Year 9 Geography

Name:

Hot Deserts

Extreme Environment

Brooke Weston Trust Geography

Learn to change the World

Useful websites

- BBC Bitesize: https://www.bbc.co.uk/bitesize
- Cool Geography: http://www.coolgeography.co.uk/
- National Geographic: https://www.natgeokids.com/uk/category/kids-club/

Part 1: Where are Hot Deserts located?

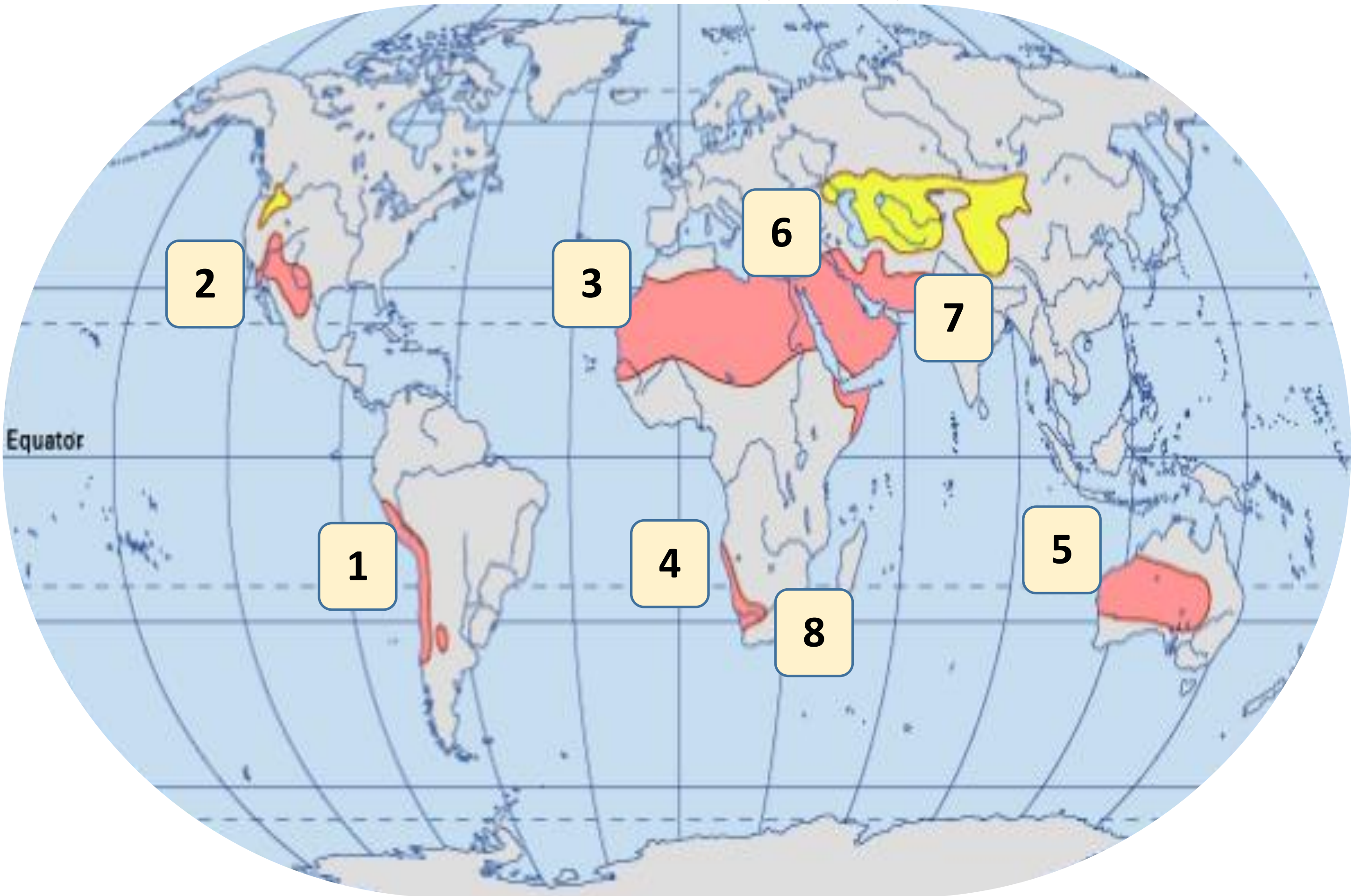
Where are the hot deserts of the world located?

Why are hot deserts so hot?

There are many areas around the world which are classed as deserts. A desert is an area that receives less than 250 mm of rainfall per year. Did you know that Antarctica is the largest desert on Earth? The hot deserts of the world are located between 15° and 30° of latitude north and south of the Equator. This is a zone of sinking air known as an area of high pressure. Air that rose due to the intense heat at the equator flows north and south. When it reaches 15° to 30° of latitude it begins to sink, because it has lost so much of its heat. This sinking air creates a zone of high pressure. As the air is sinking, no clouds can form and a lack of clouds means these areas are very dry.

Task

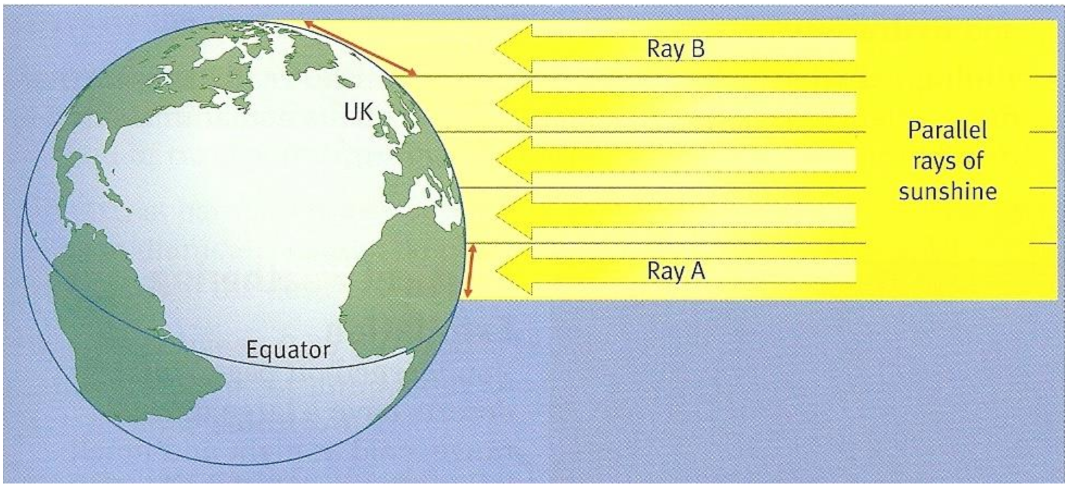
Below is a map of the world's hot deserts, the areas in red. Match the name of the desert to the correct number in the table below. The Arabian Desert has been completed for you.



Name	Number	Name	Number
Sahara		Arabian	6
Gibson, Simpson and Great Victoria		Atacama	
Kalahari		Namib	
Thar		Great Basin, Mojave and Sonoran	

Why are these deserts so hot?

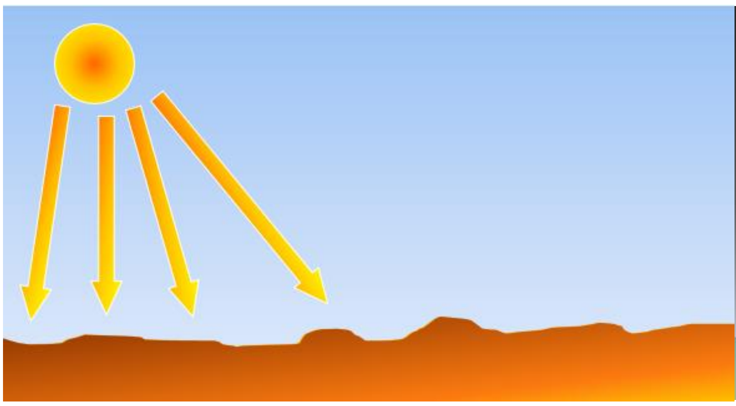
It is mainly caused by the concentration of energy from the sun. Look at the diagram which shows parallel rays of sunshine. Ray B is striking the Earth near the UK. Ray A is striking the Earth where hot deserts are located. Ray A has to heat a small area of the ground and so the heat is very concentrated. Due to the way the Earth is curved, Ray B has to heat a larger area and so the heat is much more dispersed and not as intense. In addition, Ray B travels through more atmosphere and is reflected by more dust; therefore it is not as strong on arrival.

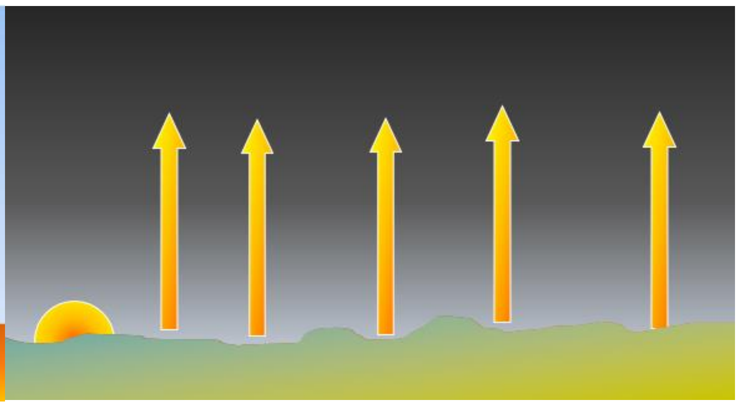


Diurnal range in hot deserts

The diurnal range (the difference in temperature from the highs of the day to the cools of the night) of temperature in deserts is much greater than the annual one (the difference between average summer and winter temperatures). In the Atacama Desert, the day is 25°C hotter than the night. Why is this the case? We know that due to sinking air there are hardly any clouds in the desert. Clouds can reflect up to 80 per cent of sunlight. Without clouds, the ground gets very hot during the day. At night, however, this heat is lost rapidly because there are no clouds to trap the heat in. This results in a large diurnal range and sometimes produces frost at night.

<u>Task</u> – annotate the diagrams below to explain why hot deserts are hot during the daytime and much colder during the night. Remember to include information about the concentration of the sun's energy.



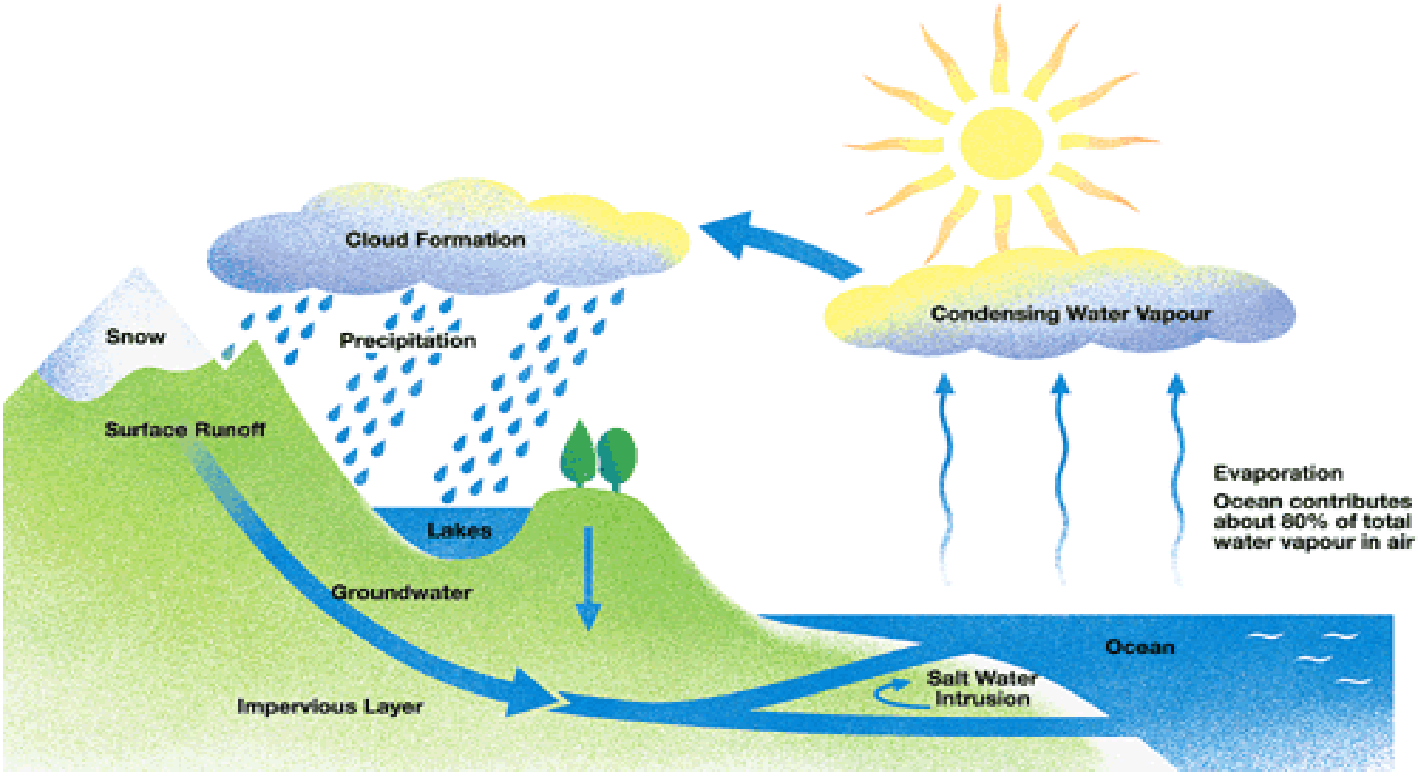


Part 2: Why do hot deserts receive very little rainfall?

Why are hot deserts very arid?

In order to understand the climate of deserts we need to understand why they get very little rain. In order to understand why they get little rain we must understand how rain is formed.

Rain is formed as part of the water cycle where water is evaporated from the seas and winds then blow onto the land. The moist air is then forced to rise and cool which causes the moisture (water vapour) to condense to form clouds and then rain.



There are three types of rainfall each having a different way of causing air to rise and the process of condensation to occur.

Relief rainfall - where hills cause the air to rise, the water vapour in the air cools and condenses and causes rain.

Frontal rainfall - where a mass of warm air meets a mass of cold air and the warm air is forced to rise, the water vapour in the air cools and condenses and causes rain.

Convectional rainfall - where the air warms causing it to rise, the water vapour in the air cools and condenses and causes rain.

So how about deserts?

We are going to look at two types of hot desert.

Rain-shadow desert

The Atacama Desert can be considered to be a rain shadow desert.

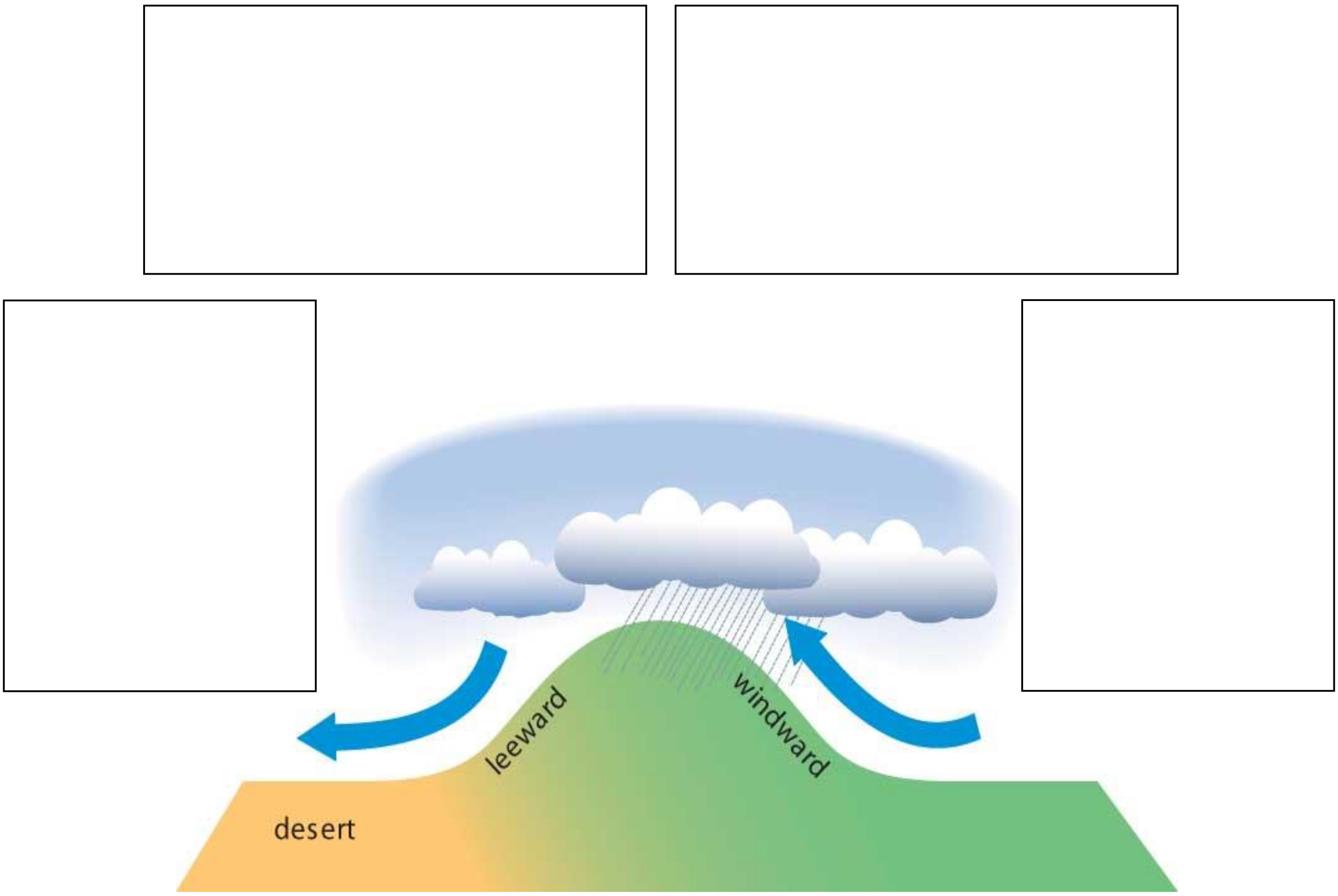
The PREVAILING Winds ie the winds which blow MOST of the time come from the east. They have travelled over a large land mass and are therefore dry. Also they have had to pass over the Andes Mountains where any moisture they had has been lost as relief rain. As winds travel up a mountain range they cool but when they fall down the leeward side of the mountain they warm up and can carry much more water before condensation will occur.

The eastern side of Britain is much drier than the west for this reason.

<u>Task</u>

Add the labels below to the diagram to explain how rain-shadow deserts are formed. They will need to be put in the correct order.

- As the warm air rises, the water vapour (gas) cools and condenses (turns to a liquid), water droplets then form clouds.
- The air then sinks (descends) on the leeward side of the mountain. The air warms, no clouds form and it doesn't rain. This is known as a rain shadow.
- As more water droplets form they join together and become heavier. When they are too heavy to be suspended in the air (as a cloud) they fall to the ground as rain which is known as precipitation. This happens on the windward side of the mountain.
- The warm air contains lots of moisture which has been evaporated from the ocean. The warm air is forced to rise due to the mountain.



Trade wind desert

Example: the Sahara desert.

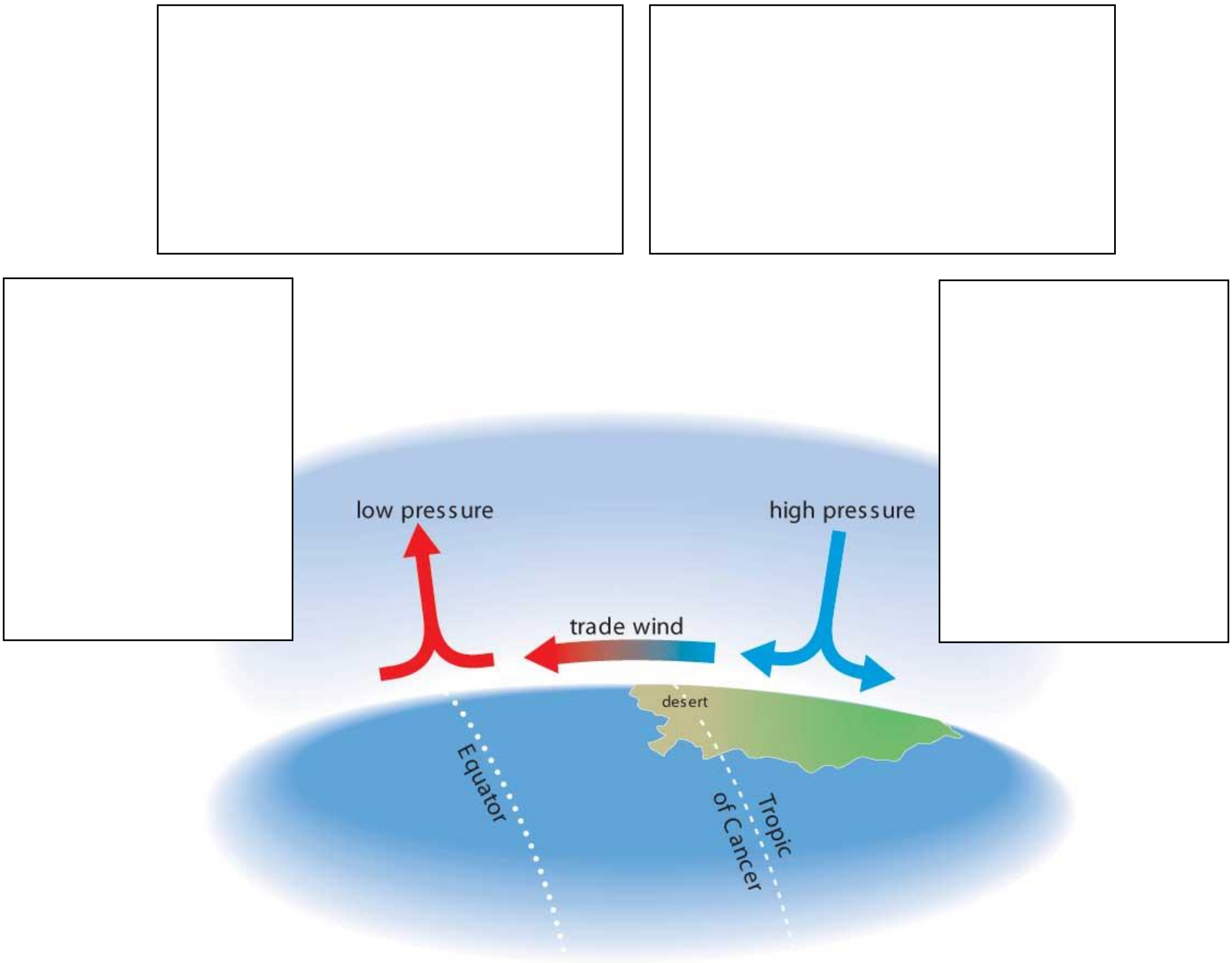
These deserts are in zones of the permanent trade winds and high pressure i.e. they get their winds from the same direction all year.

The Sahara gets winds from the North East. These winds are very dry as they have passed over huge areas of land and have not been able to pick up any moisture. They also pass over very hot areas so these warm winds can hold lots of moisture before condensation occurs

Task

Add the labels below to the diagram to explain how trade wind deserts are formed. They will need to be put in the correct order.

- Cool air sinks in areas of high pressure. The air warms as it gets closer to the ground so clouds do not form.
- As the trade winds are hot and move over land, very little moisture is collected along the way and the cooling and condensing of water vapour doesn't happen so clouds and rainfall is very rare.
- Intense heat from the sun at the Equator heats the air causing it to rise rapidly. As the air rises the water vapour cools and condenses causing storms and lots of rainfall.
- Hot dry trade winds mover over the surface of the Earth from areas of high pressure to areas of low pressure at the Equator.



Part 3: Desert adaptations

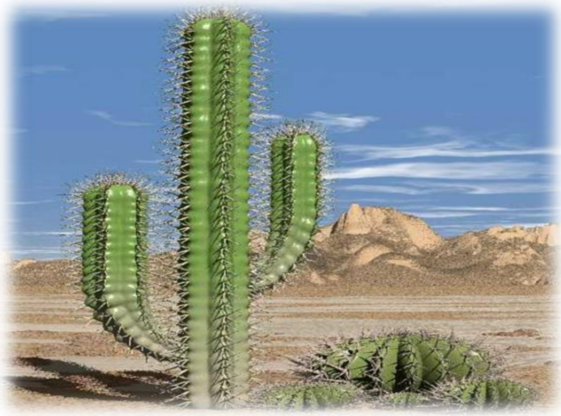
How have plants and animals adapted to survive in hot deserts?

Living in hot deserts isn't easy, plants and animals have adapted to survive in this harsh environment.

Animal adaptations

Animals have adapted their behaviour and physical characteristics to survive in the desert, some animals are nocturnal i.e. they only come out at night when it's cooler, whereas other animals have large appendages e.g. legs, ears, which helps to increase heat loss keeping them cooler. Camels could be considered the perfect desert animal as they have adapted in several ways to survive and excel in the desert environment e.g. fat stored in humps, nostrils that can close etc.

Plant adaptations



There are two categories of plants that have adapted in different ways to survive in the desert.

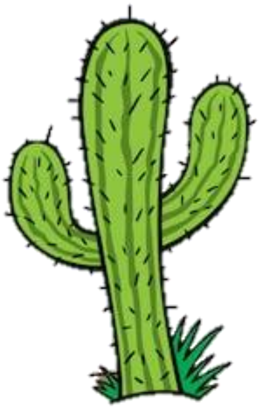
Xerophytes, like the cacti, have adapted in different ways to survive (see the cacti adaptations diagram on the next page) in the desert environment.

Ephemerals have changed their behaviour to suit the environment; they lie dormant for months or even years and only grow, flower and produce seeds after rain, and this usually happens within just a few weeks.

Task

Using your knowledge about hot deserts, explain how each of the adaptation would help the camel to survive. Think about the heat, lack of water, lack of food, difficult terrain and the large diurnal range (very hot in the day but cold at the night).

Description	Explanation
Long, powerful legs	
Tough leathery knee pads	
Fat stored in humps	
Broad flat and padded hooves	
Long eyelashes and two sets of eyelashes on each eye	
Nostrils that can close	
Thick woolly fur	
Concentrated urine and dung	



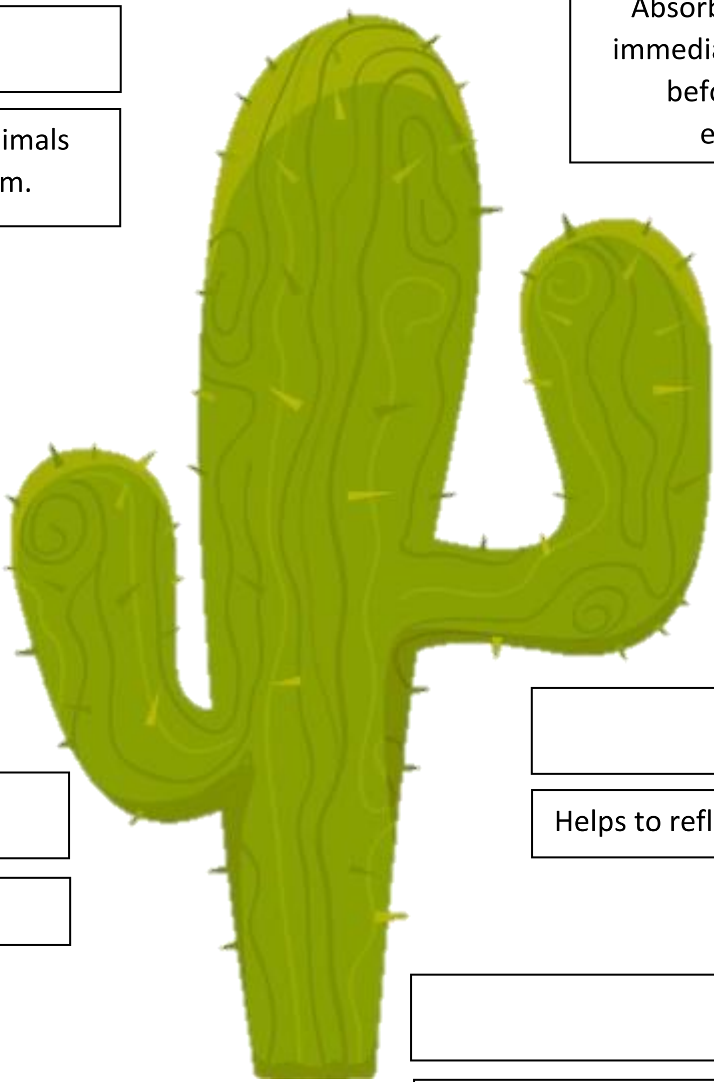
Task

Using your knowledge about hot deserts, use the terms below to identify the cacti adaptation that have been explained.

- Widespread shallow surface roots
- Long tap roots
- Green body
- White mesh on the surface
- Pleated stem
- Waxy skin
- Spines

Help to prevent animals from eating them.

Absorbs surface water immediately after it rains before the water evaporates.



Help the cacti to reach water stored deep underground.

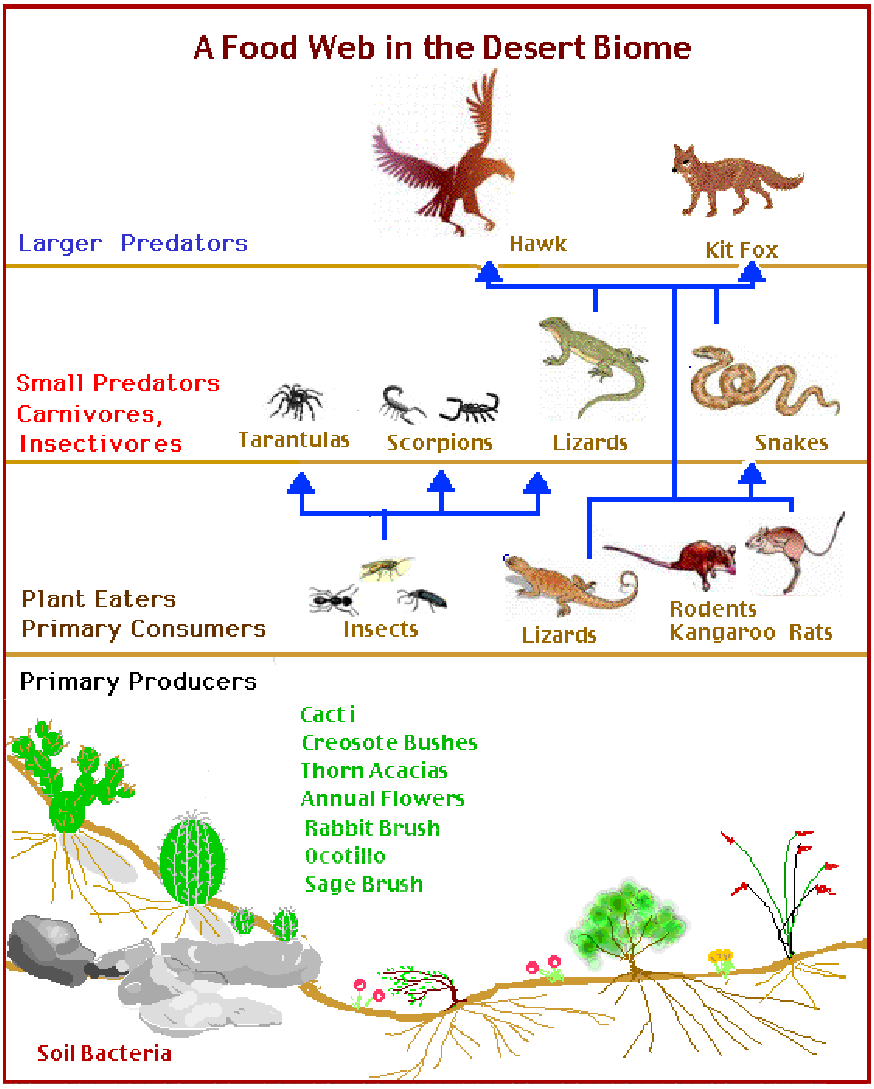
…rather than having leaves which helps with CAM photosynthesis.

Helps to reflect the sunlight.

Reduces water loss.

Expands to store large amounts of water after it rains.

Desert ecosystems



While on the face of it deserts can look to be devoid of life, the opposite is in fact true, with plants and animals living in this extreme environment as desert survival experts. A food chain is a way to show feeding connections within an ecosystem.

The links in a food chain are known as trophic levels. The trophic level of an organism represents the position it occupies in the food chain.

Primary producer – organisms in an ecosystem that can produce their own energy – for example the creosote bush

Primary consumer – an animal that eats grass and other plants in the food chain (a herbivore) – e.g. the kangaroo rat

Secondary consumer – an animal that feeds on smaller plant-eating animals. Secondary consumers can be carnivores (feeds only from animals) or omnivores (feeds from animals and plants) – e.g. the Fennec fox

Tertiary or apex consumer – predators at the top of the food chain with no natural predator – e.g. the Jackal

Task

Using the diagram, explain what would happen if there was a decrease in the snake population in this desert ecosystem.

Part 4: Processes and landforms

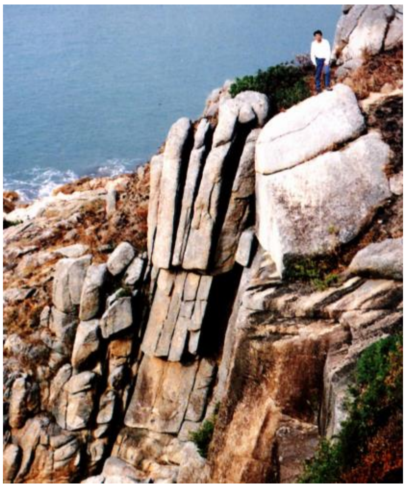
What processes and landforms exist in hot desert environments?

There are four main types of desert processes: weathering, erosion, transportation and deposition. These processes can then be divided into subcategories, except for deposition.

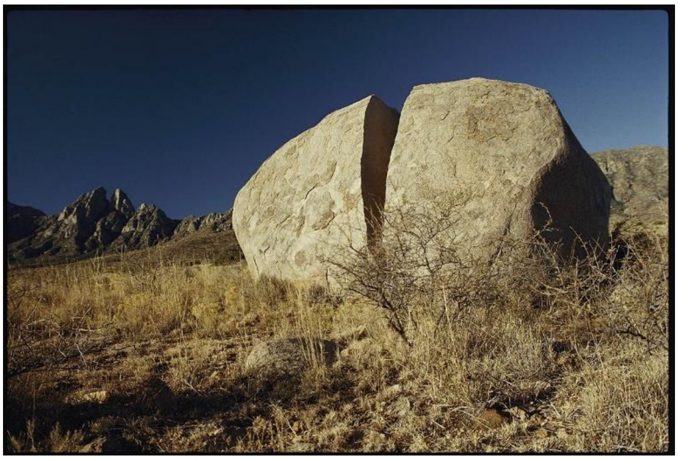
Weathering

Weathering is the breaking up of rocks in the place they are found. There are two main types of weathering that occur in the desert:

Insolation



Deserts have a large diurnal range: cold at night and much hotter during the day. Rocks are made up of lots of different minerals. The minerals that make up the rocks heat up and cool down at different rates. This causes stress in the rock which, over a long period of time, can either make the surface layers peel off, rather like the skin of an onion called exfoliation (top right and bottom right image) or cause individual grains or blocks to break away called granular or block disintegration (top left image).



Freeze-thaw

Deserts are cold at night and this can cause freeze-thaw or frost shattering. Moisture can collect in cracks in rocks. If the temperature falls below freezing, the water will freeze into ice; this causes it to expand by 10 %. Over time, this expansion can cause the cracks to expand and the rocks to break (see image to the left and below).

Erosion

Erosion is the removal of material that has been loosened by weathering. In deserts, erosion is mainly caused by wind, but sometimes by water.

During times of flash flood the fast run off can erode rock to form steep sided valleys and gullies (such as a wadi or canyon).

The two types of erosion that occur in the desert are:

Deflation

The removal of fine, loose particles from the surface of rocks.

Abrasion

The particles that are carried by the wind (or occasionally water) scrape off particles from the rock surface. The image shows how material (can be moved around the desert by the wind)

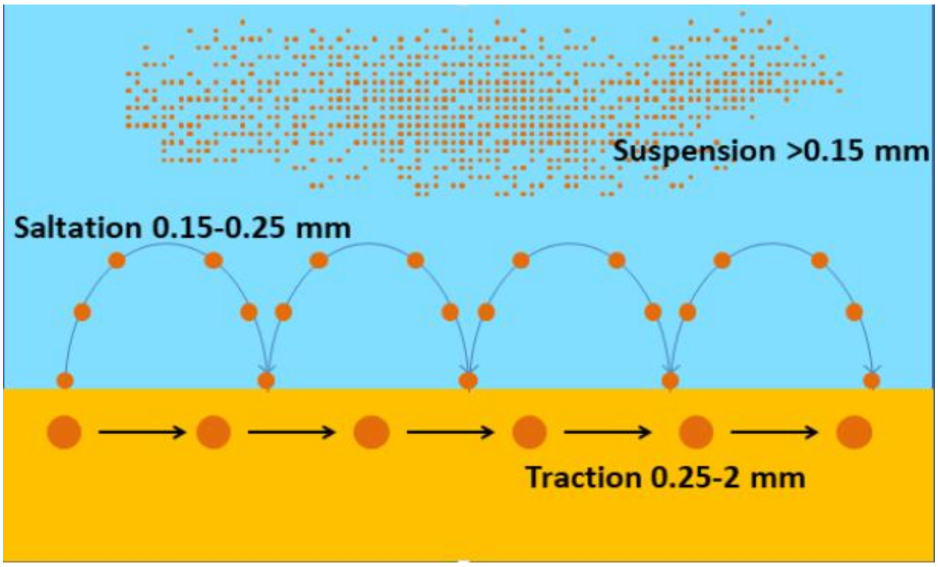
Transportation

The transporting of material by the wind (Aeolian process) can be divided into three categories;

Suspension – when the material is small enough to be suspended in the air.

Saltation – when the material is too large to be suspended in the air, so it bounces along the ground.

Traction – the material is too large to be lifted at all, so it rolls along the ground.



Deposition

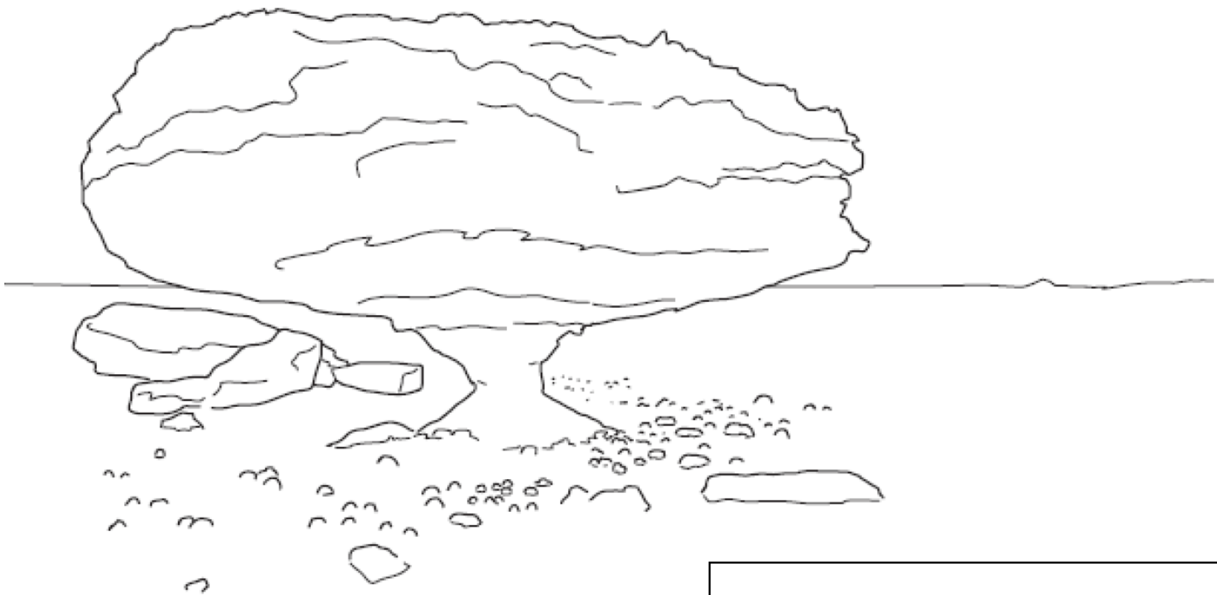
This is the laying down, or depositing, of material that has been eroded. Sand dunes are one of the main landforms created by deposition.

Desert landforms

This is an image of a **rock pedestal**. A rock pedestal resembles a mushroom and they are sometimes called mushroom rocks. The lower parts of the rock are worn away by rock particles carried by the wind. This is especially true towards the base of the rock, where wind action is at its strongest i.e. less than 1m. As a result, the base of the structure is eroded and the top remains wide. Eventually the top will collapse as the base gets too thin to support it.

Task

Using everything you have learnt about hot desert processes, annotate the diagram below to explain how a rock pedestal is formed. Some of the explanation is contained in the paragraph above, however, this is only a small part of the formation. Weathering, erosion and transportation all play a part. You can also see material deposited at the base. The rock formation also contains more and less resistant rock – where do you think the more resistant rock is located on a rock pedestal?



Yardangs form in rocks that have vertical bands of hard and soft rock. The weaker rock is removed, leaving ridges of harder rock. Yardangs can reach a height of about 15 m. They are common in the deserts of central Asia and the Atacama. They are long and thin in appearance, and three or more times longer than they are wide. When viewed from above they resemble the hull of a boat (see image below)

Inselbergs are steep-sided hills that rise up from desert plains. They're made from hard rock that's more resistant to erosion than the surrounding rock. The surrounding rock is eroded by wind and water, leaving the harder rock standing out. Uluru in Australia is an example of an inselberg.

Task

Using the images below to help, explain the process of how inselbergs are formed.