

Year 9 GCSE Geography Home Learning Booklet



Name: _____

Contents:

Week commencing	Topic/Activity	Page Number
23 rd – 27 th April 2020	Lesson 1: Characteristics of a Tropical Rainforest	3
	Lesson 2: How plants and animals adapt to tropical rainforests	6
30 th – 3 rd April 2020	Lesson 3: Issues of biodiversity in tropical rainforests	8
	Lesson 4: Changing rates of deforestation	10
20 – 24 th April 2020	Lesson 5: Amazon Rainforest – causes of deforestation	14
	Lesson 6: Impacts of Deforestation	17
27 th – 1 st May 2020	Lesson 7: Value of tropical rainforests	20
	Lesson 8: Managing tropical rainforests sustainably	23
4 th – 8 th May 2020	Lesson 9: Mini assessment: tropical rainforests	26
	Lesson 10: Physical characteristics of cold environments	28
11 th – 15 th May 2020	Lesson 11: Interdependence in cold environments	28
	Lesson 12: Plant/animal adaptations to cold environments	31
18 th – 22 nd May 2020	Lesson 13: Issues of biodiversity in cold environments	31
	Lesson 14: Alaska – development opportunities	33
1 st – 5 th June 2020	Lesson 15: Alaska – challenges in cold environments	35
	Lesson 16: Alaska – challenges in cold environments	35
15 th – 19 th June 2020	Lesson 17: Management of cold environments	37
	Lesson 18 Management of cold environments	37
22 nd – 26 th June 2020	Lesson 19: Mini assessment: cold environments	41
	Lesson 20: Location of UK upland/lowland areas and rivers	43
29 th – 3 rd July 2020	Lesson 21: Coasts: types of wave	45
	Lesson 22: Coastal Processes	47
6 th – 10 th July 2020	Lesson 23: Coastal processes	49
	Lesson 24: Coastal erosion – headlands and bays	51
13 th – 15 th July 2020	Lesson 25: Coastal erosion – caves, arches and stacks	53
	Lesson 26: Coastal erosion – wave cut platforms	56

Tropical Rainforests

Rainforests are Interdependent Ecosystems

All the parts of the rainforest (climate, water, soils, plants, animals and people) are dependent on one another — if any one of them changes, everything else is affected. For example:

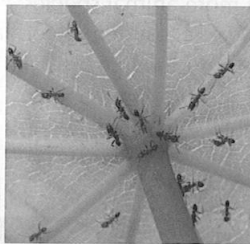
- 1) The warm and wet climate helps fungi and bacteria on the forest floor to decompose dead plant material rapidly. This makes the surface soil high in nutrients, meaning plants can grow easily.
- 2) Plants pass on their nutrients when eaten by animals. The dense vegetation provides lots of food, so animal populations are high. When the animals die, their nutrients are transferred back to the soil, making it richer and encouraging lots of vegetation. This is a key part of the nutrient cycle (see p.20).
- 3) Many plant and animal species have formed symbiotic relationships (where they each depend on the other for survival). For example:



Agouti (a rodent) are one of the only animals that can crack open the hard seed pod of the Brazil nut to eat the nut inside. Sometimes, the agouti bury the nuts — these can sprout into new seedlings. If the agouti became extinct, Brazil nut tree numbers would decline and so could the populations of all the other animals that depend on Brazil nut trees for food or shelter. People who sell Brazil nuts to make a living could also be affected.



© Nature Picture Library / Alamy Stock Photo



Cecropia trees have hollow stems and produce an energy-rich foodstuff at the base of their leaves. This makes the trees an ideal home for Azteca ants, who rely on the trees for food and shelter. Without Cecropia trees, the Azteca ants could struggle to survive. The ants fight off other insects that try to feed on the tree. They also attack lianas, which compete with the Cecropia for sunlight by winding vines around their stems. Without the Azteca ants, Cecropias would be much more vulnerable to predators.

But Humans are Interfering with these Ecosystems

- 1) Changes to one part of the rainforest ecosystem can have knock-on effects on the whole ecosystem. For example, cutting down trees (deforestation) can contribute to climate change.
- 2) Trees intercept and take up lots of water, and release it back into the atmosphere, providing moisture for further rainfall. Reducing tree cover may increase the risk of drought, affecting the plants and animals that live in the rainforest ecosystem.
- 3) Trees stabilise soil with their roots and provide some nutrients when they drop their leaves. With fewer trees, the soil would have less protection from heavy rainfall, the few nutrients present would wash away more easily and plants would struggle to grow.



For more on deforestation
turn to p.26-27.

Rainforests — hot, wet and full of creepy bugs, eugh...

Check you know the characteristics of a rainforest ecosystem and how those characteristics are interdependent. Cover the page, write down what you know, then check you've got it all. Now drip on over to the next page for...

Tropical Rainforests

If you want to set the scene for this page, I recommend a hot shower and a CD of shrieking monkey noises...

Tropical Rainforests are Hot and Wet All Year Round

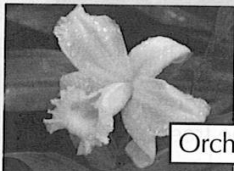
Climate

- 1) The climate is the same all year round — there are no definite seasons.
- 2) It's hot (the temperature is generally between 20-28 °C and only varies by a few degrees over the year). This is because the sun's energy is more intense near the equator as it is overhead all year round.
- 3) Rainfall is very high, around 2000 mm per year. It rains every day.



Plants

- 1) Most trees are evergreen to help them take advantage of the continual growing season.
- 2) Many trees are really tall and the vegetation cover is dense — very little light reaches the forest floor.
- 3) There are lots of epiphytes (plants that grow on other living plants and take nutrients and moisture from the air), e.g. orchids and ferns.



Orchid



Fern

Soil

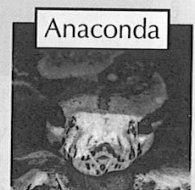
The soil isn't very fertile as heavy rain washes nutrients away. There are surface nutrients due to decayed leaf fall, but this layer is very thin as decay is fast in the warm, moist conditions.

Animals

Rainforest ecosystems are believed to contain more animal species than any other ecosystem. Gorillas, jaguars, anacondas, tree frogs, sloths and howler monkeys are all found here, and there are also many species of insects and birds.



Tree Frog



Anaconda

People

Many indigenous people have adapted to life in the rainforests. They make a living by hunting and fishing, gathering nuts and berries, and growing vegetables in small garden plots.



Rainforests Have Very High Biodiversity

- 1) Biodiversity is the variety of organisms living in a particular area — both plants and animals.
- 2) Rainforests have extremely high biodiversity — they contain around 50% of the world's plant, animal and insect species, and may contain around half of all life on Earth.
- 3) Rainforests are stable and productive environments because their climate is constant — it's hot and wet all the time. Plants and animals don't have to cope with changing conditions and there is always plenty to eat.
- 4) Many organisms have evolved to depend on just a few other species for survival — they are specific to a particular habitat and food source. Many species are also only found in a small area.
- 5) Deforestation (see p.26) and uncontrolled development of the rainforest are likely to lead to the extinction of many species and the loss of biodiversity. The number of threatened species in Brazil increased from 628 in 2008 to 1182 in 2014.



Tropical Rainforests — Adaptations

It can be difficult to survive in tropical rainforests, so plants and animals have adapted to make life easier.

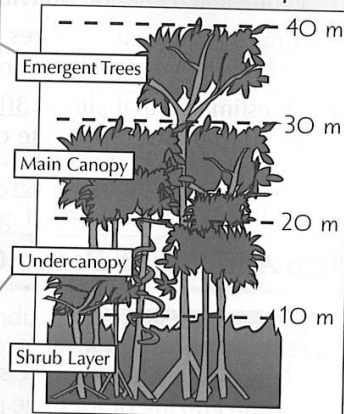
Plants Have Adapted to the Physical Conditions

Plants in the rainforest are adapted to high rainfall, high temperatures and competition for light.

- 1) Trees compete for sunlight by growing tall.
- 2) Plants have thick, waxy leaves with pointed drip-tips. These channel rainwater to the point, encouraging runoff so the weight of the water doesn't damage the plant. This also means there's no standing water for fungi and bacteria to grow in. The leaves' waxy coating also helps to repel the rain.
- 3) Climbing plants, such as lianas, use tree trunks to reach sunlight.
- 4) Many trees have smooth, thin bark as there's no need to protect the trunk from cold temperatures. The smooth surface also helps water to run off easily.
- 5) Large, stable buttress roots support the tall trees' trunks.
- 6) Plants drop their leaves gradually throughout the year, meaning they can go on growing all year round.



The rainforest has four layers of plants with different adaptations:



Emergent trees only have branches at their crown, where the most light is available.

Some undercanopy plants have large leaves to absorb as much sunlight as possible.

Animal are Adapted To Finding Food And Escaping Predators

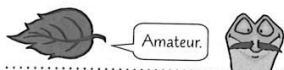
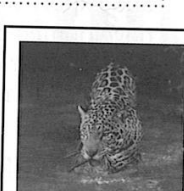
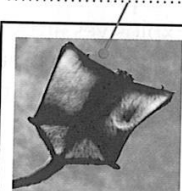
Many animals spend their entire lives high up in the canopy. They have strong limbs so that they can move around their habitat quickly and easily, e.g. howler monkeys.



Some birds have short, pointed wings so that they can easily manoeuvre between the dense tangle of trees, e.g. the harpy eagle.



Suction cups help some animals climb, e.g. tree frogs. Others have flaps of skin that help them glide between trees, e.g. flying squirrels.



Some animals are camouflaged, e.g. leaf-tailed geckos look like leaves so they can hide from predators.

Some animals are adapted to the low light levels on the rainforest floor, e.g. anteaters have a sharp sense of smell, so they can detect predators without seeing them.

Many animals are nocturnal, e.g. sloths. They feed at night when it's cooler — this helps them to save energy.

Many animals can swim, e.g. jaguars. This helps them cross river channels.

What's a tree's favourite drink? Root beer...

You may be given a picture in the exam and asked to describe how an organism is adapted to its environment. Don't panic if you don't know what it is — think how the features shown might be adaptations to help it survive.

Lesson 2:



Now Tropical rainforests are found in places with a _____ (over 30°C) and wet (over _____ mm of rainfall) climate.

Rainforests grow in the tropics, close to the _____ and the plants have a _____ month growing season. As a result, the rainforest is the most biodiverse ecosystem in the world.

The tropical rainforest is different from all other ecosystems because of its biodiversity. Over 50 species of tree may be found in only 1 hectare of soil in the rainforest. The forests appear to be evergreen but the trees are _____ and take it in turns to lose their leaves.

Figure 1—global distribution of tropical rainforests

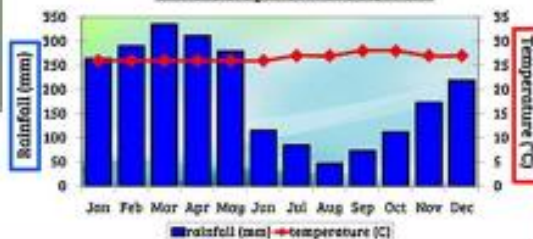


Task 1: describe the distribution of tropical rainforests. Use the atlas map in your planner to help you.

Nearly all tropical rainforests are found near to the equator, between the Tropic of _____ and the _____ of _____.

Rainforests can be found in **South East Asia**, as well as the continents of _____ and _____.

Climate Graph for Manaus, Brazil



Task 2: Describe the climate of Manaus (a city within the Amazon Rainforest)

The **temperature** in tropical rainforests remains very _____ throughout the year, between _____ and _____ degrees Celsius.

Rainfall levels between January and December _____ - _____ quite a lot.

The wettest month is _____, where there is _____ mm of rainfall.

The driest month is _____, where there is only _____ mm of rainfall.

Environmental characteristics of tropical rainforests

Task 3: Layers of a rainforest

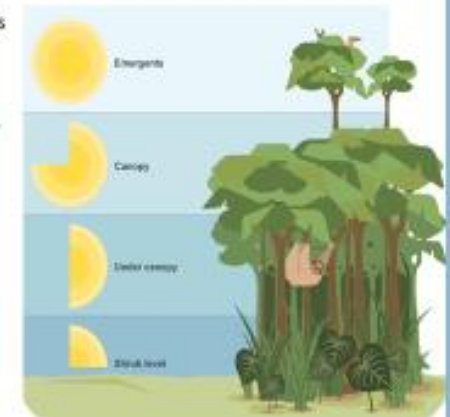
The highest layer of the rainforest is the _____ layer. Trees here can reach _____ m high and need to be very tough. To cope with the wind and _____.

Next is the _____ layer where most of the _____ live.

Next is the _____. Trees here only grow to _____ m high as there is not much sunlight.

At the very bottom is the _____, where it is very _____ and not much grows.

40 rain Shrub layer undercanopy emergent
10 animals dark canopy



Task 4: How do plants adapt to live in the rainforest?



1. drip tip and waxy leaves

3. Night coloured flowers



2. Lianas

4. Buttress roots



Challenge: Suggest how this species of frog has adapted to survive in tropical rainforests



Study **Figure 8** below, showing part of a tropical rainforest in Central Africa.

Figure 8



02.9 Using **Figure 8** and your own knowledge, explain how plants and animals adapt to the physical conditions in tropical rainforests

(6 marks)

Lesson 3:

ACTIVATE: This section covers information on interdependence within a tropical rainforest and what relies on what.

Interdependence means where one factor is reliant on one or more other factors. There are many examples of interdependence in a tropical rainforest. Figure 8 shows the main characteristics of the tropical rainforest ecosystem: climate (rain and sun), soil, vegetation (trees and plants), animals and people. The arrows demonstrate how they interact to create an interdependence. For example, the warm and wet climate means that dead material is decomposed quickly by fungi and bacteria on the forest floor. This makes the surface soil high in nutrients, as a result plants can grow quickly and easy.

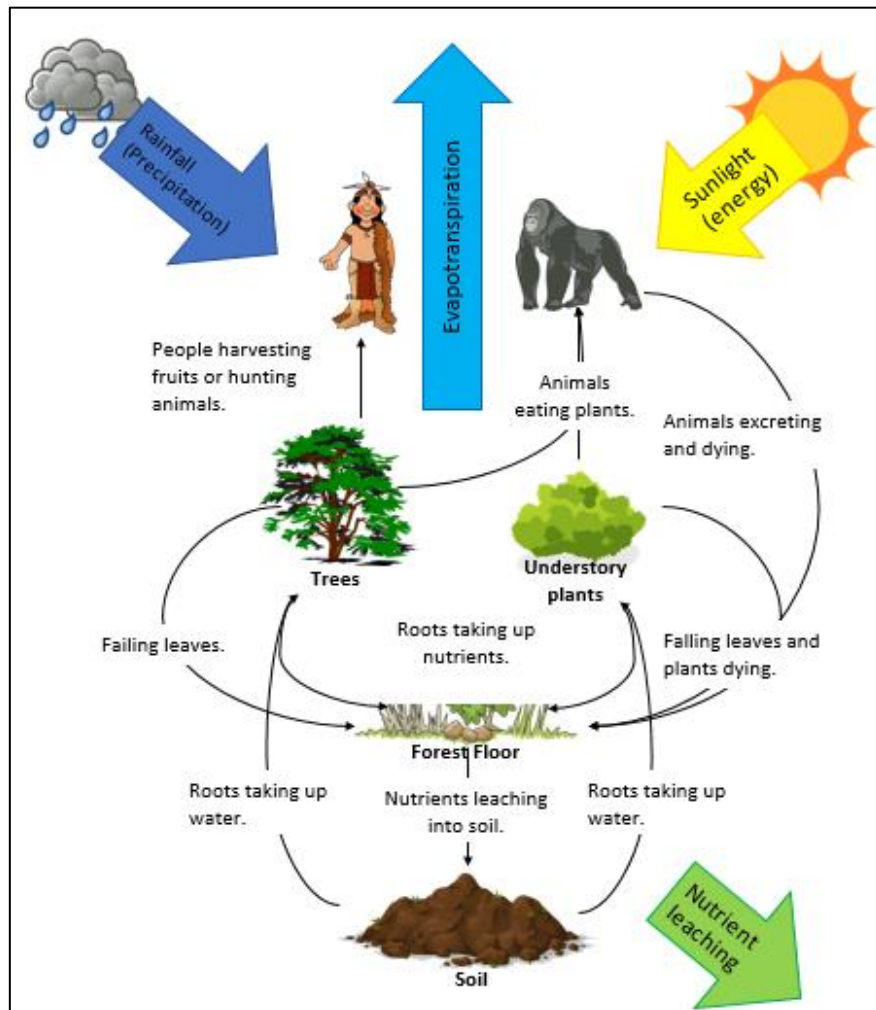


Figure 8 Tropical Rainforest Ecosystem

Another example is plants passing on their nutrients to animals when they're consuming the plants. The dense vegetation provides lots of food, so animal populations are high. Many plant and animal species have formed symbiotic relationships (where they each depend on the other for survival).

This is demonstrated by agouti (a rodent), they are only animals that can crack open the hard seed pod of nut to consume the nut inside (Figure 9). Sometimes, bury the nuts which can then sprout into new the agouti becomes extinct, then Brazil nut trees decline and so could all the other animals that live in the Brazil nut trees as their habitat or food source has who sell Brazil nuts to make a living may also be reduced income.



Figure 9 Agouti and a Brazil Nut

one of the the Brazil the agoutis seedlings. If would or feed on gone. People affected by a

Changes to the tropical rainforest ecosystem from deforestation such as people reducing tree cover (deforestation), can have a direct effect on the whole ecosystem. For example, by reducing the tree cover, there will be a direct reduction in the amount of CO₂ absorbed from the atmosphere through photosynthesis, therefore there will be more CO₂ in the atmosphere, adding to the greenhouse effect and changing the climate.

A final example is interception, trees intercept rainfall and take up lots of water and releases it back into the atmosphere through evapotranspiration, this provides moisture for further rainfall. Deforestation means the climate may change and the risk of drought increases. This will affect the plants and animals living in the ecosystem.

DEMONSTRATE: Explain the interdependence shown in **Figure 8**.

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Outline what would happen if vegetation (trees and plants) coverage was reduced.

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Explain how the soil and plants in tropical rainforests are dependent on one another **(2)**.

★ **TIP:** Think about how plants depend on soil and then vice versa.

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Lesson 4:

Deforestation of Tropical Rainforests

LO: To explore the changing rate of deforestation.

DO IT NOW: Study Figure 14, a bar chart to show tropical deforestation rates between 2000 and 2005.

Describe the countries that have the highest and lowest deforested area between 2000 and 2005.

★ **TIP:** Use **data** such as place names and average area deforested per year.

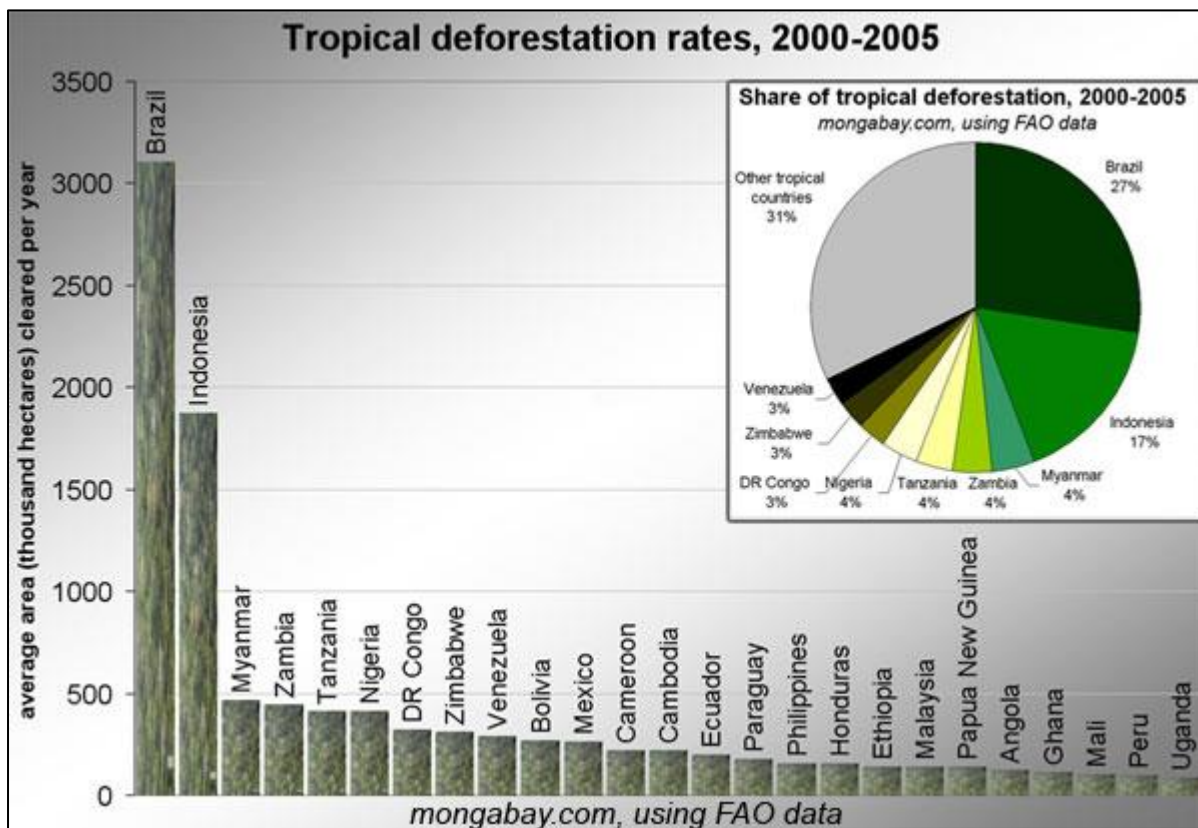


Figure 14 Deforestation Rates

Define deforestation.

ACTIVATE: This section has information about the changing rate of deforestation and the current situation of deforestation in **Brazil**.

In the last 100 years, the impact of deforestation on tropical rainforests has become serious. There are 62 countries with a tropical rainforest within their borders. The United Nations Food and Agriculture

Organisation (UNFAO) estimate that around half of the world's tropical rainforests have now been deforested.

Figure 15 shows that the rate of deforestation during the first decade of the twenty-first century has increased in all three continents: Asia (Indonesia, Malaysia and Thailand), Africa (Madagascar and Mali) and South America (Peru, Guatemala and Bolivia).

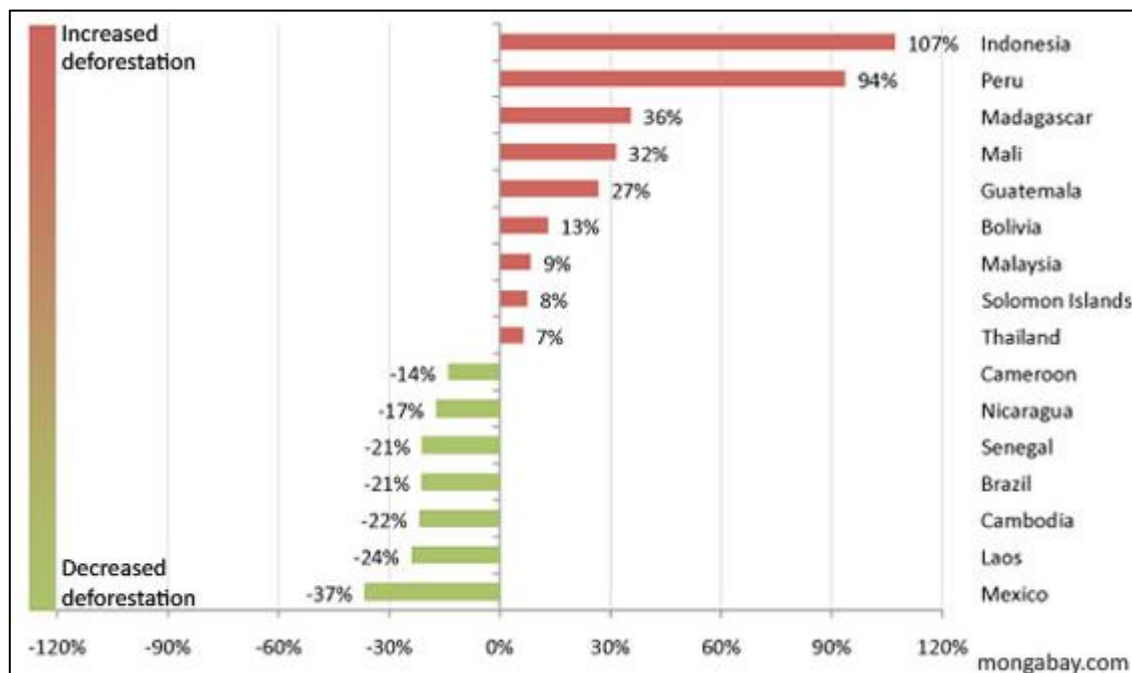


Figure 15 Change in Annual Deforestation Rate (2000 and 2010)

The rate of deforestation decreased in seven countries. The rate of deforestation has fallen in Brazil to a record low. It is estimated that around 50% of Brazil's remaining rainforest now has some form of protection status. However, 20% of the Amazon rainforest has now been cleared since 1970; that's an area of 761,000 km² (about three times the size of the UK).

The rate of reductions elsewhere may indicate that other countries have also put measures in place to protect and preserve their rainforests. In Mexico, strenuous efforts are being made to protect the little rainforest that remains but it disappears entirely.

It is important to note that only the rate of deforestation has increased, deforestation continues in all countries shown in **Figure 15**. Borneo and Nigeria are just some of the hotspots where the rate of deforestation is increasing. Today, the global rate of tropical rainforest deforestation is estimated to be:

- 1 hectare per second.
- 60 hectares per minute.
- 86,000 hectares per day (an area larger than New York City).
- 31 million hectares per year (an area larger than Poland).

The Brazilian rainforest occupies the large area of lowland basin drained by the Amazon and its tributaries. **Figure 16** illustrates how much the tropical rainforest cover was cleared up to 2006.

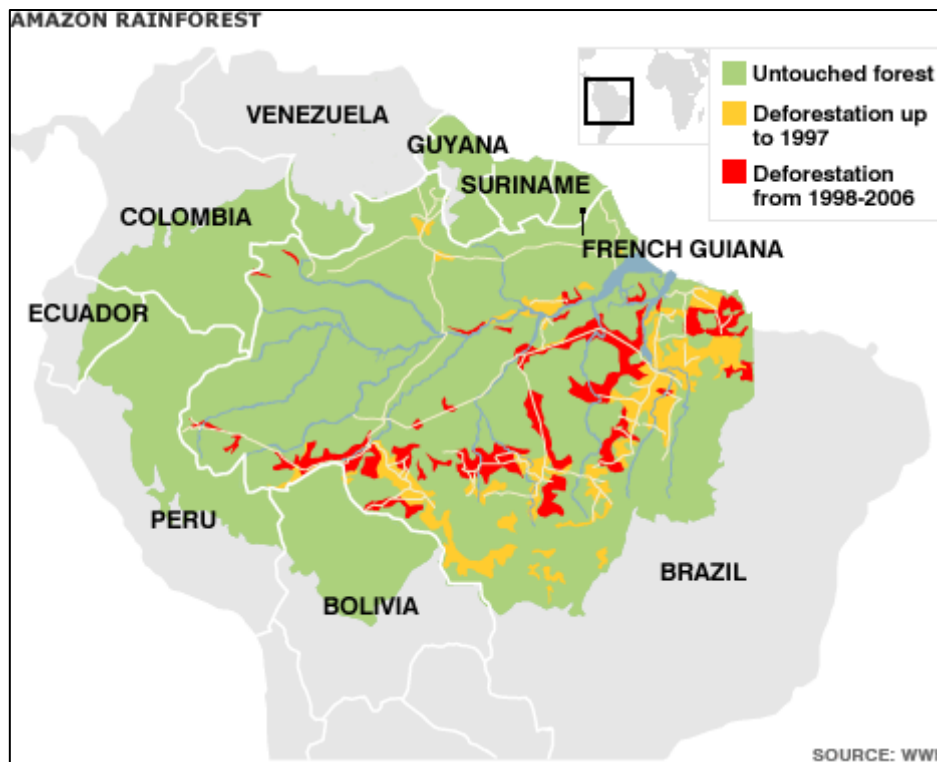


Figure 16 Deforestation in the Amazon Rainforest

There is noticeable clearance to the south of the Amazon. This part of the rainforest is most accessible from the main cities in Brazil such as Rio de Janeiro, São Paulo and Brasília. For centuries, the rainforest has been lived in by indigenous tribes that have harvested fruits and nuts, cut wood for fuel, used timber to build their own dwellings, discovered cures for numerous illnesses and cleared small areas of the rainforest through slash and burn (a type of subsistence agriculture). Forested land is clear cut and any remaining vegetation gets burned. The resulting layer of ash provides the newly-cleared land with a nutrient-rich layer to help fertilise crops. Slash and burn has done little lasting damage to the tropical rainforest ecosystem. When the soil in one small area becomes exhausted, the tribe move on and clears another. It is sometimes referred to as 'shifting cultivation'. Once left, the forest that was being used can regenerate.

An important point to remember is that human activity does not always mean deforestation. Many cases of human activity lead to forest degradation, this is where the rainforest ecosystem is changed in a negative way and the supply of resources declines.

DEMONSTRATE: Identify the differences between deforestation and forest degradation.

★ **TIP:** Define the two terms and identify the differences.

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In the past, before urbanisation and globalisation, what would people have used the tropical rainforests for?

★ **TIP:** Think about the human activity of indigenous tribes.

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Study Figure 16, and explain why there is much untouched forest to the north of the Amazon basin (3).

★ **TIP:** Think about human activity and accessibility.

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Lesson 5: Causes of Deforestation in Brazil

LO: To explore a case study of a tropical rainforest to illustrate the causes of deforestation.

ACTIVATE: This section will introduce you to how people exploit the rainforests resources and the activities that cause deforestation.

Brazil is located in South America. It is the fifth largest country in the world and contains the largest area of tropical rainforest. The Amazon covers an area of around 8 million km², including parts of Brazil, Peru, Columbia, Venezuela, Ecuador, Bolivia, Guyana and Suriname. Since 1978, around 761 000km² has been destroyed by deforestation. Like other countries the tropical rainforest in Brazil is being exploited in two ways: by using its resources such as timber, water and minerals and by deforesting the area to make way for other activities such as growing crops and rearing livestock. **Figure 17** shows the mains reasons for deforestation in Brazil.

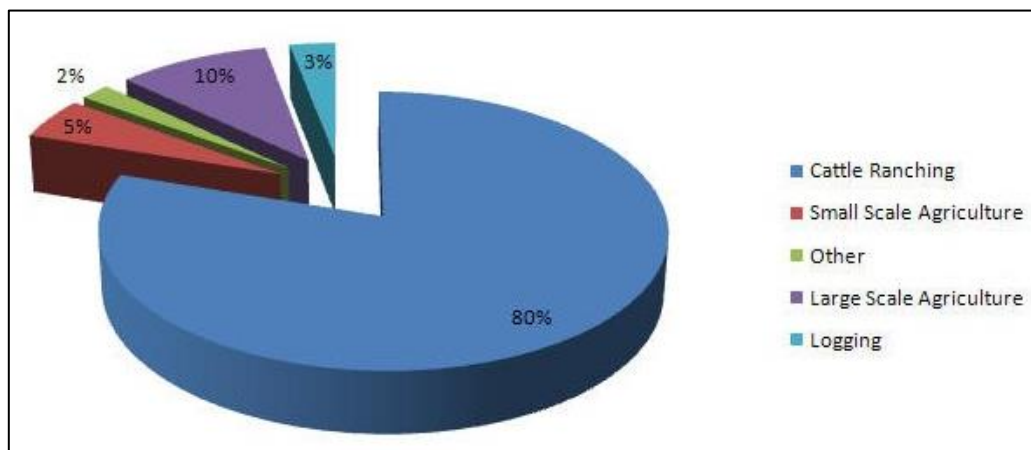


Figure 17 Causes of Deforestation in the Brazilian Rainforest

The main resource extraction activities include logging, mineral extraction and energy development.

Logging (**Figure 18**) is the first step in the conversion of forest land to other uses. This may seem surprising giving that logging only accounts for 3% of the causes of deforestation. This is because it is the eventual use of the cleared land is put to that is recorded in the pie chart. Timber companies are interested in specific trees such as mahogany and teak (selective logging), they sell the timber to other countries to make furniture. Smaller trees are used as wood for fuel or made into pulp or charcoal. Vast amounts of the rainforest are cleared in one go (clear felling). There is also lots of illegal logging.



Figure 18 Logging in the Brazil Rainforest



Mineral extraction such as gold mining fall into the other category that accounts for 2% of the causes for deforestation. In 1999, there were 10,000 hectares of land being used for gold mining. Today, there is over 50,000 hectares of land being used for gold mining. The rainforest also suffers from bauxite extraction which is used to make aluminium.

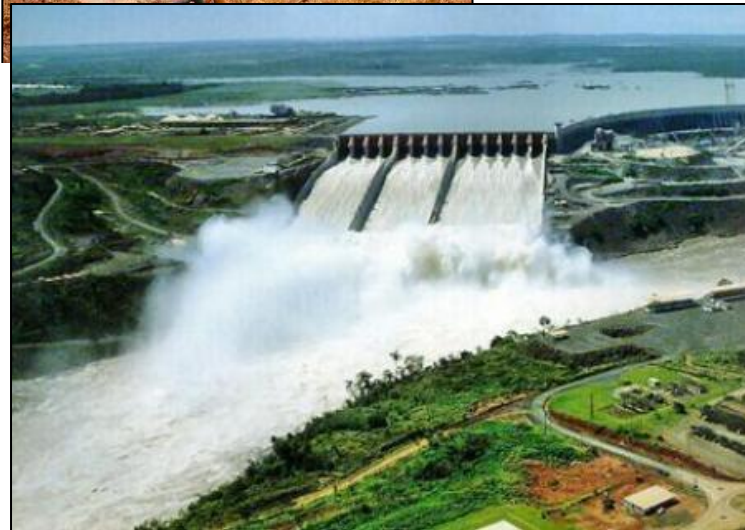


Figure 20 Itaipu Dam, Brazil

Also, included in the other category is energy development. An unlimited supply of water and ideal river conditions have encouraged dams to be built to generate hydroelectric power (HEP). This involves flooding vast amounts of rainforest. Often, the dams have a short life. The submerged forest eventually rots, making the water very acidic which then corrodes the HEP turbines. The dams also become blocked with soil washed down deforested slopes by the heavy rain.

Figure 17 also mentions the activities that are causing the rainforests to be cleared such as subsistence and commercial farming, road

building, settlement and population growth.

Agriculture is one of the main causes of deforestation in the Brazilian rainforest. Subsistence farming (which means farming to feed oneself and family) is the traditional method of agriculture and temporarily clears small patches of the rainforest. This is mainly done by indigenous tribes and accounts for 5% of the causes of deforestation in the Brazilian rainforest.

Commercial farming is far more damaging the rainforest. Large areas of the Amazon have been cleared to make room for livestock rearing. The rearing of cattle is estimated to account for 80% of the causes of deforestation in Brazil. However, the land cannot be used for long. The quality of the pasture quickly declines which means that the farmers move on and clear more rainforest to create more room for cattle pastures.



Figure 21: Cattle on Deforested Land

In addition to cattle rearing, commercial farming also includes the growing of crops. The cleared to make way for vast plantations of crops such as bananas, palm oil, pineapple, sugar cane, tea and coffee. The cultivation of soybean has also caused much forest clearance in Amazonia. The amount of rainforest cleared for this crop has doubled between 1990 and 2010. Like cattle ranching, the soil will not remain fertile for long and therefore does not have a long-life span for sustaining crops. After a few years, farmers must fell more rainforest for new plantations. Growing sugar can for biofuel is beginning to become a major crop.



Figure 22 The Trans-Amazonian Highway, Brazil

Road building is accounted for in the 2% other category. Roads are needed to bring in equipment and transport products to markets, it means cutting great amounts of the rainforest down. Additionally, a road built for one commercial activity makes the forest more accessible to other exploiters of the rainforests resources. The Trans-Amazonian Highway began construction in 1972 and is 4,000km long. Although only a small part of it paved, it has played an important role in opening up areas of the rainforest.

Population growth and migration to the area is also putting pressure on the Amazon rainforest, especially as the Brazilian government offers land in the rainforest to poor

people from overcrowded cities. Many people migrate to the rainforest for work in the industries mentioned above. In turn, this means that land needs to be cleared to make way for settlements where workers and their families can live.

DEMONSTRATE: Study Figure 17, describe the importance of different causes of deforestation.

★ **TIP:** Use data in your answer.

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Explain why logging has such low value as a cause of deforestation in Brazil.

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List which activities are accounted for in the 2% other category of Figure 17.

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Lesson 6:

Impacts of Deforestation in Brazil

LO: To explore a case study of a tropical rainforest to illustrate the impacts of deforestation.

DO NOW: Study Figure 22, a photograph of Itaipu Dam in Brazil, recall two environmental impacts of building dams in rainforests.



Figure 22 An enlarged photograph of Itaipu Dam, Brazil (Figure 20).

Impact 1:

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Impact 2:

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ACTIVATE: This section will cover the local and global impacts of deforestation in Brazil.

There are many consequences or impacts of deforestation, whilst two are of global significance, the others are essentially local. Climate change is amongst the significant global impacts of deforestation in the rainforest. During photosynthesis, the tree canopy absorbs carbon dioxide (a greenhouse gas) in the atmosphere which reduces the rate of climate change. The Amazon stores around 100 billion tonnes of carbon. When the trees are felled, this stops and more carbon dioxide remains in the atmosphere. Fire is often used to clear the rainforests, this means that the carbon stored in the wood is released back into the atmosphere where it will absorb heat and increase Earth's climate. Deforestation is responsible for at least 15% of global CO₂ emissions each year – more than all the world's transport emissions combined. In addition, trees give off moisture from the process of transpiration; deforestation reduces the moisture in the air resulting in a drier local climate. With less moisture comes less condensation and in turn rainfall. The natural recycling of water is like a cooling system, once the recycling is reduced (through less moisture) the local climate becomes warmer. Increasing dryness and rising temperatures are not good for people or activities such as agriculture.



Figure 23 Burning Rainforest

Biodiversity is a measure of the variety of plants and animals in an ecosystem. Rainforest are the most biodiverse ecosystem in the world. Clearing tropical rainforests means that the biodiversity will be reduced and individual species will become endangered and trees possible extinct. It has been estimated that 137 plant, animal and insect species are being lost each day due to deforestation. This amounts to 50, 000 species each year. As the rainforest species disappear, so do many cures for life-threatening diseases. Currently, over 120 prescription drugs sold worldwide come from plant sources. 25% of the active ingredients in today's cancer-fighting drugs come from the organisms found only in the rainforest. Recent research has shown that the Amazon rainforest could lose between 30 and 45% of their main species by 2030.

Figure 24 Vincristine: an anti-cancer drug made from Periwinkle; a rainforest plant



Soil takes thousands of years to form, but it can be stripped away in a matter of hours. Removal of soil by wind and rain is called soil erosion. The roots of trees and plants bind the soil together. As soon as any part of the rainforest is cleared, the thin layer of topsoil is quickly removed by heavy rainfall. Bare slopes are prone to soil erosion. Once the topsoil has been removed, there is little hope of anything growing in that area again. Soil erosion also leads to the silting up of river courses. Even when the soil is protected, it quickly loses the little fertility it has when covered by trees. Grazing and plantations do little if anything to keep the soil fertile. The decline in soil fertility leads to pastures and plantations being abandoned, so more areas of the rainforest are cleared.

Deforestation in many parts of the world is driven by profit. Deforestation may lead to short-term economic gains but it may also lead to long-term economic losses. The natural rainforest has brought wealth to countries that were poor. Agriculture makes a lot of money in the rainforest. In 2008, Brazil made \$6.9 billion from trading cattle, Brazil is also the world's second biggest exporter of soy bean. The mining industry creates jobs for local people, for example the Buenaventura mining company in Peru employs over 3100 people. Logging contributes a huge amount to Brazil's economy. Companies will pay taxes to the government which can be used to improve

public service such as education, healthcare and water supply. However, in the long-term, deforestation can destroy the resources that countries depend on such as timber and non-timber products, tourist numbers may also decline as the area reduces in attractiveness. The livelihoods of some local people are destroyed as deforestation can cause a loss of animals or plants that they rely on to make a living. For example, local Brazilian rubber tappers who extract natural rubber from rubber trees have lost their livelihoods as trees have been cut down.

DEMONSTRATE: Make a **list** of the short-term economic gains and the long-term economic losses of deforestation in Brazil.

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Short-term economic gains	Long-term economic losses

Explain the local impacts of climate change in Brazil.

★ **TIP:**

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Lesson 7:

Value of the Tropical Rainforest

LO: To explore the value of tropical rainforests to people and the environment.

DO IT NOW: **Outline** one positive economic impact of deforestation.



Outline one negative social impact of deforestation.



ACTIVATE: You will now read about the different goods and services that the tropical rainforest provides.

The resources and opportunities offered by the tropical rainforest itself are widely known as goods and services. Goods are things that can be directly obtained from the rainforest whereas services are benefits that the rainforest can offer to both people and the environment. **Figure 25** demonstrates these.

Goods	Services
Native food crops (fruit & nuts)	Air purification (absorbing CO ₂)
Wild meat and fish	Water and nutrient cycling
Building materials (timber)	Protection against soil erosion
Energy from HEP	Wildlife habitats
Water	Biodiversity
Medicines	Employment opportunities

Figure 25 Goods and Services in the Tropical Rainforest

The plants of the tropical rainforest include many of the things that we eat, such as cocoa, sugar and bananas. Cinnamon, vanilla and many other spices also come from the rainforest. Useful products like rubber, ropes and baskets are made from rainforest plants. Some of the chemicals from rainforest leaves, flowers and seeds are used to make perfumes, soaps, polishes and chewing gum. Traditional subsistence farming is still very much about the harvesting of rainforest goods. The use of these forest products has been going on for a very long time.

However, we are beginning to realise that the rainforest has more to offer. It is the stock of plants that pharmaceutical companies are finding to contain ingredients to help treat and cure diseases. Indigenous tribes have a very long tradition of using parts (barks, resins, roots and leaves) of various plants for this purpose. Currently, over 120 prescription drugs sold worldwide come from plant sources. About a quarter of drugs used in the developed world are derived from rainforest ingredients. Less than 1% of rainforest tropical trees and plants have been tested by scientists to find out if they have any medical value. 25% of the active ingredients in today's cancer-fighting drugs come from the organisms found only in the rainforest (**Figure 24**). In 1980, there were no pharmaceutical companies researching possible new drugs

and cures from plants. Today, there are well over 100. It is in the interest of global healthcare to protect the tropical rainforest and its medicinal plants. It is vital that these plants are not over exploited.

Perhaps the single most important global issue today is climate change. Climate change will only be checked by:

- Greatly reducing the burning of fossil fuels and so lowering CO₂ emissions.
- Greatly reducing the rate of deforestation to ensure that as much of the Earth as possible is covered by trees to absorb CO₂ from the atmosphere.

As one of the largest carbon sinks in the world, the tropical rainforest has a critical role to play. Protecting the remaining rainforest requires doing two things:

- Ensuring that much of it is left untouched, so that it remains in a pristine state, for example, making large areas of rainforest into nature reserves and national parks.
- Allowing the goods and services of the tropical rainforest to be used to benefit people and the environment, but only in a sustainable way.

DEMONSTRATE: Outline the difference between the goods and services of an ecosystem.

★

Discuss the ways that tropical rainforests are good for global health.

★

Tropical Rainforests — Sustainable Management

It's not all doom and gloom for rainforests. In fact, this page is dedicated to the ways to manage

Tropical Rainforests are Very Valuable to People and the Environment

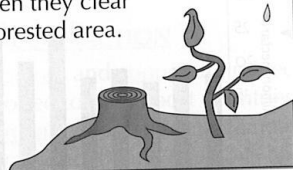
- 1) Many products, including rubber, coffee, chocolate and medicines, are sourced from the rainforest. If species become extinct, it's harder to discover new medicines and develop new products.
- 2) Sustainable development can offer long-term economic benefits, e.g. ecotourism.
- 3) Protecting the rainforests may reduce the greenhouse effect (p.16) by reducing CO₂ emissions (from burning, etc.), and allowing the trees to continue absorbing CO₂.
- 4) Some of the impacts of rainforest destruction, e.g. climate change, could affect all countries, not just the countries where deforestation is happening.
- 5) Rainforests also help regulate the climate and water cycle — without them the risks of drought and flooding in certain areas can increase.

Tropical Rainforests can be Sustainably Managed

Rainforests can be managed in a way that's sustainable, i.e. getting the resources we need today without damaging the environment so that resources aren't available in the future. Here's how:

Replanting

- 1) This is when new trees are planted to replace the ones that are cut down.
- 2) It's important that the types of trees replanted match those that were cut down.
- 3) In some countries there are laws to make logging companies replant trees when they clear a forested area.



Selective Logging

- 1) Only some trees (e.g. old ones) are felled — most trees remain.
- 2) This is less damaging to the forest than clearing a whole area. If only a few trees are taken from an area the overall forest structure is kept — the canopy remains and the soil isn't exposed. This allows the forest to regenerate.
- 3) The least damaging forms are 'horse logging' or removing them with helicopters instead of chainsaws.



EXAMPLE: Helicopter logging is used in Sarawak.

Ecotourism

- 1) Ecotourism minimises damage to the environment and benefits local people.
- 2) Only a small number of visitors are allowed into an area at a time and rules are imposed to minimise environmental impacts. E.g. waste and litter are disposed of properly to prevent the contamination of land and water supplies.
- 3) Ecotourism provides a source of income for local people, e.g. they can act as guides and provide accommodation or transport. It can also raise awareness of conservation issues and bring in more money to help protect rainforests.
- 4) If local people are employed in tourism, they don't have to log or farm to make money, meaning fewer trees are cut down. If a country's economy relies on ecotourism, there's an incentive to conserve the environment.

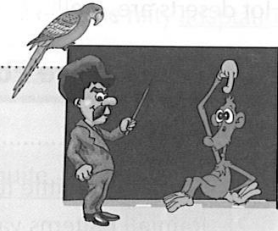
EXAMPLE: Ecotourism has been very successful in Costa Rica. It is the largest source of income for the country and has led to 21% of the country being protected from development.

Tropical Rainforests — Sustainable Management

A few more sustainable ways to manage rainforests...

Education

- 1) Educating the international community about the impacts of deforestation can encourage people to buy products from sustainable sources.
- 2) Local people might damage the forest (e.g. by logging illegally) to overcome their poverty, without realising the long-term effects of their actions.
- 3) Educating local people about the impacts of deforestation can help to reduce damage to rainforests.
- 4) Teaching local people about alternative ways to make money that don't damage the environment as much, means they won't be dependent on unsustainable options in order to make a living.



EXAMPLE: The Rainforest Alliance is teaching communities in Guatemala about sustainable livelihoods.

Conservation

- 1) Many countries have set up national parks and nature reserves within rainforests. In these areas damaging activities, e.g. logging, are restricted. However, a lack of funds can make it difficult to police the restrictions.
- 2) As a result, some countries have set up funds which overseas governments and businesses can invest in. The countries get the money in exchange for rainforest conservation.
- 3) The money can be used to enforce restrictions on damaging activities and to promote sustainable use of the rainforests.

EXAMPLE: In 2018, Norway paid \$70 million into Brazil's Amazon Fund to be used for conservation.

Reducing Debt

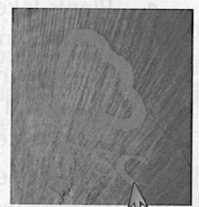
- 1) Many tropical rainforests are found in lower income countries, which often borrow money from wealthier countries or organisations (e.g. the World Bank).
- 2) This money must be paid back with interest, so poorer countries log, farm and mine in the rainforests to make money to pay back the debt.
- 3) Reducing debt means countries don't have to do this and the rainforests can be conserved.
- 4) Debt can be cancelled by countries or organisations, but there's no guarantee that the repayment money will be spent on conservation.
- 5) A better solution is a conservation swap, where part of a country's debt is paid off in exchange for a guarantee that the money will be spent on conservation.



EXAMPLE: In 2011, the USA reduced Indonesia's debt by \$29 million in exchange for conserving their rainforests.

International Hardwood Agreements

- 1) Hardwood is a general term for wood from certain tree species, e.g. mahogany or teak. The wood tends to be dense and hard, so it's often used to make furniture.
- 2) High demand for hardwood from consumers in richer countries means that some tropical hardwood trees are becoming increasingly rare as more are cut down.
- 3) There are international agreements in place to try to prevent illegal logging, and to promote the use of hardwood from sustainably managed forests.



EXAMPLE: The Forest Stewardship Council® (FSC®) mark sustainably-sourced timber with their logo so that consumers can choose products that don't contribute to unsustainable deforestation.

Sustainable management of revision — exam success now and forever...

Sustainability sounds complex but it's simple really — present needs shouldn't negatively impact future needs.

How can tropical rainforests be managed sustainably?

Task A:

Strategy	How the strategy works
1. Selective logging and replanting	
2. Conservation and education	
3. Ecotourism	

Challenge task: Describe and explain two benefits of international cooperation in sustainably managing tropical rainforests

2 (c) (iii) For a tropical rainforest you have studied, describe **one or more** strategies being used to reduce the rate of deforestation.

[4 marks]

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Extra space

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Lesson 9: Tropical Rainforest Mini Test

1. Use Figures 2a and 2b below to explain how plants adapt to climatic conditions in a tropical rainforest



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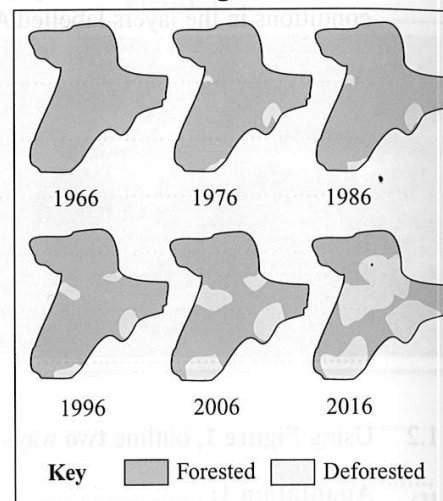
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Tropical Rainforests — Deforestation

- 1 Study **Figure 1**, a series of maps showing the extent of deforestation in an area of tropical rainforest between 1966 and 2016.

Figure 1



- 1.1 Using **Figure 1**, describe the changes to the rainforest between 1966 and 2016.

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[2]

- 1.2 Outline **two** possible causes of deforestation in the area shown in **Figure 1**.

Cause 1:

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Cause 2:

.....

[2]

- 1.3 Outline **one** positive economic impact of deforestation.

.....

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[1]

- 1.4 Outline **two** environmental impacts of deforestation.

Impact 1:

.....

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Impact 2:

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[4]

- 1.5 For a tropical rainforest that you have studied, assess the extent to which deforestation benefits the people who live there.

[9 + 3 SPaG]

[Total 21 marks]



Lesson 10 and 11:

34

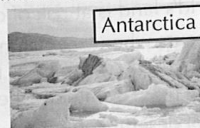
Cold Environments — Polar and Tundra

Woolly hats at the ready — it's time for a foray into the ice cold world of polar and tundra environments...

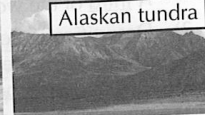
Polar and Tundra Environments are Found in Cold Climates

Climate

- 1) Polar areas are very cold, normally below freezing. Winters tend to drop to -40°C and can reach -90°C .
- 2) Tundra areas are also cold. Warm months only reach a maximum of 10°C , while winters can plunge to -50°C .
- 3) Precipitation is low — less than 100 mm a year in polar areas and less than 380 mm in tundra areas.
- 4) The seasons are well defined in both environments — cold summers and even colder winters.



Antarctica



Alaskan tundra

Soil

- 1) Ice sheets cover polar areas, so no soil is exposed.
- 2) Tundra soil is thin, acidic and not very fertile.
- 3) Beneath the thin soil is a layer of permafrost (frozen ground), holding trapped greenhouse gases.



© iStock.com / SeppFriedhuber

Plants

- 1) Polar areas have few plants — lichens and mosses grow on rocks, and grasses grow on the coast.
- 2) In tundra areas, hardy shrubs (e.g. bearberry), grasses, mosses and lichens are common. Small, short trees may grow in warmer areas.



Animals

- 1) There are relatively few species in these ecosystems.
- 2) Polar bears, penguins, whales and seals are found in polar areas.
- 3) Lemmings, wolves and reindeer live in tundra areas.



© Juniors Bildarchiv GmbH / Alamy Stock Photo



Lemming

People

- 1) Polar areas are mostly uninhabited, but the Arctic has some indigenous residents and a few scientists work in Antarctica.
- 2) Tundra areas are home to many indigenous people, as well as oil and gas workers in larger towns.



Cold Environments are Fragile, Interdependent Ecosystems

- 1) The biotic (living) components of cold environments (plants, animals, people) and the abiotic (non-living) components (climate, soils, permafrost) are closely related — many of them are dependent on each other.
 - The cold climate causes plants to grow slowly and to decompose slowly when they die, so plant cover is low. This means that the soil is relatively low in nutrients, further limiting plant growth.
 - Herbivores (e.g. reindeer) that rely on plants (e.g. mosses) to survive must migrate to areas where plants are able to grow. Carnivores (e.g. wolves) have to follow the herbivores.
 - In summer, when the tundra has greater plant cover, the surface plants absorb heat from the sun, preventing the permafrost below from thawing. The permafrost provides water for plants.
- 2) Changes to one component of the ecosystem can have knock-on effects on the whole ecosystem:

If humans trample lots of plants, the soil is exposed to sunlight and warms up. This may thaw the permafrost, saturating soil and preventing plant growth. With fewer plants to eat, animals will struggle to find enough food to survive. Melting permafrost also releases greenhouse gases, which contribute to global warming.

Cold, acidic and full of gas — permafrost sounds like my Uncle Tony...

ICY you there... reading this page. Don't forget to take plenty of breaks — revising is easier when you're chilled.

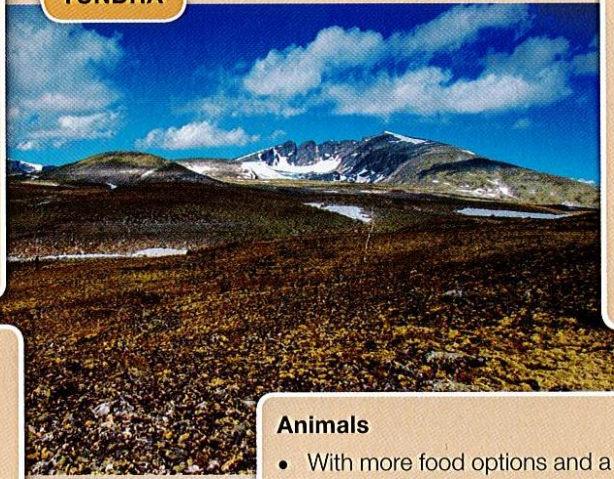
TUNDRA

Climate

- This climate is less extreme. Winter temperatures may drop to -20°C .
- The brief summers can be quite warm.
- Amounts of precipitation – mainly snow – can be high in coastal regions.

Plants

- Low-growing flowering plants such as bearberry, Arctic moss and tufted saxifrage.
- Low bushes and small trees may grow in warmer regions.



Soils

- Soils are frozen (**permafrost**) but in summer will melt closer to the surface.
- Soils are generally infertile. Water draining through soils removes nutrients.
- Soils become waterlogged because water is trapped by permafrost.

Animals

- With more food options and a less extreme climate, several animals live here, including the Arctic fox and Arctic hare.
- Birds such as ptarmigans and insects such as midges and mosquitoes are abundant in the summer.

Climate

- Winter temperatures often fall below -50°C
- These areas have low precipitation (snow) totals.

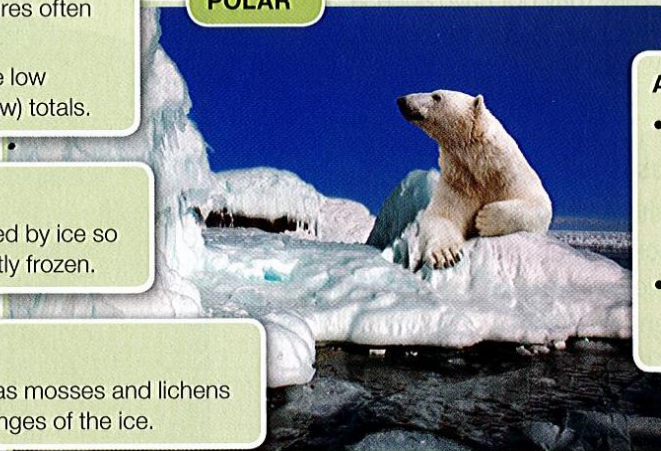
Soils

Permanently covered by ice so soils are permanently frozen.

Plants

Some plants such as mosses and lichens are found on the fringes of the ice.

POLAR



The location of the world's cold environments

Animals

- Polar bears are well adapted to the polar environment. To retain heat they have thick fur, an insulating layer of fat, with a black nose and foot pads to absorb sunshine.
- In the Antarctic, penguins lay their eggs on land and bring up their young before returning to the ocean.

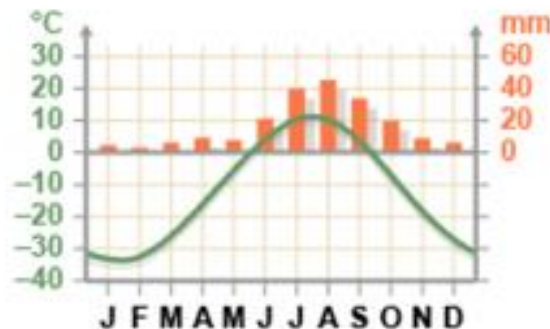
Characteristics of cold environments

L.O. Describe the characteristics of cold environments

Starter: what is a cold environment?



A The location of the world's cold environments



Key

- = temperature
- = rainfall

Task 1: Describe the location of the world's cold environments on the world map. You should use:

- names of countries/continents
- Directions of the compass

Challenge: Suggest reasons for the location of these cold environments (hint words: equator / mountains)

Task 2: Describe the climate (temperature and rainfall) of Alaska in the graph

Temperature:

In January, the temperature in Alaska is ____ °C. It then increases/decreases up to July, where the temperature reaches ____ °C. Between August and December it decreases very quickly/slowly, getting as low as ____ °C by the end of the year.

Rainfall:

Lowest month of rainfall: _____ How many mm? _____

Highest month of rainfall: _____ How many mm? _____

Challenge: Describe the pattern trend of rainfall in Alaska between January and December. Write it in a way similar to how we described the temperature.

Wednesday, 25th April 2018

Task 3: Read through the information about the tundra cold environment below. Use the information to answer the following questions:

Climate

- This climate is less extreme. Winter temperatures may drop to -50°C.
- The brief summer can be quite warm.
- Amounts of precipitation: mainly snow - more in high in coastal regions.

Plants

- Low-growing flowering plants such as heather, Arctic poppy and Arctic willow.
- Low bushes and small trees may grow in warmer regions.

TUNDRA

Soils

- Soils are frozen (permafrost) just below the surface and that closer to the surface.
- Soils are generally acidic. Water draining through soils becomes nutrient-rich.
- Soils become waterlogged because water is trapped by permafrost.

Animals

- Most many food chains are less extreme climate, some warm forests, including the Arctic fox and Arctic hare.
- Grass such as clover and insects such as moths and mosquitoes are abundant in the summer.

a) What is permafrost?

b) What happens to the summer in the summer, and why does it happen?

c) What range of wildlife live in tundra cold environments?

Challenge: Suggest how animals such as the arctic fox (below) have **adapted** to be able to survive in cold environments



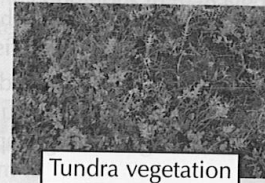
Cold Environments — Adaptations

Cold environments are pretty tricky to survive in — even well-equipped polar explorers can get it wrong. Plants and animals have some nifty tricks to survive, which you can read about from your nice warm chair...

The Plants and Animals have Adapted to the Cold, Dry Climate

Plants in tundra environments have adapted to survive the extreme cold and strong winds. They must also endure the dry winter conditions when all moisture is frozen, and wet summer conditions when the top layer of soil thaws and the ground becomes boggy and waterlogged.

- 1) Most plants become dormant (inactive) to survive the cold, dark winters.
- 2) Plants are low-growing and round-shaped to provide protection from the wind.
- 3) Most plants have shallow roots because of the layer of permafrost beneath the soil layer.
- 4) Leaves are generally small to limit the amount of moisture lost through transpiration.
- 5) The warmer, wetter summer is very short, so most plants have adapted to have a growing season of just 50-60 days.
- 6) Many plants reproduce using underground runners or bulbs to cope with the cold and because the growing season is short.

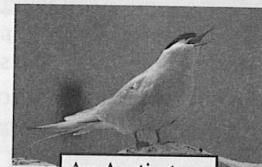


Tundra vegetation



Animals in cold environments have also adapted to the cold, dry, snowy conditions:

- 1) Animals in cold environments tend to be well-insulated — they might have thick fur like polar bears or a layer of blubber like seals. This reduces the amount of energy they have to use to keep warm.
- 2) Some animals hibernate to conserve energy and survive the winter, e.g. Arctic ground squirrels hibernate for 7-8 months of the year and can survive even if their body temperature drops below freezing.
- 3) Animals that don't hibernate have adapted to survive on the limited food sources available, e.g. reindeer eat lichens during the winter.
- 4) Many birds migrate to warmer areas for the winter, e.g. Arctic terns live in the Arctic during the northern hemisphere summer, then fly to the Antarctic for the southern hemisphere summer.
- 5) Many animals grow white winter coats for camouflage — this helps predators to sneak up on their prey, and helps prey to hide in the snow, e.g. some weasels (also called ermine), Arctic foxes and Arctic hares.



An Arctic tern



An Arctic hare, camouflaged (and cute)

Cold Environments have Low Biodiversity

- 1) Cold environments have very low biodiversity (particularly Antarctica) — there are fewer species of plants and animals in cold environments than most other environments.
- 2) Low biodiversity means when the population of one species changes it can affect the population of dependent species — e.g. changes to the lemming population will affect the populations of their predators, e.g. Arctic foxes.
- 3) Global warming is causing some species to move towards the poles, where it is colder, in response to temperature rises in their natural habitat. Species already adapted to polar environments can't go anywhere colder, so are at risk of decline or extinction if climate change causes the polar areas to warm up too much.



Now I'm in my thirties, I'm finding more Arctic hairs every day...

I know it's tempting to hibernate until your exams are over, but a cooler idea (not sorry) is to do a smashing job of learning how plants and animals adapt to their conditions, and why biodiversity is low in cold environments.

Using the information on the previous page: Complete the below table:

Plant adaptations	Animal Adaptations

Describe and Explain how plants and animals have adapted to a cold environment (6 Marks)

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Lesson 14:

Alaska: opportunities

1. Resources



Over 50% of Alaska's income comes from oil and gas.

(e.g. Prudhoe Bay oilfield – 100,000 jobs and \$14 billion contribution to economy each year)

Alaska: opportunities

2. Minerals

Gold, iron silver and other minerals contributed over \$2.2 billion to Alaska's economy in 2013



Alaska: opportunities



3. Tourism

2 million tourists visit Alaska each year

Alaska: opportunities

4. Fishing

Employment for 79,000 people.
Contributes to \$5 billion of Alaska's economy each year



1) Define the term social impact

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2) Define the term economic impact

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3) Explain the social and economic opportunities of living in a cold environment that you have studied (6 marks)

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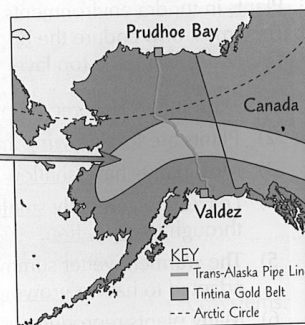
Cold Environments — Alaska

Alaska is one example of a cold environment where the extreme climate creates challenges to development.

There are Development Opportunities in Alaska...

Alaska is a cold environment that's part of the USA. Northern Alaska is inside the Arctic circle. Opportunities for economic development include:

- 1) Energy — over half Alaska's income comes from the oil and gas industry. Most oil fields are around Prudhoe Bay, which is linked to Valdez by the Trans-Alaska oil pipeline so that oil can be shipped to customers.
- 2) Mineral resources — materials such as gold, silver, iron ore and copper are all mined in Alaska, particularly in the Tintina gold belt. In 2015, \$154 million worth of gold was exported from Alaska.
- 3) Fishing — In 2016, Alaska's fishing industry had a value of \$1.7 billion and employed almost 30 000 fishermen (e.g. of salmon, cod and crab).
- 4) Tourism — tourists are attracted by Alaska's scenic wilderness areas. Each year, around 2 million tourists visit Alaska, bringing in almost \$2.5 billion and generating employment for about 39 000 people.

**...but there are also Challenges to Development**

- 1) Alaska's state population is one of the smallest in the US, despite being the largest state by area. Most people live on the state's southern and south-eastern coastline where it is warmer and less remote.
- 2) It's difficult to access resources and find a workforce in Alaska because of the extreme conditions, remote location and poor infrastructure. These factors make development very challenging:

Extreme Temperature

- 1) It's really cold — Prudhoe Bay's mean annual temperature is about -9 °C and extreme weather, such as snow and strong winds, is common. Exposure to extreme cold makes working outside dangerous, so opportunities for development are limited.
- 2) Daylight hours vary a lot — Barrow, north Alaska, is in darkness for up to 67 days in the winter, but in the summer it might see 80 warmer days of uninterrupted sunlight.

**Inaccessibility**

- 1) Alaska is a long way from the rest of the US. Some areas are extremely remote, and the mountainous terrain makes access difficult and expensive, limiting development.
- 2) In winter, the only way to get to some towns is via expensive air travel or dangerous ice roads. In summer, there are no roads to some towns because the ground is too soft.
- 3) The population of Alaska is small and scattered — people in small towns may be a long way from employment opportunities or services.

Buildings and Infrastructure

- 1) Providing buildings and infrastructure to cope with either soft or frozen ground and extreme weather is difficult and expensive.
- 2) Most construction work can only take place in summer, when the days are longer and temperatures are warmer.
- 3) The value of some resources means that people find ways to overcome the challenges, e.g. some parts of the Trans-Alaska oil pipeline are raised on stilts to prevent it melting the permafrost, which would make the ground unstable.

I tried a gold belt once — not my best look...

Cold environments can be challenging — it's what you get when you combine a beautiful, frozen wilderness with some jolly useful development opportunities. Now get learning. Examiners might ask you about this...

Challenges and risks

Temperatures in Alaska can reach as low as ____°C in the winter months, making it difficult to travel across parts of the state. This is a challenge, because _____

They can also therefore only complete construction work in the summer months. The low temperatures also mean that there is a risk that buildings might melt the _____ that lies underneath them, leading to subsidence.

Furthermore, the growth in oil drilling increases the risk of oil spills, such as the _____ oil spill of 1989, where ____ million gallons of oil spilled in to the ocean. This led to a range of environmental problems, such as _____

Increasing oil drilling might also have a knock-on effect on the tourism and fishing industries, because _____

Exam Question:

Describe and explain the opportunities and challenges found in a cold environment you have studied (6 Marks)

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Cold Environments — Sustainable Management

Cold environments are fragile areas that need to be sustainably managed to protect them from damage.

Cold Environments are Valuable Wilderness Areas Worth Conserving

Large parts of cold environments are wilderness areas — wild, natural environments that are mostly undeveloped, uninhabited and undisturbed, e.g. Denali Park, Alaska.

It is important to conserve wilderness areas in cold environments because:

- 1) They provide habitats for organisms that couldn't survive elsewhere.
- 2) Scientists can study natural environments including landforms, plants and animals that are relatively unaffected by people — this provides valuable knowledge about fragile ecosystems.
- 3) Studying natural ecosystems may help scientists to replicate the same conditions in managed ecosystems. This can help preserve rare species outside the protected areas.



Cold Environments are Fragile and Take a Long Time to Recover

Cold environments are extremely fragile — it can take centuries for them to return to their original state after human interference. This is because:

- 1) Plant growth is slow — if plants are damaged (e.g. by vehicle tyres), regrowth takes time.
- 2) Species are highly specialised, so find it difficult to adapt to change. E.g. polar bears are adapted to hunt on ice — their numbers are decreasing as sea ice melts earlier each year.



Strategies are Needed to Balance Economic Development with Conservation

International Agreements

- 1) Some cold environments are protected by international agreements, e.g. Antarctica.
- 2) The 1959 Antarctic Treaty, signed by 12 nations, limits visitors to 100 per site, ensures peaceful non-military activities, prohibits nuclear activities and prevents cruise ships with over 500 passengers from stopping.
- 3) This allows tourism, but in a controlled way that won't harm the fragile ecosystem.

Using Technology

- 1) Development can cause problems. E.g. heated buildings can melt permafrost, leading to subsidence which may cause buildings to collapse and pipes to crack.
- 2) However, modern construction methods can minimise environmental impacts, e.g. by building on gravel beds to prevent buildings warming the ground.

The Role of Governments

- 1) Unregulated development can damage the environment, e.g. mining can pollute water and oil pipelines can disrupt animal migration.
- 2) Governments can pass laws, such as the 1964 Wilderness Act, to protect designated wilderness areas (e.g. much of Alaska) from development. This means that development has to take place elsewhere, reducing conflict over land use in wilderness areas.

Conservation Groups

- 1) Conservation groups, e.g. Greenpeace and the WWF, pressure governments to protect cold environments.
- 2) This can lead to more sustainable development that doesn't damage at-risk areas.



EXAM QUESTION

No space for ice cream — a worrying development in my freezer...

Here's a lovely question to help you on your way to the next page:

- 1) Suggest one way that cold environments can be developed with conservation in mind. [2]

Why are cold environments fragile?

L/O: explain how human activity can damage cold environments

DO NOW: explain what damage has been caused in this image

What do you think caused this damage?



Task 2: Read the newspaper article below:

Cold environments have rich reserves of oil, gas and other precious minerals such as gold. Oil and gas in particular are in high demand as a source of energy and countries are keen to exploit their resources for the economic benefits. To extract these resources, roads have to be constructed through forests and across the tundra and supply bases built. Housing for hundreds of workers also needs to be constructed. All this can have a huge impact on the environment.



Q: Explain why the demand for natural resources is the reason for cold environments like Alaska being damaged

Task 1: Study the image below – it shows an oil spill in Siberia, Russia. Siberia is a cold environment.



Q: Identify and explain three ways in which the oil spill has damaged this environment

Challenge: Oil is an important source of income for Alaska, and the industry provides many people with jobs. Suggest what could be done to stop oil spills from happening in Alaska, but at the same time keep people in jobs.

Task 4: Exxon-Valdez Oil Spill, 1989



While watching the following video explain what happened during the Exxon-Valdez Oil Spill in the space below

<https://www.youtube.com/watch?v=A7hfQ8mTVrU>

Exxon-Valdez Oil Spill – writing task

Recap – Opportunities vs Challenges

Categorise the following statements into the following:

- Opportunities facing cold environments
- Challenges facing cold environments

Mineral extraction – supports the economy and provides employment.	Richest fishing grounds in the world	Mineral extraction – potential pollution to nearby water sources
Construction of buildings to support economic development – destruction to local habitats.	Restricted accessibility	Energy development – geothermal energy
Construction of roads – damage to cold environment.	Extreme temperatures	Tourism – employment and supports the economy and

ALL: Identify how cold environments can be managed

MOST: Explain different strategies to reduce the risks to cold environments

SOME: Justify why cold environments should be protected as wilderness areas.

Exam Q: Using a case study, explain how different strategies can help reduce environmental damage in cold environments? (9marks)

Sentence starters:

*One way people can protect cold environments is by **international agreements**. This is where.....*

A second way of protecting cold environments is _____. This works by

A third way.....

*In conclusion, I think the **most successful** way of protecting cold environments is by _____, because...*

ALL: Identify how cold environments can be managed

MOST: Explain different strategies to reduce the risks to cold environments

SOME: Justify why cold environments should be protected as wilderness areas.



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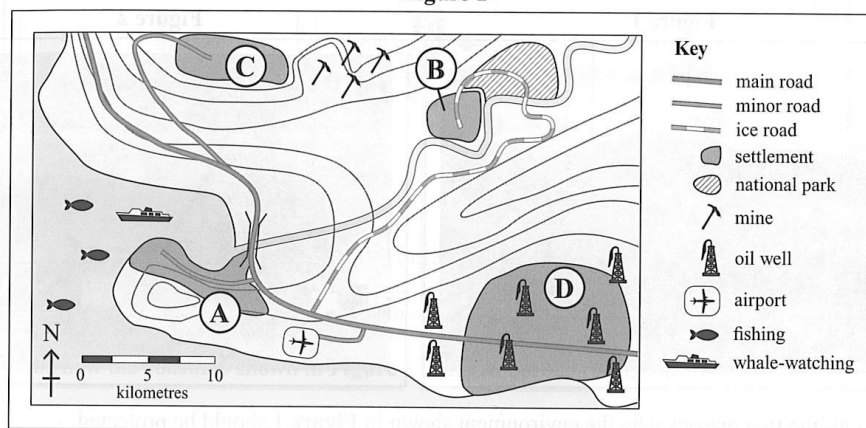
Lesson 19: Cold Environments mini assessment

31

Development in Cold Environments

- 1 Study **Figure 1**, a map of a cold environment.

Figure 1



- 1.1 Using **Figure 1**, describe the economic opportunities at location A.

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[3]

- 1.2 Using evidence from **Figure 1**, outline **one** challenge to the economic development of location B.

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[2]

- 1.3 Using **Figure 1**, describe and explain the extent of settlement at location C compared to location D.

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[4]

- 1.4 For a named cold environment, discuss the opportunities and challenges for development.

[9 + 3 SPaG]

[Total 21 marks]

☹️ ☐ ☺️ ☐ ☺️ ☐

Unit 1B — Cold Environments

Cold Environments — Biodiversity

- 1 Study **Figure 1**, a photograph of an Arctic fox, and **Figure 2**, a photograph of Arctic poppies.

Figure 1



Figure 2



- 1.1 Outline **one** way in which the Arctic fox shown in **Figure 1** is adapted to its habitat.

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- 1.2 Outline **two** ways in which the Arctic poppy plant shown in **Figure 2** is adapted to its habitat.

Adaptation 1:

.....

Adaptation 2:

.....

- 1.3 Which of the statements below is true? Shade **one** oval only.

- A Tundra ecosystems tend to have more plant species than tropical rainforests. ☐
- B Biodiversity is low in cold environments compared to most other environments. ☐
- C Biodiversity is higher in the Antarctic than in the Arctic. ☐
- D Biodiversity is lower in deciduous forests than in polar environments. ☐

- 1.4 Suggest how a warming climate could affect the Arctic fox shown in **Figure 1**.

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[Total 7 marks]



Unit 1C — The UK Physical Landscape

39

The UK Physical Landscape

Ah, the UK landscape. Majestic mountains, cracking coasts and raging rivers — I could go on all day...

The UK has large Upland and Lowland Areas, and Important Rivers

- 1) The UK's main upland areas (orange and red on the map below) tend to be in the north and west of the country. These areas (e.g. the Scottish Highlands and northern Wales) are formed of hard, igneous (e.g. granite) and metamorphic (e.g. slate and schist) rocks that are resistant to erosion.
- 2) The UK's main lowland areas (green on the map) to the south and east, are formed of softer, sedimentary rocks (e.g. chalk and clays) that erode more easily.
- 3) Most cities are in lowland areas and often on the UK's main rivers — such as London (on the Thames), Liverpool (on the Mersey) and Cardiff (on the Severn Estuary).

River Clyde Lower Valley

The River Clyde (see p.55) has a wide lower valley and flood plain. The city of Glasgow is situated on the flat ground of the Clyde's flood plain.

Lake District

A national park that is very popular with tourists (see p.66), the Lake District is an upland area that has lots of glacial features.

Snowdonia

Snowdonia is a glaciated upland area formed from rock from an extinct volcano. It contains steep mountains, such as Snowdon, and glaciated valleys (see p.64).



Grampian Mountains

Part of the Highlands and home to Ben Nevis (the highest mountain in the UK), the Grampians are steep, rocky and sparsely populated.



Holderness Coast

The Holderness Coast is made mainly of soft boulder clay. The cliffs are eroding quickly, which allows landforms such as the Spurn Head spit to form.

Dorset Coast

There are bands of hard and soft rock in the Dorset coast, which lead to landforms such as stacks, arches and spits (see p.45).

The Fens

The Fens are a marshy, flat, low-lying area. They used to be larger, but a lot of land has been drained for farming.



I think you'll find the UK physical portrait is much easier to fit on a page...

This is a lovely little introduction to the rest of the UK physical landscapes section. You can actually revise it by looking through your holiday snaps or out the window on a long journey. Or by gazing at a lovely map...

1. Read through the statements and decide if they are activities for upland or lowland areas.

Upland	Lowland

Hillwalking	Skiing and Adventure Sports	Sheep Farming
Wind Farms	Hydro-electric power (HEP)	Water Recreation
Settlement	Crop Farming	Dairy Farming

2. Why does the land use in upland and lowlands differ?

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3. Explain two reasons how the land is used in upland areas. (4 Marks)

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Lesson 21: Types of Waves

Waves can be Destructive or Constructive

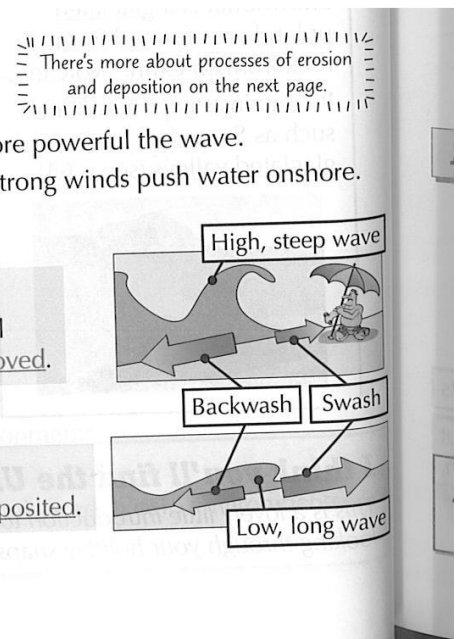
- 1) When wind blows over the surface of the sea, it creates waves. The greater the fetch (the distance the wind blows over the sea), the more powerful the wave.
- 2) Storms can create storm surges — temporary sea level rises caused as strong winds push water onshore.

Some waves erode the coast — these are called destructive waves:

- They have a high frequency, and are high and steep.
- Their backwash (water moving down the beach) is more powerful than their swash (water moving up the beach), so material is removed.

Some waves deposit material — these are called constructive waves:

- Constructive waves have a low frequency, and are low and long.
- Their swash is more powerful than the backwash, so material is deposited.



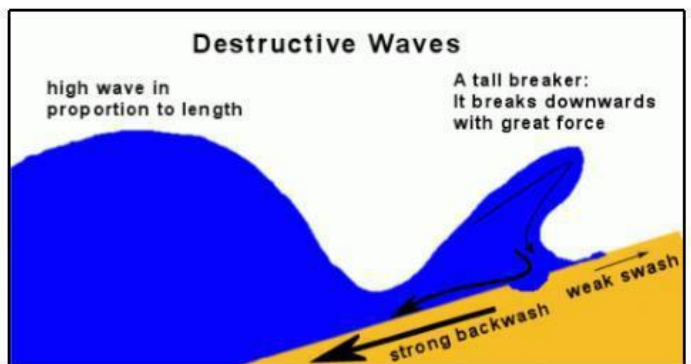
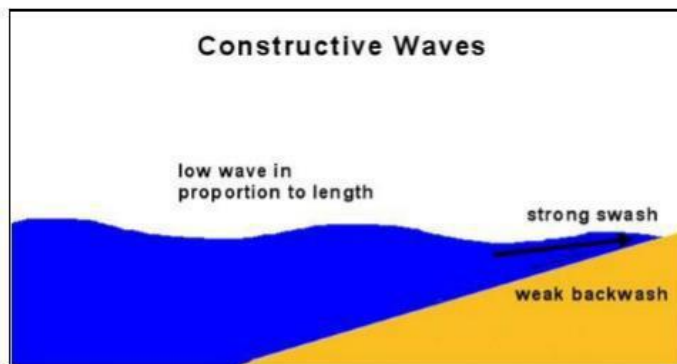
Unit 1C — Coastal Landscapes in the UK

Coastal landscapes in the UK

Key idea: The coast is shaped by a number of physical processes.

Study the diagrams of waves types.

3. Define 'swash'.



Waves and Coastal Changes

Waves form through the transfer of e_____. The wind, blowing over the surface of the sea, creates f_____ between the two, and the water begins to move in a c_____ orbit (because of the spinning of the Earth combined with the friction between the ocean and the atmosphere).

The amount of energy gained by a wave, and its size, are determined by three factors:

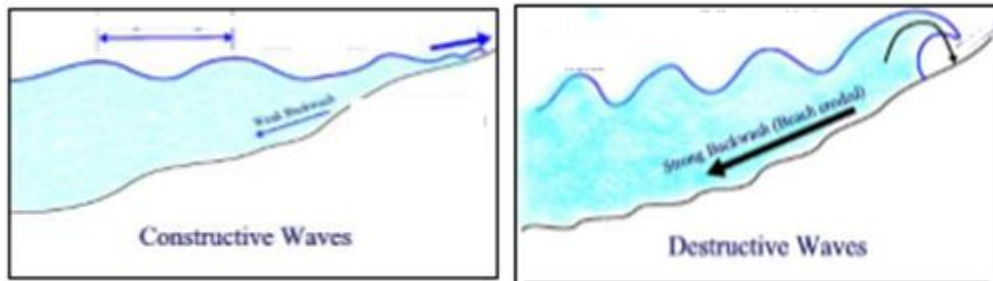
- 1.
- 2.
- 3.

When a wave reaches shore, it loses some of its energy. The wave gaining energy and height moves quickly towards the shore as s_____. When it hits the coast and loses energy, it moves back at a lower height as b_____.

C_____ waves are low with little energy. The swash from such waves pushes material _____ the coastline from the sea and makes the beach longer/wider.

D_____ waves are taller and stronger, and rip material _____ from the beach when they crash into the land. They cause coastal e_____.

Types of wave

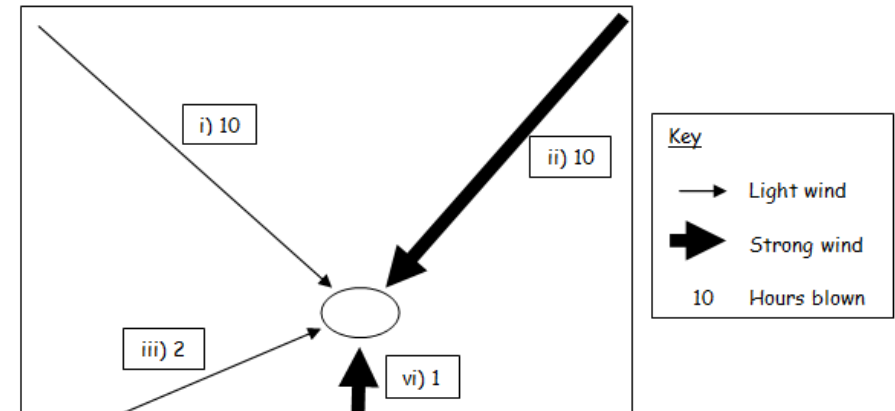


What controls waves?

1. Name four factors which affect waves:

1.	3.
2.	4.

2. Order the letters from the strongest waves to the weakest waves.



- a. Letter _____ has the strongest waves.
- b. Letter _____ has the next strongest waves.
- c. Letter _____ has the second weakest waves.
- d. Letter _____ has the weakest waves.

3. How do you know which letter has the **strongest** waves?

4. How do you know which letter has the **weakest** waves?

Lesson 22:

Weathering is the breakdown of rocks in situ (where they are), and erosion is when rocks are broken down and carried away by something, e.g. by seawater. Poor coastal zone, I bet it's worn down.

Rock is Broken Down by Mechanical and Chemical Weathering

- 1) Mechanical weathering is the breakdown of rock without changing its chemical composition. One type of mechanical weathering that affects coasts is freeze-thaw weathering:
 - 1) It happens when the temperature alternates above and below 0 °C (the freezing point of water).
 - 2) Water enters rock that has cracks, e.g. granite.
 - 3) When the water freezes it expands, which puts pressure on the rock.
 - 4) When the water thaws it contracts, which releases the pressure on the rock.
 - 5) Repeated freezing and thawing widens the cracks and causes the rock to break up.
- 2) Chemical weathering is the breakdown of rock by changing its chemical composition. Carbonation weathering is a type of chemical weathering that happens in warm and wet conditions:
 - 1) Rainwater has carbon dioxide dissolved in it, which makes it a weak carbonic acid.
 - 2) Carbonic acid reacts with rock that contains calcium carbonate, e.g. carboniferous limestone, so the rocks are dissolved by the rainwater.

Explain how freeze-thaw weathering can cause coastal cliffs to break up.

Q1. Would the rate of freeze-thaw weathering be greater on the coast of Scotland or the coast of Spain? Why?

In the boxes provided, draw **labelled diagrams** to show how the processes of **hydraulic power**, **abrasion** and **attrition** erode rock.

41

Coastal Processes

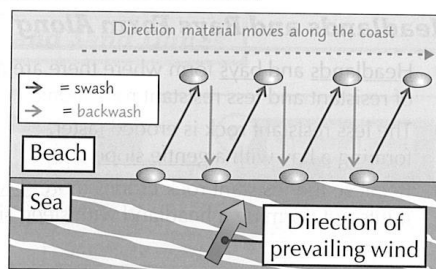
Waves Wear Away the Coast Using Three Processes of Erosion

Erosion occurs when waves hit the shore:

- 1) Hydraulic power — waves crash against rock and compress the air in the cracks. This puts pressure on the rock. Repeated compression widens the cracks and causes bits of rock to break off.
- 2) Abrasion — eroded particles in the water scrape and rub against rock, removing small pieces.
- 3) Attrition — eroded particles in the water collide, break into smaller pieces and become more rounded.

Material is Transported Along the Coast by Longshore Drift

- 1) Waves follow the direction of the prevailing (most common) wind.
- 2) They usually hit the coast at an oblique angle (any angle that isn't a right angle).
- 3) The swash carries material up the beach, in the same direction as the waves.
- 4) The backwash then carries material down the beach at right angles, back towards the sea.
- 5) Over time, material zigzags along the coast.



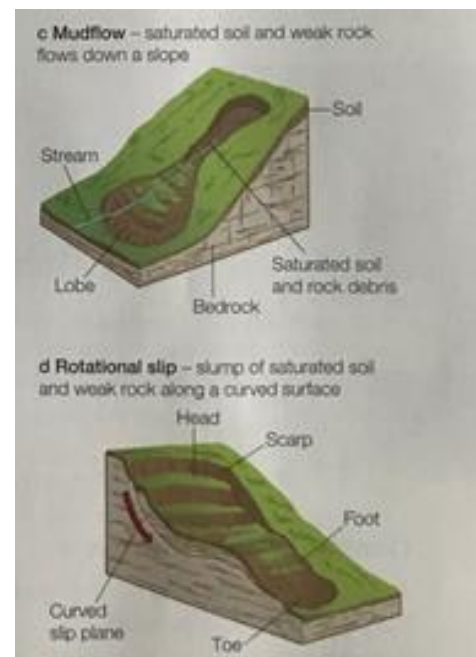
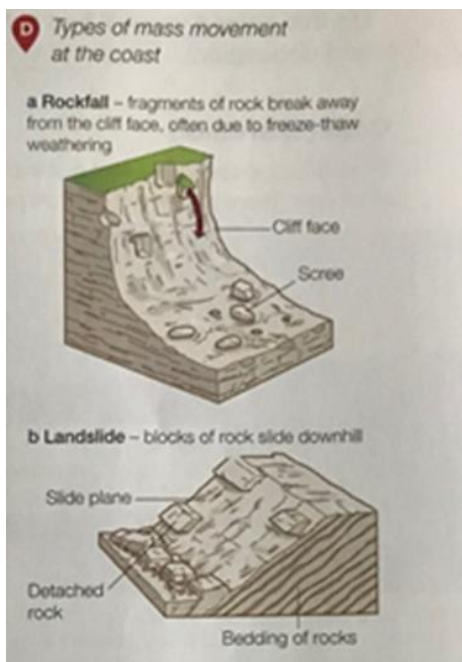
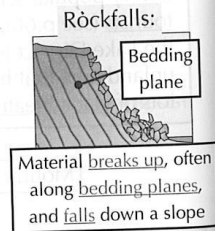
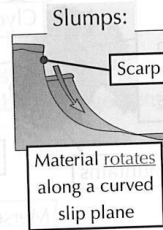
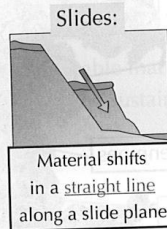
Abrasion	Attrition	Hydraulic action

Q: Explain how the rate of erosion would be different depending on the type of rock

Lesson 23: Mass Movement

Mass Movement is when Material Falls Down a Slope

- 1) Mass movement is the shifting of rocks and loose material down a slope, e.g. a cliff. It happens when the force of gravity acting on a slope is greater than the force supporting it.
- 2) It causes coasts to retreat rapidly.
- 3) It's more likely to happen when the material is full of water — water acts as a lubricant, and makes the material heavier.
- 4) When material shifts, it can create a scarp (a steep 'cut' in the side of the slope).



Produce a labelled diagram of the 4 types of mass movement

Rockfall	Landslide
Mudflow	Rotational Slip

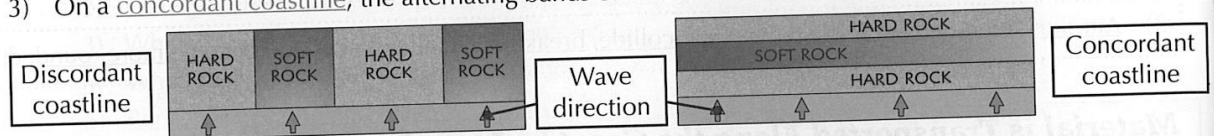
The photograph below shows cliffs in North Yorkshire, which suffered mass movement in 1993. Explain what causes mass movement to occur.



Lesson 24: Formation of Headlands and Bays

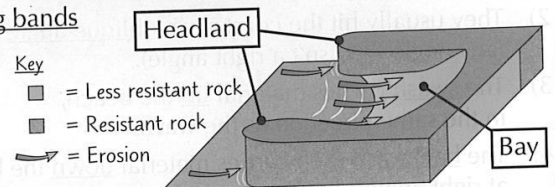
Coastlines can be Concordant or Discordant

- 1) Rock type and geological structure influence the erosional landforms that develop on a coastline:
 - Hard rocks like granite take a long time to erode, while softer rocks like sandstone erode more quickly.
 - Rocks with lots of joints and faults (cracks and weaknesses in the rock) erode faster.
- 2) Discordant coastlines are made up of alternating bands of hard and soft rock at right angles to the coast.
- 3) On a concordant coastline, the alternating bands of hard and soft rock are parallel to the coast.



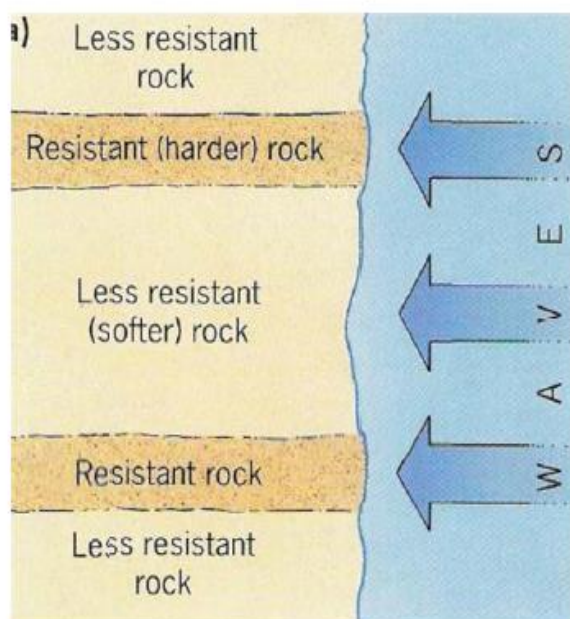
Headlands and Bays Form Along Discordant Coastlines

- 1) Headlands and bays form where there are alternating bands of resistant and less resistant rock along a coast.
- 2) The less resistant rock is eroded faster, forming a bay with a gentle slope.
- 3) Because the resistant rock erodes more slowly, it juts out, forming a headland with steep sides.

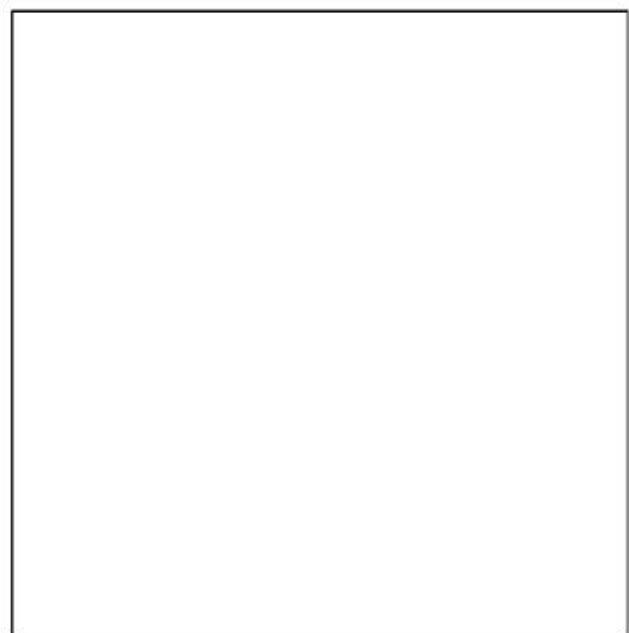


Draw a labelled sketch diagram of the coastline 500 years from now showing the impact of coastal erosion

Stage 1 -



Stage 2 -



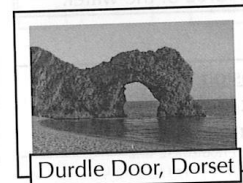
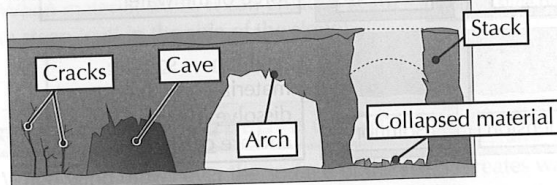
Activity 4: Explain the formation of headlands and bays (5 marks)

[illegible]

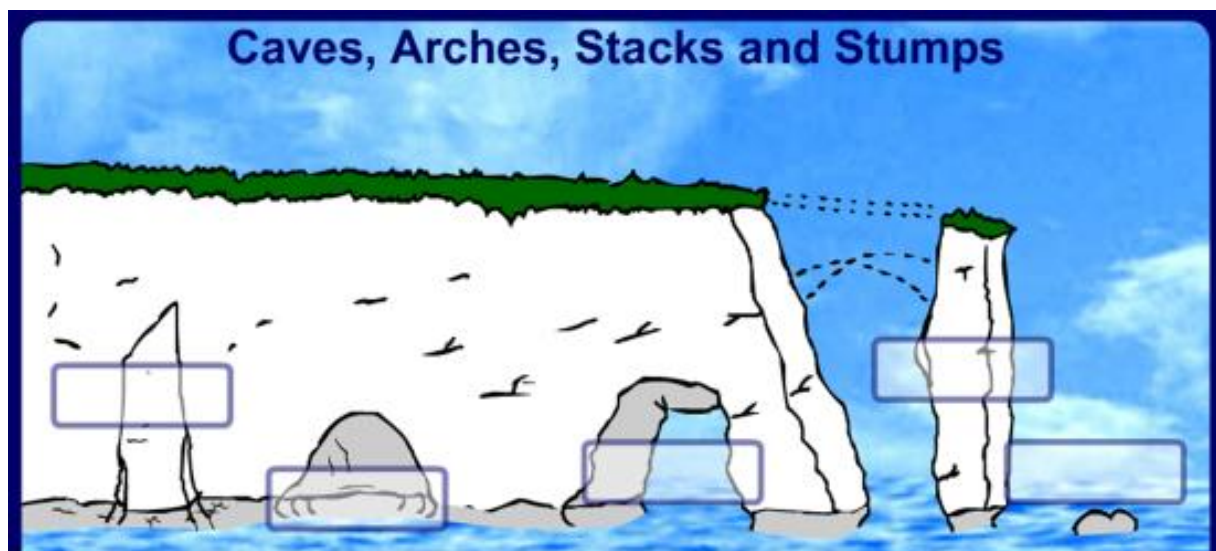
Lesson 25: Caves, Arches, stacks and stumps

Headlands are Eroded to form Caves, Arches and Stacks

- 1) The resistant rock that makes up headlands often has weaknesses like cracks.
- 2) Waves crash into the headlands and enlarge the cracks (mainly by hydraulic power and abrasion).
- 3) Repeated erosion and enlargement of the cracks causes a cave to form.
- 4) Continued erosion deepens the cave until it breaks through the headland to form an arch, e.g. Durdle Door.
- 5) Erosion continues to wear away the rock supporting the arch, until it eventually collapses.
- 6) This forms a stack — an isolated rock that's separate from the headland, e.g. Old Harry in Dorset.



Caves, arches, stacks and stumps



Task 1: Label the four features correctly on the diagram (left). One has already been done for you.

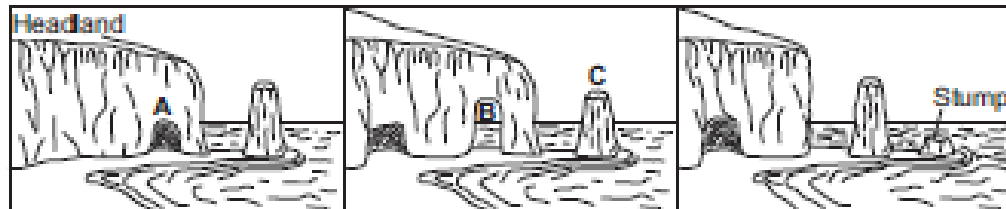
Task 2a: Explain how a cave turns in to an arch:

Task 2b: Explain how an arch will eventually become a stack

Task 3: How does hydraulic action cause the coastline to slowly erode?

- 1 (e) Study Figure 4. Figure 4 shows a headland which has been affected by weathering and erosion.

Figure 4



Explain how the features A, B and C, in Figure 4, were formed.

[6 marks]

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Extra space

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The formation of wave-cut platforms

A - Destructive waves hit the rock face between the high and low water marks.

B - Waves undercut the rock face forming a wave-cut notch. Rock overhangs the notch.

C - After constant attack by destructive waves, the overhanging rock collapses forming a wave-cut platform.

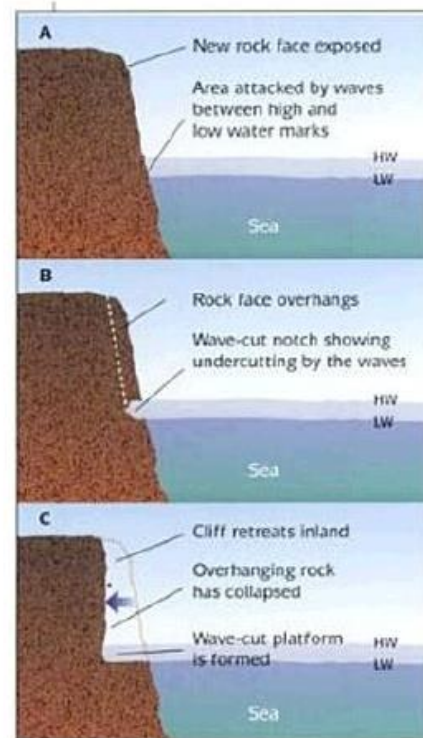
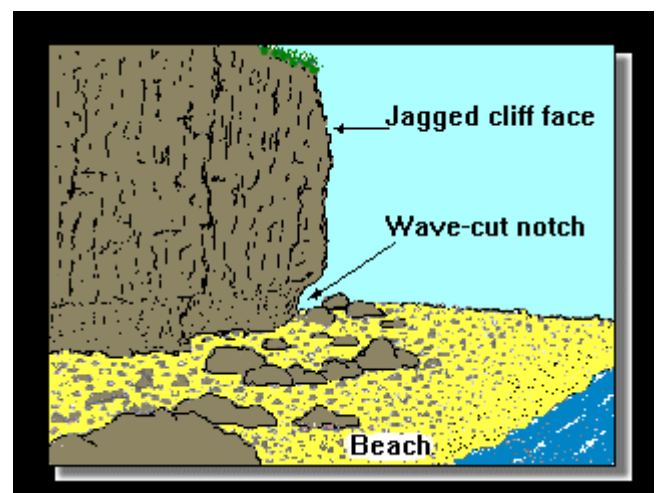


Figure 2 Formation of cliff and wave-cut platform.

Task 1: complete the step-by-step sequence for the formation of a wave-cut platform

A sequence of five empty boxes for a step-by-step sequence, followed by a large right-pointing arrow.

Challenge 1a: Look back to lesson () Suggest and explain which process (or processes) of weathering are likely to weaken the top of the cliff. Explain your choices. You can also annotate the diagram below to show what would happen.



Exam Question Practice:

- 1) Explain the process of chemical weathering (2 Marks)

- 2) Explain how an Arch can be formed (2 Marks)

- 3) Explain the formation of a wave-cut platform (4 Marks)
