

GCSE GEOGRAPHY

LIVING WITH THE PHYSICAL ENVIRONMENT

UNIT 3 – THE LIVING WORLD

YEAR 9 2017-20

Student Name: _____

Class: _____

Specification Key Ideas:

Key Idea:	Oxford text book:
Ecosystems exist at a range of scales and involve the interaction between biotic and abiotic components.	P52-57
Tropical rainforest ecosystems have a range of distinctive characteristics.	P58-59
Deforestation has economic and environmental impacts.	P60-63
Tropical rainforests need to be managed to be sustainable.	P64-67
Hot desert ecosystems have a range of distinctive characteristics.	P68-69
Development of hot desert environments creates opportunities and challenges.	P70-73*
Areas on the fringe of hot deserts are at risk of desertification.	P74-77*

Scheme of Work:

Lesson	Learning intention:	Student booklet:
1	Ecosystems	P7-9
2	World biomes	P9-11
3	Intervention	P11
4	Introduction to tropical rainforests	P11-13
5	Causes of deforestation	P14-15
6	Impacts of deforestation	P16
7	Sustainable management of rainforests	P16-18
8	Value of rainforests	P18-19
9	Intervention	P19
10	Introduction to hot deserts	P19-22
11	Morocco – a hot desert	P23-24
12	Challenges of development in a hot desert	P24-26
13	Desertification	P27-28
14	Reducing desertification	P28-29
15	Intervention	P29
16	Assessment	P29
17	Assessment review	P29
18	Intervention	P29

3.1 Living with the physical environment

This unit is concerned with the dynamic nature of physical processes and systems, and human interaction with them in a variety of places and at a range of scales.

The aims of this unit are to develop an understanding of the tectonic, geomorphological, biological and meteorological processes and features in different environments, and the need for management strategies governed by sustainability and consideration of the direct and indirect effects of human interaction with the Earth and the atmosphere.

3.1.2 Section B: The living world

In this section, students are required to study **Ecosystems**, **Tropical rainforests** and one from **Hot deserts** or **Cold environments**.

3.1.2.1 Ecosystems

An example of a small scale UK ecosystem to illustrate the concept of interrelationships within a natural system, an understanding of producers, consumers, decomposers, food chain, food web and nutrient cycling.

The balance between components.

The impact on the ecosystem of changing one component.

An overview of the distribution and characteristics of large scale natural global ecosystems.

3.1.2.2 Tropical rainforests

The physical characteristics of a tropical rainforest.

The interdependence of climate, water, soils, plants, animals and people.

How plants and animals adapt to the physical conditions.

Issues related to biodiversity.

Changing rates of deforestation.

A case study of a tropical rainforest to illustrate:

- causes of deforestation – subsistence and commercial farming, logging, road building, mineral extraction, energy development, settlement, population growth
- impacts of deforestation – economic development, soil erosion, contribution to climate change.

Value of tropical rainforests to people and the environment.

Strategies used to manage the rainforest sustainably – selective logging and replanting, conservation and education, ecotourism and international agreements about the use of tropical hardwoods, debt reduction.

3.1.2.3 Hot deserts

The physical characteristics of a hot desert.

The interdependence of climate, water, soils, plants, animals and people.

How plants and animals adapt to the physical conditions.

Issues related to biodiversity.

A case study of a hot desert to illustrate:

- development opportunities in hot desert environments: mineral extraction, energy, farming, tourism
- challenges of developing hot desert environments: extreme temperatures, water supply, inaccessibility.

Causes of desertification – climate change, population growth, removal of fuel wood, overgrazing, over-cultivation and soil erosion.

Strategies used to reduce the risk of desertification – water and soil management, tree planting and use of appropriate technology.

GLOSSARY

Ecosystems

Key Term	Definition
Abiotic	components in an ecosystem that are non-living environmental factors such as climate (temperature and rainfall), soil, water temperature and light
Biome	global-scale ecosystems such as a tropical rainforest or deciduous woodland
Biotic	components in an ecosystem that are living such as plants and fish
Component	an individual part or element of a wider system
Consumer	organism that eats herbivores and/or plant matter
Decomposer	organisms such as bacteria or fungi that break down plant and animal material
Ecosystem	a community of plants and animals that interact with each other and their physical environment
Food chain	connections between different organisms (plants and animals) that rely upon one another as their source of food
Food web	a complex hierarchy of plants and animals relying on each other for food
Global atmospheric circulation	large scale circulation (movement) of the atmosphere
Global ecosystems	large scale ecosystem, such as tropical rainforest or tundra
Lines of latitude	lines that run parallel to Earth's Equator, measured in degrees
Nutrient cycle	on-going recycling of nutrients between living organisms and their environment
Producer	an organism or plant that is able to absorb energy from the sun through photosynthesis

Tropical rainforests.

Biodiversity	the variety of life in the world or a particular ecosystem
Canopy	the continuous layer of branches in a forest, which in tropical

	rainforests hosts the majority of plant and animal species
Carbon sink	the removal of CO ₂ from the atmosphere
Climate	the average weather over a long period of time
Climate change	a long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature
Conservation	managing the environment in order to preserve, protect or restore it
Debt reduction	countries are relieved of some of their debt in return for an agreement that they preserve and protect their natural environments
Deforestation	the cutting down and removal of forest
Ecotourism	nature tourism usually involving small groups with minimal impact on the environment
Equator	an imaginary line that divides Earth's surface into a northern and southern hemisphere
Global warming	the increase of global temperatures
Hardwood	important resource provided by tropical rainforests
Indigenous tribes	native to a particular place, usually living in harmony with the natural environment, using resources without causing long-term harm
Infertile soil	soil which is unable to reproduce or sustain life
International agreements	promises made between countries and/or organisations to mitigate the destruction of natural habitats
Leaching	heavy rainfall quickly dissolves and carries away nutrients in rainforest soils, leaving behind infertile red, iron-rich soil called latosol
Mineral extraction	the removal of solid mineral resources from the earth
Oil palm	raw material extracted from tropical rainforests
Protection	actions taken before a hazard strikes to reduce its impact, such as educating people or improving building design
Selective logging	sustainable forestry management where only carefully selected trees are cut down
Slash and burn	a method of land clearing that involves the use of fire, which creates valuable nutrients to help plants grow, but can grow out of control and destroy large areas of forest

Soil erosion	removal of topsoil faster than it can be replaced, due to natural (water and wind action), animal, and human activity
Subsistence farming	a type of agriculture producing only enough food and materials for the benefit of a farmer and their family
Sustainability	actions that meet the needs of the present without reducing the ability of future generations to meet their needs
Transmigration	people removed from one place and moved to another
Tropical rainforest	global-scale ecosystem mainly found close to the Equator, characterised by high temperatures, high rainfall and huge biodiversity

Hot deserts.

Adaptation	actions taken to adjust to natural events such as climate change, to reduce damage, limit the impacts, take advantage of opportunities, or cope with the consequences
Appropriate technology	technology suited to the needs, skills, knowledge and wealth of local people and their environment
Aquifer	underground water source
Arid	dry, with little or no rainfall
Commercial farming	growing crops or raising livestock for profit, often involving vast areas of land
Contour traps	embankments built along the contours of slopes to prevent soil from being washed down during heavy rainfall
Evaporation	the process of water changing from liquid to vapour
Extreme temperatures	temperatures that present challenges for people, animals and plants living in in certain environments
Fuelwood	wood that is burnt as fuel
Irrigation	artificial application of water to the land or soil
Johads	man-made drinking water source found in the Thar Desert, Pakistan
Nocturnal	active during the night
Over-cultivation	where the intensive growing of crops exhausts the soil leaving it barren
Overgrazing	feeding too many livestock for too long on the land, so it is unable to recover its vegetation
Ponding banks	areas of land enclosed by low walls to store water

Salinisation	a constant flow of water containing salts combined with high rates of evaporation leads to a build-up of salts on the land surface, often the result of over-irrigation in arid regions
Soil erosion	removal of topsoil faster than it can be replaced, due to natural (water and wind action), animal, and human activity
Sustainability	actions that meet the needs of the present without reducing the ability of future generations to meet their needs
Tobas	a natural drinking water source found in the Thar Desert, Pakistan

Notes:

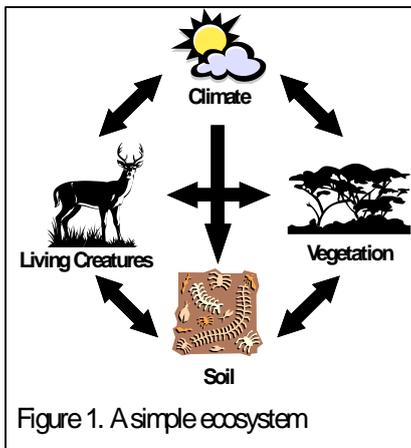
Lesson 1 - Ecosystems

What are Ecosystems?

Ecosystems look at the inputs, processes and outputs that happen in nature.

An ecosystem refers to all the animals and plants found in one place, and the way they all live together.

Ecosystems look at the **RELATIONSHIPS** between living and non-living things.



Examples of small scale ecosystems...

Hedgerow

Woodland

Sand dune

Pond

Large scale ecosystems are called a **Biome**.

There are links between the non living (physical) and living components.

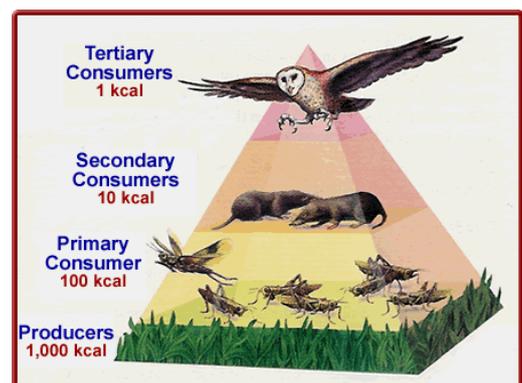
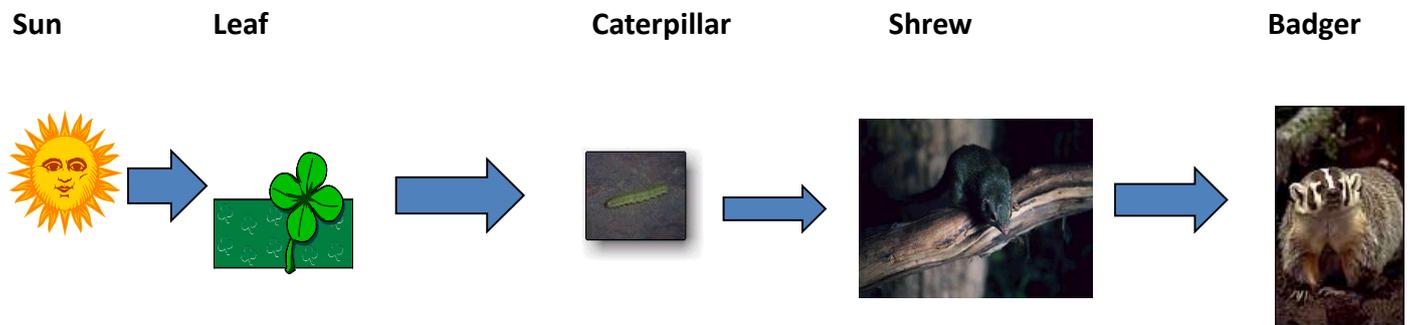
Biotic = living things Abiotic = non living things

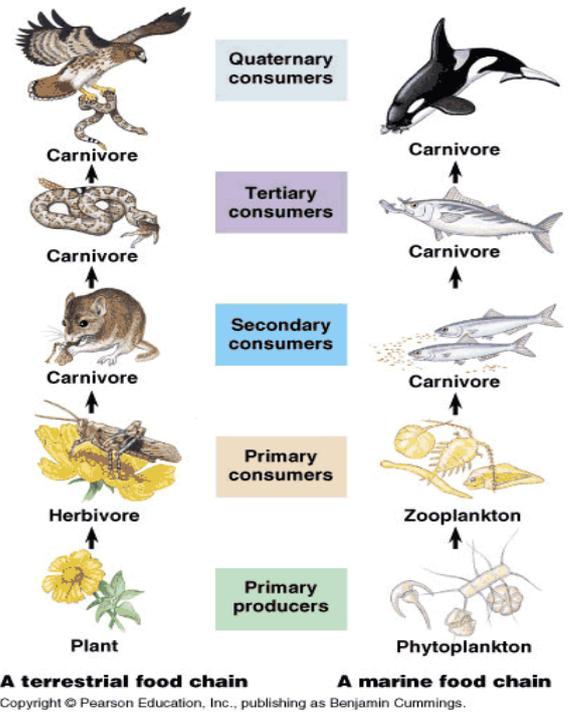
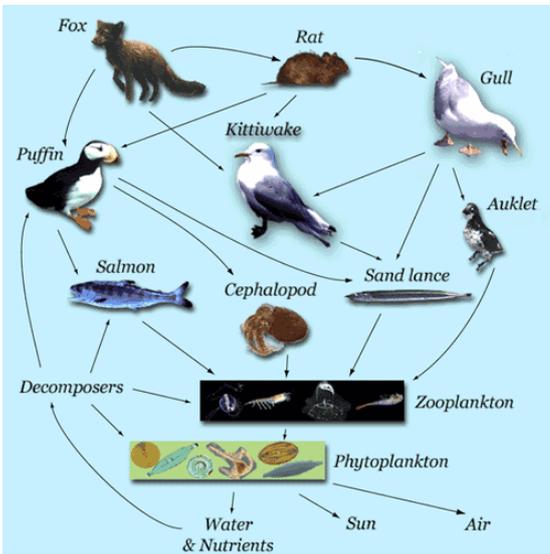
Breaking the Chain

Organisms living in an ecosystem depend on each other.

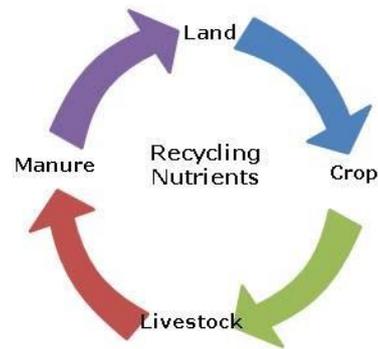
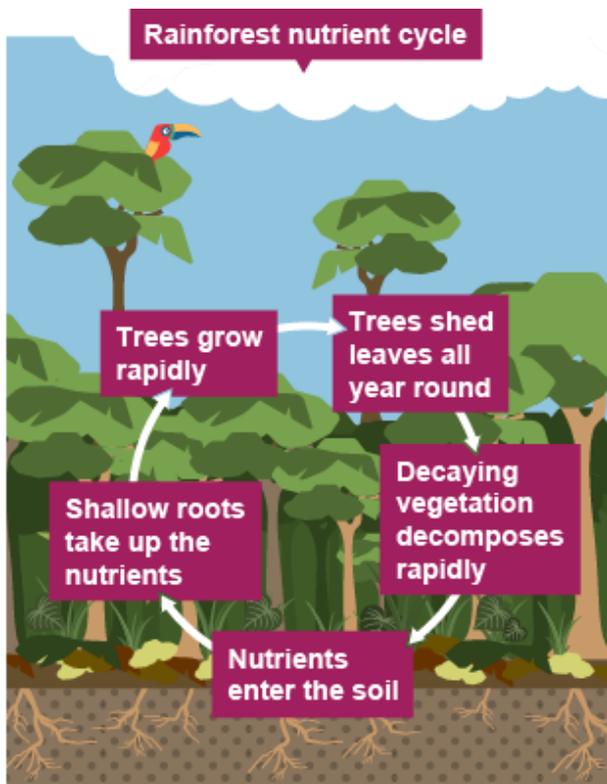
If one part of a food chain dies out or is greatly reduced, the other animals have to find alternative food, move away, or starve.

In recent years human activity is breaking the food chains and threatening these valuable ecosystems.





The Nutrient Cycle

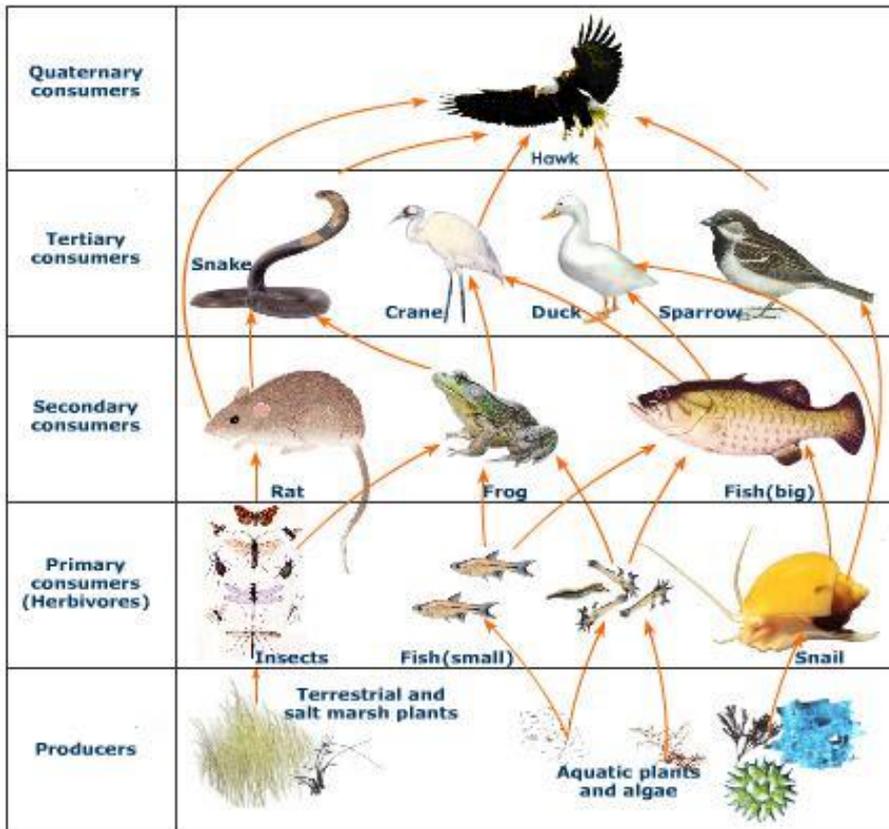
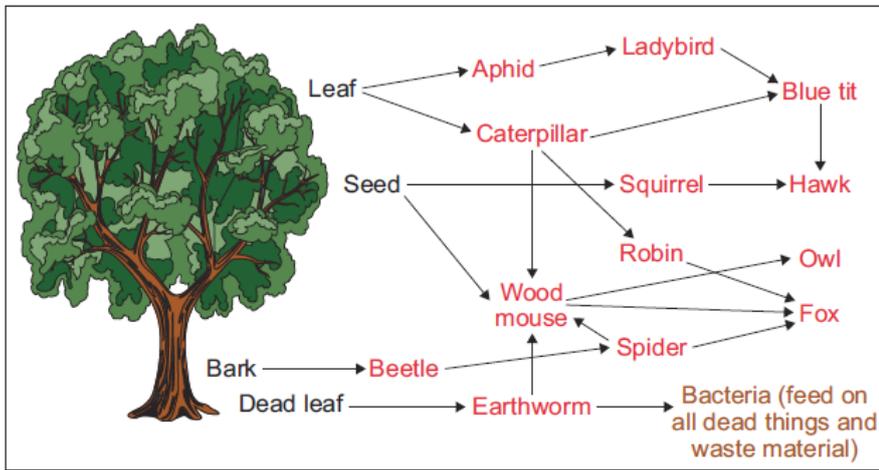


Changes can disrupt the whole system (nutrient cycle)

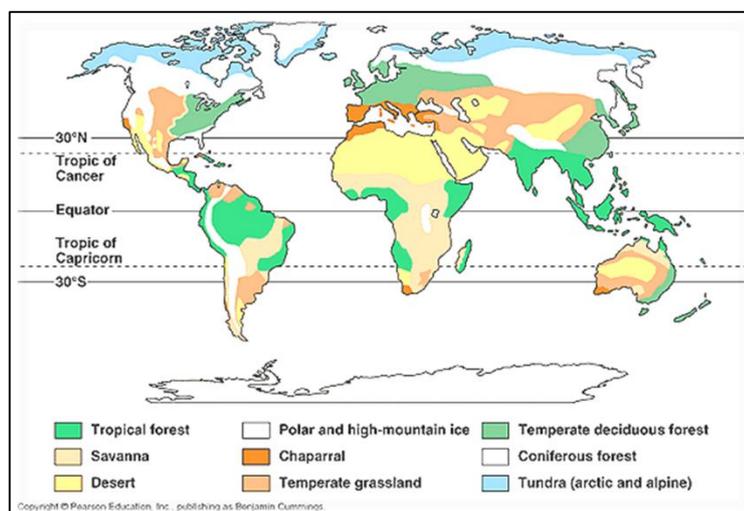
They can take place at different scales i.e. global – climate change or local – removing a hedge
Can you think of any?

They can be caused by nature or humans.

Climate change, rainfall changes, temperature changes, animals or plant diseases ...



Lesson 2 – World Biomes



There are many different classifications of biomes (Tundra, Taiga, Temperate, Chaparral Grasslands), but we will be focusing on two major terrestrial (land) ones:

- 1) Tropical Rainforest
- 2) Hot Desert

Correct SPG:

An biome is made of mAny similar ecosystems*

Ecosystems are the interactions between the Living Things & the no-nliving things in 1 location.

In a ecosystem, the plants, animals, and other organisms? rely on each other and on the physical environment – the soil, water, and nutrients, for example...

An ecosystem is often much much much much smaller than an biome, although the size varies.

At any given time, ecosystems! may get out of balance's and will adapt/change (think about the impacts of Global warming on the Tundra)

Changes in Eco-systems

Different parts of the eco-system depend on each other. If there is a change in one part, it will affect other parts.

Examples:

Climate change - affects where species can live

Habitat change - e.g. conversion from farm land

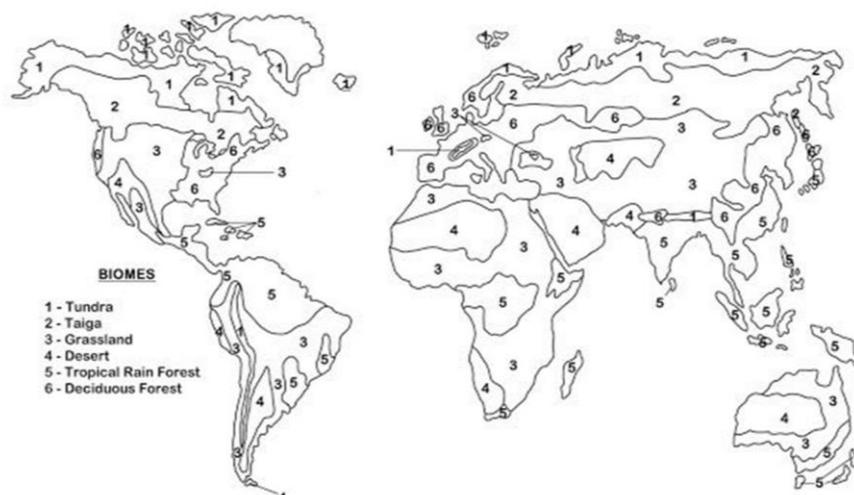
Pollution - e.g. reduce oxygen levels, cause rapid plant growth

Adaptations - what are they?

Within each biome, the living organisms have adaptations to help them survive in these sometimes extreme environments.

For example, a camel in the desert will have long eye lashes to protect its eyes from a sand storm, or large feet to make walking on the sand easier.

The unique climate and living conditions of each biome create wide variety on our planet.

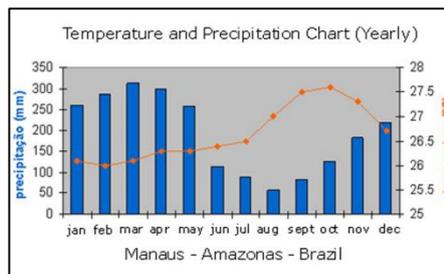


<u>Biome</u>	<u>Areas found</u>	<u>Description (what does it look like?)</u>
Hot Desert		
Tropical rainforest		

Lesson 3 – INTERVENTION LESSON

Lesson 4 – Introduction to Tropical Rainforests

Tropical Climate:



LATOSOLS - Soils In The Tropical Rainforest

Red colour due to iron oxides

Do not have distinct layers

Very deep (20-30m)

Lots of leaching (minerals being washed away) due to heavy rain every day

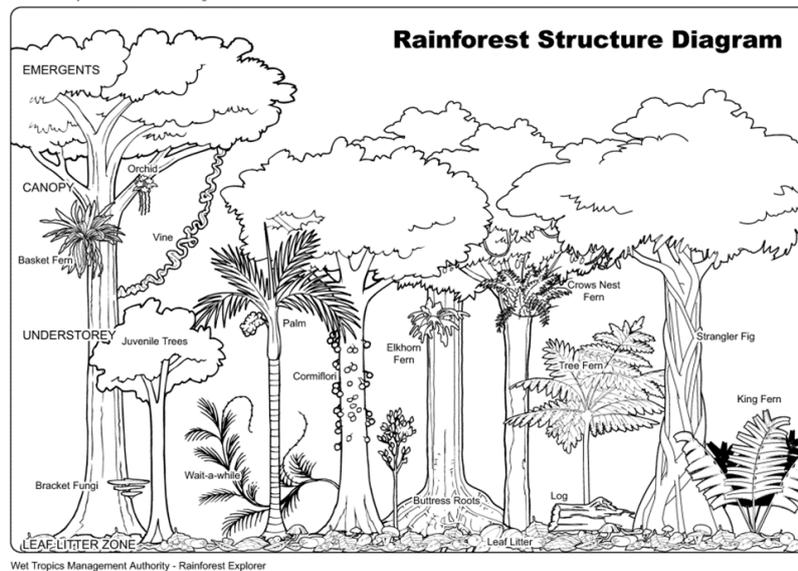
Leaf litter on surface rots quickly in humid climate

This quickly releases nutrients into the top horizon of the soil

But nutrients are either leached away OR taken up by plants again so latosols are infertile

Tropical Rainforest Vegetation & Adaptations

Transform the statements into 10 numbered labels and then add a location arrow to show the feature on the diagram below.



Emergents: Emergents are tall trees that grow above the canopy layer in order to reach sunlight. Emergents can grow in excess of 50 metres.

Canopy: The canopy layer contains about 50% of the rainforests wildlife. The canopy layer is extremely thick and sits at between 25 and 35 metres.

Shrub Layer: The shrub layer is near the forest floor and is also extremely dense. Because the canopy is so thick the shrub layer has to adapt to survive in less light.

Lianas: These are woody vines that climb up other trees to try and get into the canopy and capture sunlight.

Strangler Figs: Strangler figs grow around the outside of other trees taking their light and nutrients and slowly killing the host tree. However, when the host tree collapses so does the strangler fig.

Buttress Roots: Very long roots that are designed to support tall trees and to suck up the maximum amount of nutrients in fairly nutrient poor soil. The long roots rest on the surface of the forest floor to take up nutrients from the decomposing leaves, rather than going deep into the soil (like vegetation in the desert).

Fan Palms: Huge wide leaved plants that aim to capture as much sunlight and rainfall as possible.

Humus Layer: Rainforest soils are fairly infertile and dependent on the humus layer (decaying biological matter). If the source of humus is removed through deforestation then soils degrade very quickly.

Evergreen: Most vegetation in rainforests does shed its leaves once a year. However, because the climate of rainforests is similar all year, they shed their leaves at different times providing a constant source of biological matter and keeping the rainforest green.

Drip tip leaves: A lot of vegetation have leaves designed for rainfall to travel over them and drip to the ground. This is because the vegetation does not want to be damaged by large quantities of water.

Tropical Rainforest Characteristics – fill in the gaps using the words at the bottom – use each word once.

In their natural state, rainforests are so _____ that light does not penetrate far into them. From the air they are a continuous mass of trees- broken only by rivers. The trees are very tall with straight trunks and only branch at the very top. The forest _____ is composed of five _____ and is well adapted to the climate in which it grows.

There are a large number of species in an area, to date, at least 40,000 plant species, 427 _____ (e.g. jaguar, anteater and giant otter), 1,300 birds (e.g. harpy eagle, toucan and hoatzin), 378 reptiles (e.g. boa), more than 400 _____ (e.g. dart poison frog) and around 3,000 freshwater fishes¹ including the piranha have been found in the Amazon Rainforest alone.

The forests are not seasonal- some trees will have flowers and others will fruit, while some are losing their leaves. The _____ trees drop their leaves at any time of the year, so the forest has an _____ appearance. A tree may have _____ with no leaves while others have full foliage. It grows continuously until fully grown. Leaves on most plants and trees are broad and often have a depressed _____ vein that leads to a drip tip.

Rapid chemical _____ processes in the hot and wet climate result in very deep soils, yet the trees of the forest have very shallow buttress roots. The soils are red because they contain a lot of _____ near the surface. When the trees grow, they remove nutrients from the soil- to be returned later when their leaves fall. The leaves _____ rapidly on the forest floor in the hot and wet conditions. This adds _____ to the top layer of the soil. However, the deep soil below has few nutrients because of leaching. The nutrients have been taken down in solution and removed from the soil by rainwater.

Trees take up _____ through their roots, so the shallow _____ roots allow the trees to _____ nutrients near to the surface of the soil. These buttress roots are also essential for the _____ of the very tall trees, which need support in the wet and muddy soils.

The tropical rainforests has a very _____ and diverse animal life, because it provides a variety of _____ and an abundance of vegetation for food. Each _____ of the forest has different conditions of sunlight, _____ and moisture. Examples of animals living on the forest floor are pygmy _____, deer, rhinos and shrews. In the middle layers, certain species of monkey, squirrel, frog, lizard and tree-climbing big _____ can be found. But it's in the canopy and the emergent layers that 80% of the animals live. Many of them are now _____ species.

rich	weathering	habitats	humus	decompose	stability
branches	iron	evergreen	tiers	temperature	central
access	buttress	cats	amphibians	mammals	elephants
nutrients	layer	dense	endangered	deciduous	structure

Animals have also adapted to live in the forest (page 32 in revision guide)

Lesson 5 – Cause of deforestation

The guilty secrets of palm oil: Are you unwittingly contributing to the devastation of the rain forests?

Does your shopping basket contain KitKat, Hovis, Persil or Flora? If so, you may be contributing to the devastation of the wildlife-rich forests of Indonesia and Malaysia, where orangutans and other species face extinction as their habitat disappears. It's an invisible ingredient, really, palm oil. You won't find it listed on your margarine, your bread, your biscuits or your KitKat. It's there though, under "vegetable oil". And its impact, 7,000 miles away, is very visible indeed.

The wildlife-rich forests of Malaysia are being chain-sawed to make way for palm-oil plantations. Thirty square miles are felled daily in a burst of habitat destruction that is taking place on a scale and speed almost unimaginable in the West.

When the rainforests disappear almost all of the wildlife – including the orangutans, tigers, sun bears, bearded pigs and other endangered species – and indigenous people go. In their place come palm-oil plantations stretching for mile after mile, producing cheap oil – the cheapest cooking oil in the world – for everyday food.

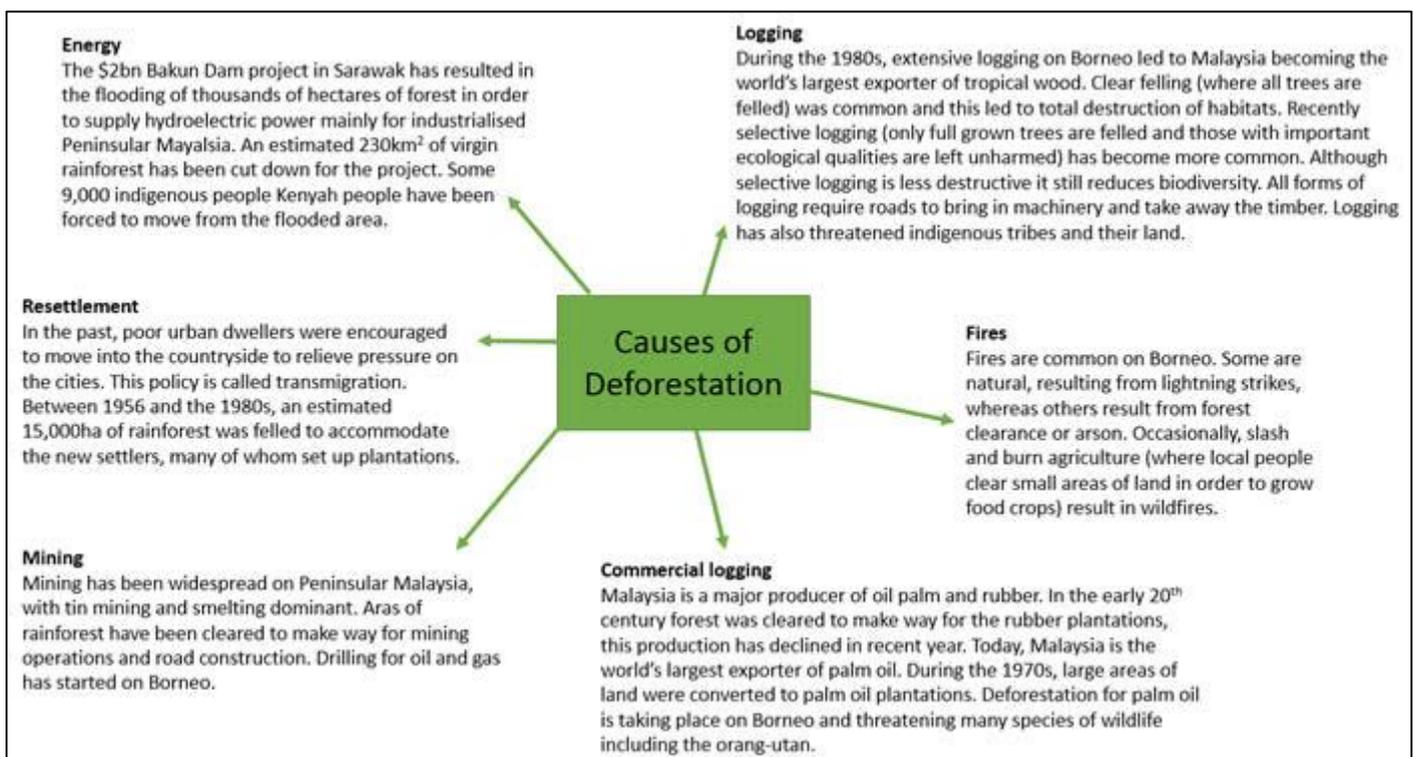
Palm oil facts:

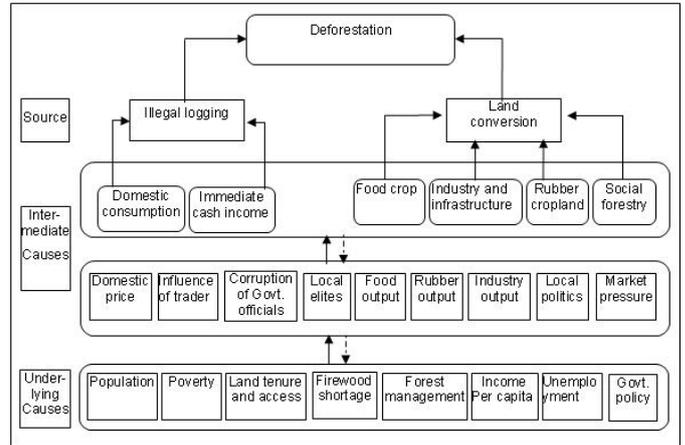
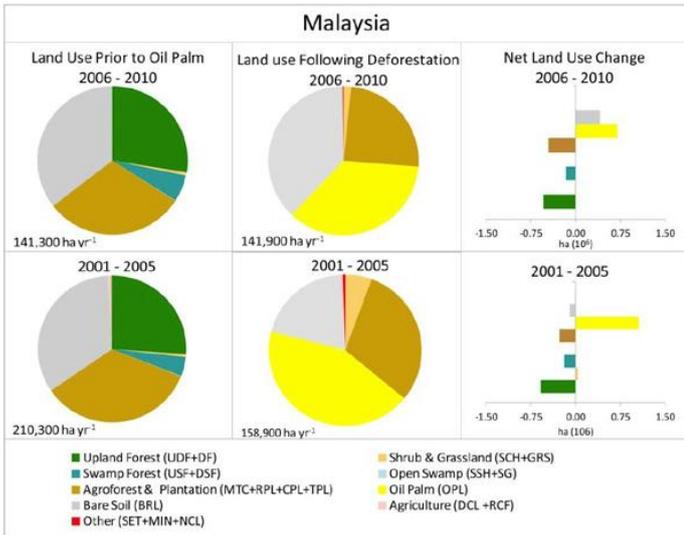
90 per cent of Sumatra's orangutan population has disappeared since 1900 - they now face extinction.

90 per cent of wildlife disappears when the forest is replaced by palm oil trees creating a biological desert.

98 per cent of Indonesia's forests may be destroyed by 2022 according to the United Nations.

43 of Britain's 100 top grocery brands contain or are thought to contain palm oil.





WHAT'S YOUR CONNECTION TO RAINFOREST DESTRUCTION?

Rainforests are hotspots of biodiversity and filter vast amounts of carbon from the atmosphere.

Rainforest destruction for palm oil plantations is driving species extinction, massive carbon pollution and community conflict.

Palm oil plantations turn rainforests into biological deserts.

Palm oil is used to make food products, cosmetics, soaps and detergents.

Cargill trades 25% of the world's palm oil and is the largest importer of palm oil into the United States.

85% of the world's palm oil comes from Indonesia and Malaysia.

50% of all packaged goods sold in the grocery store contain palm oil.

Rainforest destruction is likely found in every room of your home.

Stop Cargill's rainforest destruction.
Start by sharing this graphic and spreading the word about:
THE PROBLEM WITH PALM OIL.

(All sources: cargill.com/education | http://www.earthaid.org | www.wwf.org)

Causes of Deforestation

1. Clearing land to build housing

- Countries resort to deforestation to cope with the increasing demand for housing brought about by the growing population
2. Felling trees for wood

- Logging, or simply cutting down trees for timber is one of the main causes of deforestation
3. Agriculture

- To provide land for food crops such as palm oil and for rearing cattle, undisturbed rainforest areas end up being removed
4. Other land uses

- Land for mining and industrial projects
 - Building dams

Lesson 6 – Impacts of deforestation



Location - South East Asia



Impacts:

Economical Effects

Disruption of Livelihoods

- Deforestation greatly influences many lives
- In Southeast Asia deforestation contributed to migration and social conflicts
- In Brazil the poor people are constantly pressured to move from their villages often to remote soy plantations where they have to work under inhumane conditions
- Destroying sources of medicine
- Increasing food insecurity
- Flooding causing loss of many lives and homes

Short Term Environmental Effects

Increased Soil Erosion

- No trees anchoring the fertile soil
- Erosion is sweeping the land into rivers
- The agricultural plants replacing the forests are unable to hold onto the soil
- Since 1960 a third of world's arable land has been lost
- As fertile soil washes away producers move on, clearing more forests

Disruption of Water Cycles

- Trees play a key role in the local water cycle
- Keep balance between the water on the land and the water in the atmosphere
- Disrupted balance changes the precipitation and river flow

Long Term Environmental Effects

Reduced Biodiversity

- 80 % species can be found in tropical rainforests
- Often unable to survive in the small fragments of forested land left behind
- Accessible to hunters and poachers
- Leading to extinction

Climate Change

- Forests help to mitigate carbon dioxide and other greenhouse gas emissions
- When cut, burned or otherwise removed they become carbon source
- Tropical forests hold more than 210 gig tons of carbon
- Deforestation represents 15% of greenhouse gas emissions
- Rising temperatures, changed patterns of weather and increase of extreme weather events

Wildlife extinction:

Due to massive felling down of trees, various species of animals are lost.

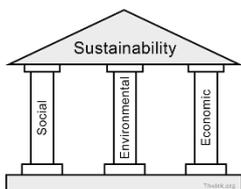
Effects of Deforestation

Bengal Tiger

Deforestation has forced much of the Bengal Tiger's preys, such as deer, antelopes, buffalo etc. to leave the place.

Bengal Tiger's main danger: Its habitat destruction through agricultural expansion, new roads and human settlements.

Lesson 7 – Sustainable Management of tropical rainforests



Sustainable management of forests has to balance _____ main factors: environmental, _____ and social. If achieved, it will provide _____ to all, ranging from helping _____ livelihood, protecting biodiversity to reducing some effects of _____ change.

What should national governments do?

The protection of the tropical rainforest should be the prime responsibility of government.

Ways government can protect the rainforest :

Creating protected areas or reserves.

Stopping the abuse of the rainforest and other biomes by developers.

Making subjects, such as ecology or environmental studies a compulsory part of the curriculum.

Encourage sustainable methods such as afforestation.

Problems national governments might face:

Few governments are willing to do anything that might slow down economic development.

Citizens expect or want better living standards rather than new nature reserves.

Governments seem unwilling to enforce and monitor laws aimed at protecting or conserving.

There is a lot of corruption in the way rainforests are treated, for instance by illegal loggers and developers paying bribes.

Strategies for managing tropical rainforests sustainably:

Sustainable management of forests has to balance _____ main factors: environmental, _____ and social. If achieved, it will provide _____ to all, ranging from helping _____ livelihood, protecting biodiversity to reducing some effects of _____ change.

Management techniques:

Replanting, biosphere reserve, stopping illegal logging, selecting logging, agroforestry, less destructive mining

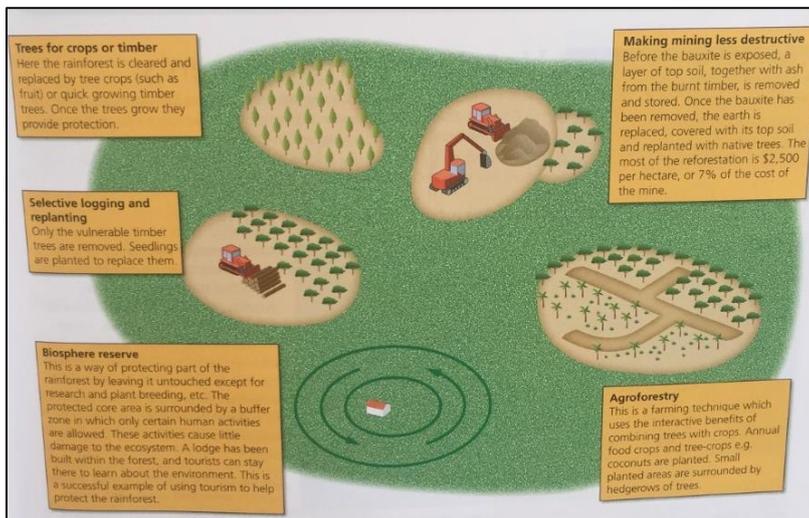
Name of sustainable management technique	Description
	1.This involves felling trees only when they are fully grown, so younger trees can mature, protecting the ground from erosion. It is a cycle lasting 30-40 years
	2. It is possible to recreate a forest cover almost like the original. This is done by collecting seeds from remaining patches of primary forest and planting them back in deforested areas
	3. Logging can go unnoticed in remote areas of the tropical rainforest. It is still happening on a large scale, however satellites and drones are now helping to monitor this.
	4. This involves combining crops and trees by allowing crops to be grown in controlled cleared areas, and growing rainforest trees on plantations outside the rainforest.
	5. Before bauxite is exposed, a layer of top soil, together with ash is removed and stored. Once the bauxite has been removed, the earth is replaced, covered with a top soil and replanted with native trees. The most of the reforestation is \$2,500 per hectare, or 7% of the cost of the mine.
	6. This is a way of protecting part of the rainforest by leaving it untouched except for research and plant breeding etc. The protected core area is surrounded by a buffer zone in which only certain human activities are allowed. These activities cause little damage to the ecosystem. A lodge has been built within the forest, and tourists can stay there to learn about the environment.

International Agreements (page 67)

Why are rainforests agreed to be of global importance?

International agreements are...

Examples of international agreements are...



Ecotourism is another solution.

Aims:

To educate visitors and increase their understanding and appreciation of nature and local cultures.

It is small-scale and local (employing locals, using local produce etc.)

Its profits stay in the local community.

Minimises consumption of non-renewable resources and the ecological impact

Lesson 8 – Value of Tropical Rainforest

Pharmaceutical companies use ingredients from the rainforest! What will happen if all of these disappeared?



Mammosa fruits are boiled in water and the steam inhaled to treat sinus infections. It is related to the eggplant. Eggplant preparations are used to treat skin cancer in some countries.

This trumpet flower, contains compounds long known to open airways during asthma - and also long known to bring hallucinations and possible death.



The most renowned plant medicine of Belize is "sorosi". This vine is used as a household tonic for the treatment and prevention of parasites and dysentery, and for the treatment of delayed or painful menstrual cramps.

Contribo is a fascinating plant that actually smells like rotting meat! In Belize it is a popular remedy for colds and flu, stomach-ache, and indigestion.



The rainforest has valuable resources

Either:

Those provided by the rainforest in its natural state

Those provided by the land once it is cleared of its forest cover

Which goods are supplied by the tropical rainforest?

Cocoa	Rubber	Medicines	Timber
Sugar	Rope	Chewing gum	Energy
Bananas	Chemicals for:		Water
Cinnamon	Soaps	Meat	
Vanilla	Perfumes	Fish	

Pharmaceutical companies are finding new medicines.

25% of the active ingredients in today's cancer fighting drugs come from organisms found only in the rainforest.

In 1980, there were no pharmaceutical companies researching new drugs and cures from plants. Today there are well over 100.

Over 120 prescription drugs come from plant sources.

Apes use medicines from the rainforest.

How might this help humans?

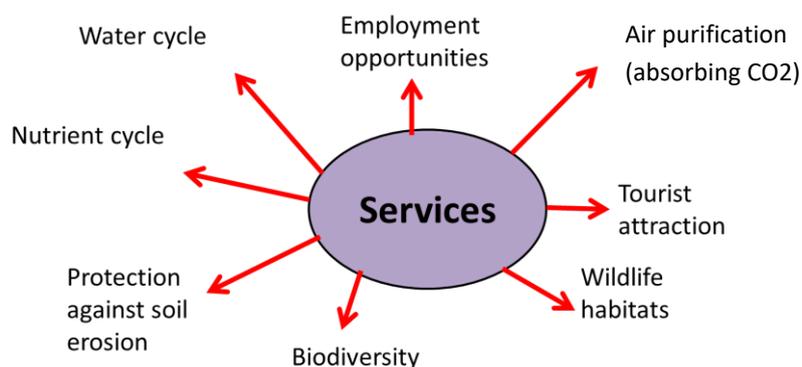
Medicines:



Vincristine is an anti-cancer drug derived from the rainforest plant, periwinkle.

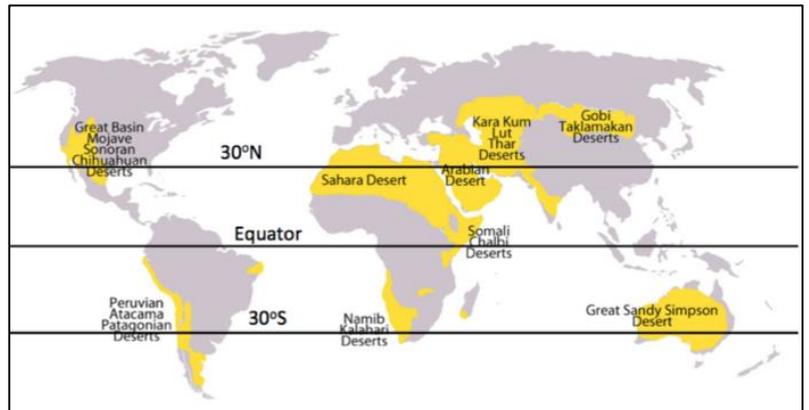
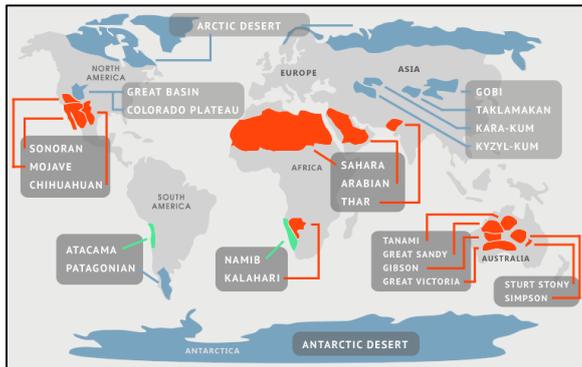


What services are supplied by tropical rainforests?



Lesson 9 – INTERVENTION LESSON

Lesson 10 – Introduction to Hot Deserts



Note that there are hot and cold deserts!

Hot deserts are generally found between 15-35° north and south.

A desert is defined as an area with a dry climate with less than 250mm of rain a year.

However, some deserts in the world experience no rain at all for years, then receive a heavy downfall, resulting in a flash flood.

Deserts are an extreme environment! Did you know...

Deserts cover more than one fifth of the Earth's land area.

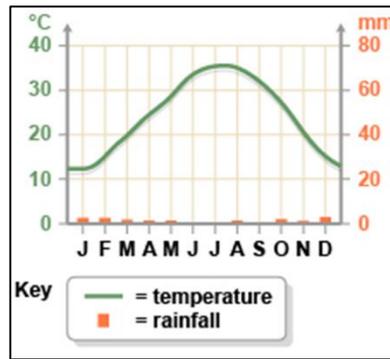
One-sixth of the Earth's population actually live in desert regions.

Northern Africa's Sahara reaches temperatures of up 50 degrees Celsius.

The driest deserts get less than 15mm of precipitation each year and that is from condensed fog not rain.



Look at this climate graph for the Sahara – annotate the graph with your answers.



Adaptations:

As you know desert environments are tough. Plants have to deal with extreme heat and sometimes cold as well as long periods of little or no precipitation.

But we still find flora and fauna in deserts - how? Plants and animals are ADAPTED to the extreme environment.

1. Small needle-like leaves	Reduces water loss through transpiration
2. Succulent	Stores water in its stem
3. Hairy leaves	Reduces water loss through transpiration
4. Long tap roots	Search for water deep underground
5. Roots close to surface	Can soak up water before it evaporates
6. Pleated skin on cactus	Cactus can expand when soaks up water
7. Slow growing	Reduces need for water/nutrients
8. Waxy coating on leaves	Reduces water loss through transpiration
9. Xerophytic	Adapted to survive in arid conditions
10. Thorns	Reduce water loss and protect from animals
11. Small plant above ground	Limited exposure to extreme heat
12. Woody stem and branches	Reduces water loss due to transpiration
13. Strong seeds	Allows it to lie dormant until it rains
14. Date palm	One of the few plants that can grow in salty (saline) groundwater

Plant Adaptations

Identify each desert plant and annotate to show how it is adapted to survive in hot deserts.

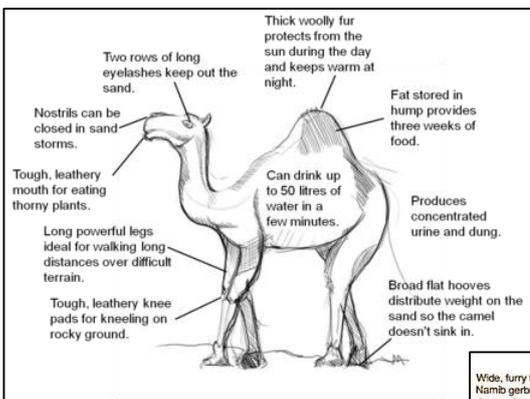




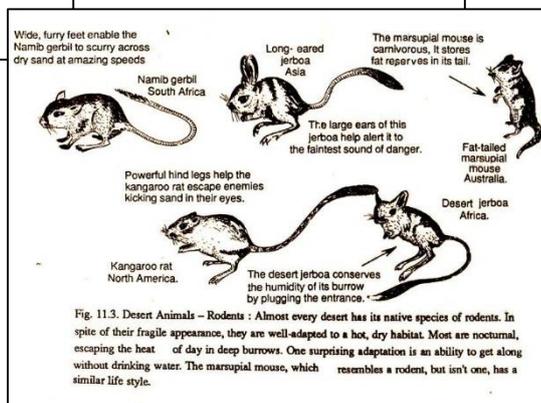
Most desert soils have no organic content and are just made up of pieces of rock and sand. They tend to be sandy or stoney due to the lack of leafy vegetation. They are dry but can rapidly soak up water after rainfall. Evaporation draws salts to the surface, often leaving a white powder on the ground. Desert soils are not very fertile.

Animal adaptations:

- Many rodents are nocturnal to avoid the daytime heat
- They live in burrows underground & venture out during the cooler nights
- Snakes & lizards retain water by having a waterproof skin and producing tiny amounts of urine
- Camels can survive many days without water and have a number of adaptations...



Animal adaptations- Fennec fox	
Adaptation	Function
burrowing and nocturnal lifestyle	Cooler temperatures at night mean less water loss while carrying out activities.
large ears (about 15cm)	help dissipate excess body heat on hot days in the desert.
Thick, sandy fur	helps insulate them from the cold desert nights but also reflects heat, As well as providing excellent camouflage.



Lesson 11 – Case Study of a hot desert – Morocco



Opportunities in Morocco's Draa Valley area:

Location

The location map shows Morocco's position relative to Tunisia, Algeria, Libya, Egypt, Mauritania, Mali, Niger, Chad, Sudan, and Nigeria. The climate map indicates annual rainfall (mm) with a legend: 0-200, 200-400, 400-800, 800-1000, and 1000-1200.

Energy

In Feb 2016 Ouarzazate, Morocco turned on the first phase of the world's largest solar energy plant. The power station on the edge of the Saharan desert will be the size of the country's capital city by the time it is finished in 2018, and provide electricity for 1.1 million people. The north African country plans to generate 42% of its energy from renewables by 2020, with one-third of that total coming from solar, wind and hydropower apiece.

Mineral Extraction

The anti-atlas domain contains occurrences of manganese, precious metals (gold and silver), and strategic metals (cobalt, tin, titanium, and wolfram). Cobalt ore is mined at the Bou-azzer underground mine located 35 kilometers (km) south of Ouarzazate, in the central anti-atlas Mountain range. In terms of value, silver was the second ranked mineral commodity in Morocco after phosphate. The Imiter mines in the Anti Atlas had a processing capacity of about 300,000 metric tons per year (t/yr).

Tourism

Ouarzazate has stood at the edge of the Sahara desert for hundreds of years. A city of palm trees, sandy streets and blocky, fort-like buildings, this is the Morocco seen in a hundred movies. Outside the city is the reason most people come to Ouarzazate: the stunning Sahara. Take a trek out to the nearby villages and kasbah and see the breathtaking Todra Gorge.

Dusty streets, terracotta buildings, huge skies. Zagora, in the south-east of Morocco, is a place that is inextricably linked with the Sahara Desert. Outside the town is the amazing Draa Valley, which follows the twists and turns of the river - an unforgettable place where thick groves of palm trees line the twists and turns of the river.

Farming in the Drâa Valley

Because of the Drâa river around 225,000 people live in the valley. Most are subsistence farmers surviving on small holdings of just one or two hectares. Traditionally a poly-culture approach (mixing crops) has been taken to farming with a mixture of dates, barley, fruit and vegetables being grown. This has allowed the local population to prosper despite the harsh arid environment in which they live.

Year	Production (tonnes)	Harvested Area (ha)
2001	~10,000	~10,000
2002	~15,000	~10,000
2003	~25,000	~10,000
2004	~45,000	~10,000
2005	~35,000	~10,000
2006	~45,000	~10,000
2007	~55,000	~10,000
2008	~60,000	~10,000

Agriculture is only possible with irrigation, using either canalized river water or pumped groundwater. The major crops cultivated in the Drâa region are cereals and fodder for livestock (around 90%). The main cultivated cereal is wheat.

According to IMPETUS Morocco an average farmer owns around 300 date palms in the Drâa region. Most dates are sold at local markets. Date palms strongly benefit from irrigation, and occupy a seemingly small area acting as boundaries between fields and serving as shade to field crops.

In 2008 Morocco produced 90,000 metric tonnes of dates and exported 1,200 metric tonnes. Ouarzazate/Zagora, within the Drâa river catchment, is one of the three main date producing regions in Morocco. Moroccans consume more than 120,000 metric tonnes of dates each year. The average domestic consumption is 2.82 kg/person, climbing upwards of 15 kg/person in some date-growing regions.

Growing watermelons
Drip irrigation is where water is supplied at very low pressure, very slowly, directly to a plant's roots from plastic tubing. It is the most efficient form of irrigation at 97% and results in very little erosion. However it is also the most expensive form of irrigation.

It has been used as a medicine by Berbers for centuries, and now the cosmetic and food industries are showing an interest. Despite the climatic challenges of their home range, argan trees manage to live for as much as 250 years. Their adaptations enable them to colonise the desert fringes where few other trees can grow, making them a vitally important bastion against desertification. They have long, questing root systems that go deep into the thin soil in search of the water table. The depth of the root system means the trees are firmly anchored to the ground and resistant to strong winds, which in turn protects the soil from erosion. Small leaves and tough stems help to reduce water loss caused by excessive transpiration.

Argan oil has been a component of Berber folk medicine for centuries, used in the treatment of skin conditions, rheumatism and heart disease, but in the past decade or so the cosmetic and food industries have woken up to its potential as an anti-ageing wonder treatment and super food.

Moroccan argan oil: the 'gold' that grows on trees

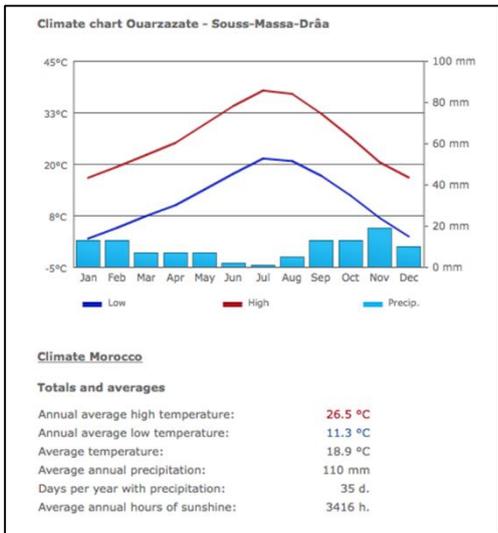



The popularity (and lucrative nature) of Moroccan argan oil is so strong that the government has decided to get involved. They are making an effort to increase the size of the argan forests—which have already been declared a UNESCO Biosphere Reserve—and triple national production of argan oil by the year 2020. If they are successful, Moroccan argan oil production could increase by as much as 4,000 tonnes within the next decade.

Lesson 12 – Challenges of development in hot deserts

1. Extreme Temperature

The South of Morocco suffers from extremely high temperatures, sometimes reaching as high as 45°C in the summer close to the border with Algeria. This presents challenges for people, plants and animals living in this environment.



1. Mehdi found working on the date farm particularly hard today due to the heat.
2. Jamilla struggled to collect enough water today, as the evaporation rates have been high for a few months.
3. Youssef spent a lot longer today rounding up his goats, as they were no longer shading themselves under the palm trees.
4. Jana found she couldn't go to the market in Zagora today, as the road had been swept away by a flash flood.
5. Karim was rushed off his feet at the hotel today, as four bus loads of Europeans arrived.

2. Water Supply

Livestock Growing Crops Population

Water supply has become a serious issue in the Draa Valley, which is worrying as the Draa valley is one of the country's largest water basins, with a 29,000km² catchment area. It is also the country's largest river at 1,100km long.

This is due to human activities, especially the irrigation of agricultural lands. Research has shown that 97% of water used in the Draa valley is used for agriculture, with 2.5% used for domestic purposes. The area has also become overpopulated with its population X2 between 1971-2004 due to the development of agriculture. This is putting more strains on the water resources.

The situation has also not been helped by the loss of traditional agricultural practises, where several crops were once produced on the same land. Today cereal production dominates the area, which requires more water. Also watermelons are now produced in the area, but they require around 1,000 irrigation pumps to provide them with enough water. On top of this Henna (a cultural heritage) is now produced in the summer months in the valley, which requires huge amounts of water.

The situation is aggravated by 5% of crops being used as animal feed. Plus people are now farming on unfertile land, which is unsustainable as it demands large amounts of water and its productivity is low.

Knock on effects have been that irrigation is leading to salinization (increasing salt content) and also the fertilizers used on the crops are polluting the groundwater sources. Local villages are suffering shortages or their water supply is becoming saline (full of salt).

Climate change will have negative effects in the future and the region has already been suffering from more frequent droughts.

<p>The current situation</p> <p>The Drâa Valley in arid south-eastern Morocco has experienced periods of drought in the last decades. During the last 10 years water availability was generally low, the Middle Drâa Valley is more concerned than the Upper Drâa basin with its rivers and wadis fed by rain and snow from the High Atlas Mountains. This results in:</p> <ul style="list-style-type: none">• Reduced water availability for irrigation agriculture downstream of the reservoir• Decreasing drinking water quality• Overexploitation of the groundwater resource in the Middle Drâa Valley resulting in decreasing groundwater levels		<p>Possible future development</p> <p>Climate change and socio-economic development of the Drâa region have different impacts on water availability and water demand, as there are:</p> <ul style="list-style-type: none">• Decreasing overall precipitation amounts generally aggravate water scarcity• Higher rain intensities might compensate for water delivery but increases risk of soil degradation• Irrigation agriculture loses importance because of non-profitability and increased remittances due to labor migration.• Urbanization increases water demand.
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3. Accessibility in Southern Morocco

Highlight key information and answer the questions.

Due to the very extreme weather and the presence of vast barren areas, until the last 5-10 years there has been a limited road network across Southern Morocco.

Improvements

A study in 1992 stated that 80% of rural roads in Morocco were in a bad condition, with a third of them impassable for at least 30 days a year and 60% of rural areas at the time were unreachable by a vehicle. A



rural roads project, initiated by the government and supported by the World Bank has improved this situation. Between 1995 – 2005 10,000km of roads were paved from dirt to gravel.

A second project was started in 2014 to ensure the country's remote villages were connected to the main road network. The project has an aim of making 80% of rural roads accessible by 2016 and already a further 2,500km of roads have been made accessible.

Extreme weather & accessibility:

Despite improvements, the high temperatures can cause the tarmac to melt and disappear without warning, being replaced by stretches of gravel, sand and potholes.



Strong winds also often blow sand over the roads, carrying a lot of dust and you will just have to wait until it eases off if you don't want to do your car considerable damage. Things get worse in April when sand storms can occur and affect accessibility in the region. November to March is the rainy season when flash floods can occur in deserts and mountainous areas. Landslides and damaged roads can

make places impassable. In November 2014 the region experienced severe flooding and widespread infrastructure damage.



Other issues:

Garages and petrol stations become fewer and further apart as you travel south. Some stations also don't always have supplies. This could prove dangerous due to the extreme temperatures experienced there.

There is also a security threat in the south and currently the border with Algeria is closed, as terrorists from the Sahel, close to this border, have abducted some westerners.

Airports – Ouarzazate and Taroudant have regular flights from major Moroccan cities enabling tourists to easily access the region.

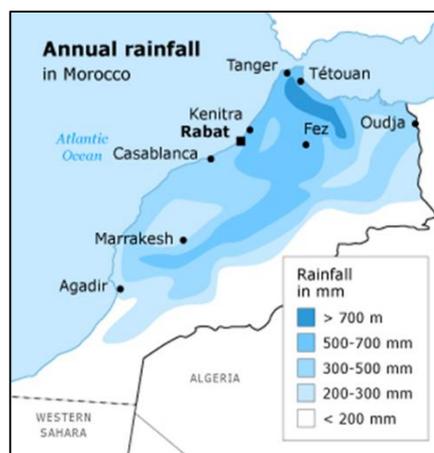
Massive investment in infrastructure:

Billions have been invested in the infrastructure in the north of the country with modern toll motorways being built and also a TGV rail line being developed, which will help to boost trade and tourism in the country.

Population Distribution



Annual Precipitation



Lesson 13 – Desertification

Desertification happens when land is gradually turned into desert, usually on the edges of an existing desert. Once exposed to the weather it will crack and break up. It will then be eroded by wind and water.

Desertification is a type of land degradation in which a relatively dry area of land becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as through climate change and through the overexploitation of soil through human activity.

Desertification can result from poorly managed human intervention in the savannah. Areas of desert are created by the destruction of natural vegetation. Causes of desertification include:

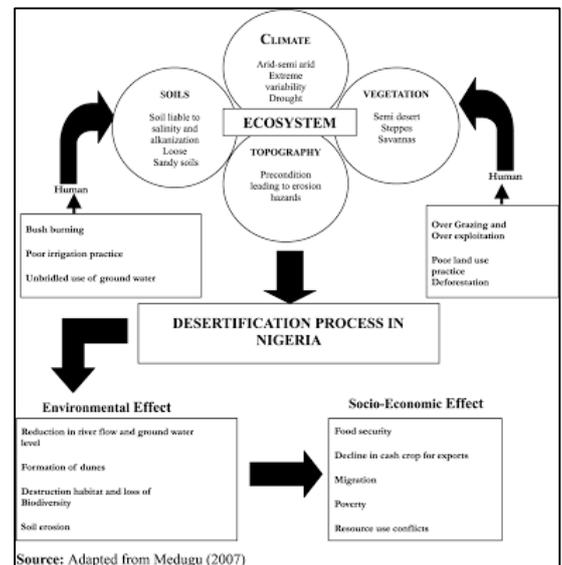
Removal of vegetation cover.

Overgrazing.

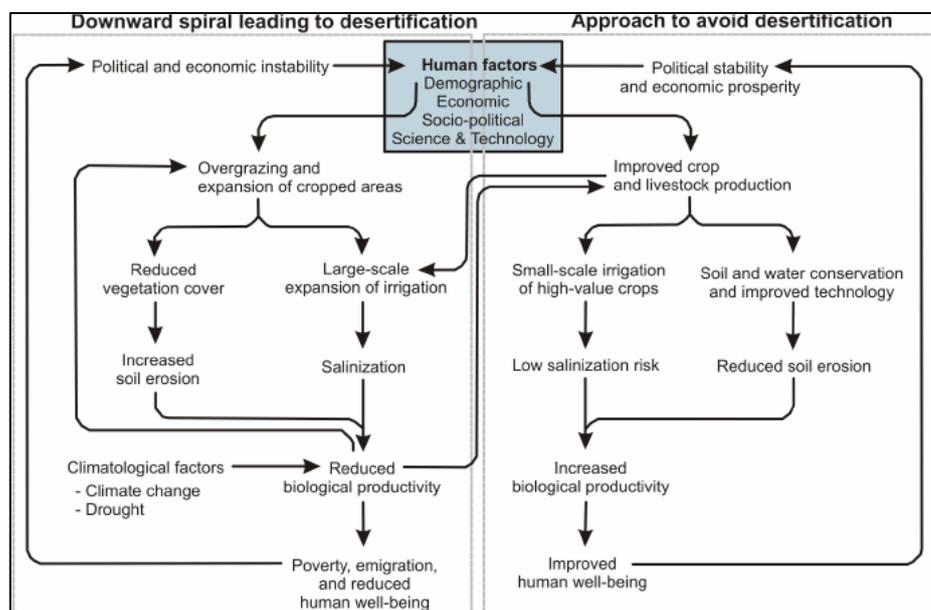
Uncontrolled fuel wood collection.

Unsustainable farming practice and loss in fertility of soil.

Excessive tree felling.



Climate variations, where areas are consistently hot and dry, with long periods of no rain can soon cause soil conditions to deteriorate. Lack of rainfall leads to drought, and eventually the necessary growing conditions for plants and animals disappear. Most plants, unless specially adapted to desert conditions, can not thrive in dry, arid conditions.



Causes of desertification

- Unreliable rainfall (climate change- much less rain now than 50 years ago)
- Overgrazing
- Need for more fuel wood
- Over- cultivation (over use of the soil to grow crops- soil becomes exhausted and turns to dust)
- Soil erosion

Effects of desertification:

Soil becomes less fertile

Vegetation is lacked or damaged

Causes famine

Food loss

People near affected areas – Desertification causes flooding, poor water quality, dust storms and pollution. All of these can have an effect on nearby regions.

In some desert regions, such as the Sahel on the southern fringes of the Sahara Desert, *climate change* is resulting in drier conditions and unreliable rainfall. On average it now rains less than it did 50 years ago.

Population pressure can result in land close to existing deserts being overgrazed. This means that there are too many animals to be supported by the limited vegetation. When the vegetation has been destroyed the land will turn to desert.

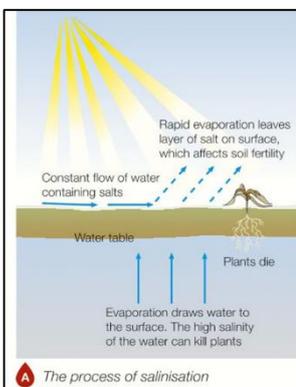
Soil erosion is often linked to desertification. When vegetation has been destroyed the soil is exposed to the wind and the rain making it vulnerable to erosion.

Over-cultivation resulting from the need to produce more food can lead to the soil becoming exhausted. It will turn to dust and become infertile.

Population growth is also increasing the demand for *fuelwood*. Trees are stripped of their branches and eventually die.

C Causes of desertification

Lesson 14 – Reducing Desertification



It is possible to live in the desert without damaging the environment, but it needs to be done in a sustainable way.

Tree Planting

- Scientists at the Central Arid Zone Research Institute have developed a breed of plum tree called a **Ber tree**.
- It produces large red fruits and can survive in low rainfall conditions.
- The fruits can be sold and the people make a profit.

Tree Planting

The most important tree in the Thar Desert is the **Prosopis cineraria**. It is well-suited to the hostile conditions of the desert and has multiple uses:

- A lot of leaves are produced which can be used to feed animals, especially during the drier winter.
- They can provide good-quality **firewood**.
- The wood is **strong** and can be used as a **building material**
- Crops can benefit from **shade** and **moist** growing conditions if spread amongst the trees.
- This as well as other species of tree are planted in blocks to help **stabilise** the **sand dunes**.

Stabilising sand dunes (tree planting)

- The sand dunes here are very mobile – blown by the wind.
- They can be a threat to farmland, roads and waterways.
- Ways in which these are dealt with include planting blocks of trees and establishing shelterbelts of trees and fences alongside roads and canals.

National Parks

National parks

In some parts of the world, hot desert areas at risk of desertification have been protected by making them into national parks.

- The Desert National Park in the Thar Desert, India was created in 1992 to protect some 3000 km² of desert and reduce the risk of desertification.



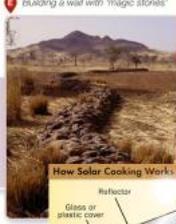
National park status protects this arid land and the endangered and rare wildlife which has adapted to its extreme conditions. It has measures in place to limit population growth to help to reduce the pressures caused by over cultivation. Also commercial farms can not be developed on National Park land- this can ensure that water is preserved in these areas.

Appropriate Technology

Many people living on the edges of deserts are poor. **Appropriate technology** involves using methods and materials that are appropriate to their level of development. They may not have access to expensive machinery. Sustainable approaches have to be practical and appropriate.

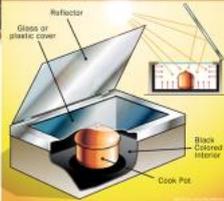
'Magic stones' in Burkina Faso, West Africa

In rural parts of Burkina Faso lines of stones have been used to reduce soil erosion. Using basic tools and trucks to transport the stones, local people have built low stone walls between 0.5 m and 1.5 m high along the contours of slopes (photo E). When rain washes down the hillsides, the walls trap water and soil. This has helped to increase crops by up to 50 per cent and reduce desertification.



Solar Cookers

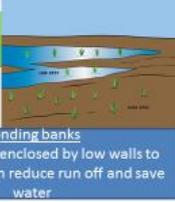
The rate of deforestation can be reduced by using solar cookers, which use the sun's energy to heat food. They are cheap and easy to make and do not require any fuel wood to work- so people are not having to cut down trees.



Sustainable- meeting the needs of people today, without compromising the environment for future generations

Water Management

Water management is key in any desert as there is a limited supply- but as populations increase as does the need for more water.



Growing crops that don't need as much water is a strategy that is being used successfully in the Thar desert. Growing crops like millet, sorghum or olives can reduce water use.

Using drip irrigation on crops instead of surface irrigation means that the soil isn't eroded by lots of water being added all in one go - in a similar way to heavy rain, too much water added too quickly can wash away the top layer of soil.

Sustainable management of the savannah:

Conservation is the key to protecting the Serengeti for future generations. A sustainable future could be achieved if the following policies are adopted:

- Local people employed by investors.
- Respect for local cultures and customs.
- Local people should receive some financial rewards from tourism.
- Sustainable methods are used in order to protect the environment.
- Improved conservation education programmes for local communities and farmers.

Possible strategies to achieve these goals:

1. Harvesting branches rather than whole trees to prevent deforestation, soil erosion and desertification.
2. Controlled burning of grassland to avoid wildfires.
3. Crop rotation to keep a varied supply of nutrients in the soil and prevent soil erosion and desertification.
4. Stone lines along the soil contours keep it in place, prevent erosion and improve crop yields. Projects such as this can involve the whole community and give them a sense of ownership and responsibility.
5. Managing grazing land to avoid overgrazing, soil erosion and desertification.

Solutions to desertification - some disadvantages:

Afforestation - newly planted trees need water, which will be a problem in a drought stricken region.

Building stone lines - reduces soil erosion, but is a labour intensive process which diverts the community from tasks essential to their survival.

Decreasing livestock - solves the problem of overgrazing but requires people to adapt if they rely on cattle or goats for their livelihoods.

Lesson 15 – Intervention lesson

Lesson 16 – Assessment lesson

Lesson 17 – Assessment review

Lesson 18 – Intervention

