are the non-living elements of a biome or ecosystem such as rocks, soil, air and water . These components interact to keep ecosystems in equilibrium for example the nutrient cycle.

Examples of biotic and abiotic interactions:

What is biological weathering?
When rocks get broken down by living things *in situ* for example tree roots growing in the joints of a rock and breaking the rock apart. Some flora and fauna also secrete acids which dissolve rock. Seabirds produce guano which contains uric acid which can dissolve rocks like limestone.

What are photosynthesis and respiration?
Living organism interact with the atmosphere. The process of photosynthesis extracts carbon dioxide from the atmosphere and produces oxygen whereas respiration uses oxygen and produces carbon dioxide. These process naturally regulate the atmosphere keeping these gases balanced.



What is the nutrient cycle?

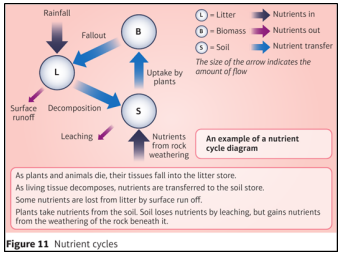
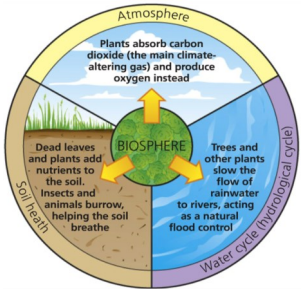


Figure 11 Nutrient cycles

The transfer of nutrients around an ecosystem. All ecosystems have three compartments: soil, litter and biomass. Nutrients are transferred between the stores.

How does it regulate the hydrological cycle?
Trees intercept and absorb rainfall and slow its passage to the ground reducing surface run-off and therefore reduces flood risk. Transpiration by plants in tropical rainforests returns moisture to the atmosphere and succulents store water slowing evaporation.

How does the biosphere act as a life support system?



Firstly, the biosphere plays a globally important role regulating the atmosphere. Carbon dioxide is seen as its most important function but without respiration and the release of carbon dioxide the earth would cool down to the point of an ice age. Secondly, soil health is also maintained because without the decomposition of leaf litter by humid conditions, bacteria and fungi (decomposers) the formation of a humus layer (rich in nutrients) would not take place and soils would be quite infertile. Lastly, through interception and absorption of water by vegetation flooding is reduced as is run-off.

How does the biosphere provide us with vital resources through commercial exploitation and how can the indigenous people benefit?

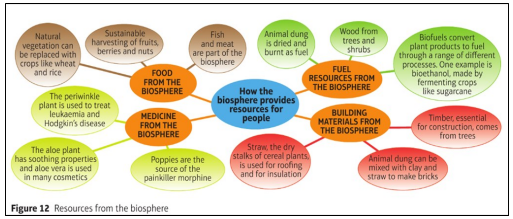


Figure 12 Resources from the biosphere

How can the increasing use of resources lead to over exploitation?

What are the global trends?
The amount of food, energy and water we consume has risen over time. We currently extract 50% more resources to obtain water, food, and energy: 60bn tonnes of raw materials per year. Our natural environment provides us with resources such as cotton, energy and building materials. People in the developed world consume 10x those in developing world E.g. on average someone living in N. America consumes 90KG of resources per day compared with only 10kg for someone living in Africa. The main reason for this trend is increasing world population although this is not the sole reason. An increase in affluence means that more people have greater wealth and are therefore able to demand and consume more.

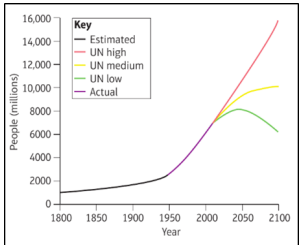


Figure 14 Global population, with different possible future scenarios as predicted by the UN

What are the regional trends?
Some developing countries are progressing towards emerging economies for example Brazil, Russia, India and China (BRIC) have grown rapidly. Collectively their GDP surpassed that of the USA in 2006 but since then Brazil and Russia have slowed. The MINT countries of Mexico, Indonesia, Nigeria and Turkey are expected to develop strongly next. As people gain more wealth their consumption of food, energy and water increases. In 2015, 10 of the world's 20 fastest growing economies were in Africa so over the next 30 years, rapid urbanisation, industrialisation and growing wealth (affluence) is going to be significant in Africa.

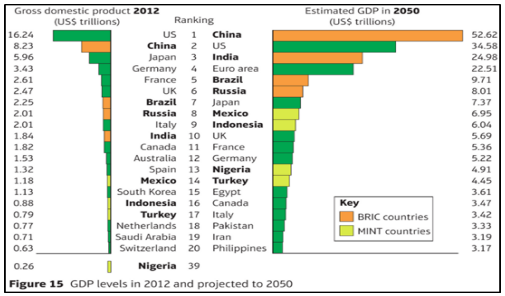


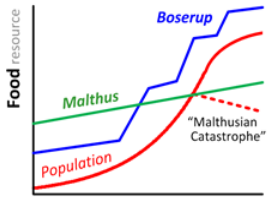
Figure 15 GDP levels in 2012 and projected to 2050

What impacts will Urbanisation and industrialisation have on biomes?
The growth of cities and an increase in manufacturing over the last 50 years has had a direct impact on biomes. A city's population requires resources to support it and often these come from remote areas away from the city. China and India are the main culprits, second and ninth largest economies respectively in 2014 and a combined population of over 2.5billion . Over the next 35 years it is expected that global energy consumption will increase by 56% with China and India being leading contributors due to the increase in living standards.

Is the biosphere being exploited?
Increased demand for resources is leading to damage of the biosphere. Demand for beef and soya, to feed the cattle, has led to widespread deforestation in the Amazon rainforest with 80% of it attributed to this. Demand for palm oil which is used in ice cream, pizza, soap, shampoo and biofuels has led to massive deforestation in Cameroon. HEP projects have led to flooding of 400KM^2 tropical rainforest in Brazil for the Santo Antonio Dam and the three gorges dam in China led to the extinction of the Yangtze river dolphin. Finally, open cast mining for tar sands in Alberta, Canada, has destroyed huge areas of Boreal forest.

Malthus or Boserup: whose theory of population and resources is most convincing?

What was the Malthusian theory? (18th century)
Thomas R Malthus believed that the human population would grow faster than resource supply. When food, energy and water resources began to run out there would be social unrest, famine and epidemics (natural checks). He argued that population grew geometrically 2,4,6,8,16,32 etc whereas resources would increase arithmetically 2,4,6,8,10,12 etc leading to a shortage of resources with resulting deaths particularly amongst the poor. Repeated cycles of population increase and crash would eventually bring the population closer to a balance with resource supply. Evidence for and against this theory: Wars and civil wars, 'bird flu' and Ebola epidemics as well as droughts and famine are all evident today. However, improved technology in food and resource production and discovery as well as improvements in development have seen birth rates fall reducing pressure on resource consumption.



What was the Boserupian theory? (20th century)
Esther Boserup suggested that as population increased and reached a 'point of crisis' beyond the country or world's 'carrying capacity', human ingenuity and innovation would find ways to increase production to meet the demand. The saying 'necessity is the mother of invention' has been applied to her theory. Evidence for and against this theory: World population has risen from 1.5bn to over7bn but there has been no worldwide crash. This is due to improvements in farming and global distribution of food and aid as well as the Green revolution, HYV's e.g. IR8, GM crops, solar power and improved birth control. However, others will evidence the AIDS pandemic, the growing number of refugees fleeing fighting and natural disaster such as drought.