Scheme of work: Hot deserts systems and landscapes

Introduction

This scheme of work offers a route through the A-level Geography (7037) specification with a core focus on Physical Geography, optional topic Hot desert systems and landscapes.

It covers the specification in a logical order and suggests possible teaching and learning activities for each section of the specification.

The specification content is shown at the start of each section, some suggested activities will target multiple specification points. The learning outcomes indicate what most students should be able to achieve after the work is completed.

Timings have been suggested but are approximate. Teachers should select activities appropriate to their students and the curriculum time available.

The order is by no means prescriptive and there are many alternative ways in which the content could be organised.

The resources indicate those resources commonly available to schools, and other references that may be helpful. Resources are only given in brief and risk assessments should be carried out.

Resources exemplify case studies in this scheme of work, but that it not an endorsement of these case studies and schools are free to choose case studies that are relevant for their students.

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Contents

You can use the title links to jump directly to the different sections of this scheme of work. (Use Ctrl and click to follow the link.)

3.1 Physical geography

Optional topic: 3.1.2 Hot desert systems and landscapes

Distribution of hot deserts

Specification content

3.1.2.1 Deserts as natural systems

- The concepts of landform and landscape and how related landforms combine to form characteristic landscapes.
- The global distribution of mid and low latitude deserts and their margins (arid and semi-arid).
- The causes of aridity: atmospheric processes relating to pressure, winds, continentality, relief and cold ocean currents.

Learning outcomes

This lesson will help students to understand:

- The different types of deserts and their landscapes.
- How the aridity index is used to classify deserts.
- The global distribution of mid and low latitude deserts.
- The global distribution of marginal desert areas.
- Reasons why these desert environments are situated in these locations.
- Begin to develop understanding of the concept of 'landscape' as a combination of related landforms.

Suggested timing

2 hours

Possible teaching and learning activities

- Hand out images of different desert environments – students could make a list of similarities and differences in the images. Use these images and prior knowledge to define what makes a desert environment. Use the images to discuss the concept of landscapes and landforms.
- Use the images to show the three main types of desert landscapes: Hamada, Reg and Erg.
- Explain the concept of the UNESCO aridity index and how this can be used to classify desert environments: Hyper arid, arid and semi-arid. Students could research other classifications of desert environments e.g. sub-tropical, polar, interior, rain shadow and coastal according to causes.

- Show a map of the present day location of hot deserts and their margins and ask students to memorise locations and recreate it on a blank world map.
- Group discussion of reasons for these locations, linking back to knowledge from GCSE/KS3.
- Recap global atmospheric circulation model from GCSE and ask students to discuss how this might impact the distribution of desert environment. Group work to research one factor in desert locations: ITCZ – pressure and winds, ocean currents, continentality and relief. Each group should link their factor to an example of a hot desert.
- Annotate a map of locations to show reasons why these environments are located here considering, global atmospheric circulation (ITCZ, pressure and winds), ocean currents, continentality and relief.
- Consider how distribution of deserts has changed over time and use maps of past desert locations to compare to today.

Resources

- Read the article Desert types (National Geographic).
- Explore the map The Global Aridity Index (Research gate) – showing classification by the aridity index.
- Watch the 6 minute video on Deserts, Ecosystems and Biomes (BBC Teach) – introducing hot deserts (especially useful for students who haven't studied hot deserts at GCSE).
- Read the article Causes of Aridity and Geography of the World's Deserts (Landau) – notes on the causes of aridity.

Characteristics of hot deserts and their margins

Specification content

3.1.2.1 Deserts as natural systems

Characteristics of hot desert environments and their margins: climate, soils and vegetation (and their interaction).

Learning outcomes

This lesson will help students to understand:

- The physical characteristics of hot desert environments and their margins.
- The climate of desert environments and how to use climate graphs to interpret climate.
- The soils of desert environments.
- The characteristics of the vegetation in desert environments.
- How the interactions of climate, soil and vegetation interact to give characteristic landscapes in desert regions.

Suggested timing

2 hours

Possible teaching and learning activities

- Student discussion about learning from previous lesson and how the locations might determine physical characteristics of desert environments.
- Research the key characteristics of mid and low latitude deserts, and desert margins. Produce fact cards to show the key differences.
- Draw climate graphs and/or annotate climate graphs to show the key characteristics. Use the data to show understanding of central tendency as a comparison tool. You can also use this opportunity to apply range and interquartile range and consider their usefulness.
- Discuss the factors affecting desert climates and how these give differences in the climates of these regions: high levels of insolation, diurnal temperature changes, high pressure systems, strong winds, coastal fog.
- Annotate soil profiles of desert environments to explain differences. Compare to brown earth profile from the UK.
- Study images and/or watch a video of the desert ecosystem and discuss the characteristics of the vegetation. Compare vegetation in deserts on different continents.
- Explain the adaptations such drought resistance and avoidance, water storage and salt tolerance. Introduce concepts of environmental fragility and low biodiversity. Summarise key adaptations and relative importance of climate and soils in these.
- Recap knowledge of nutrient cycling and consider nutrient cycling in desert areas and how this is different to tropical rainforests (link with Water and Carbon unit). How does this link with low biodiversity and environmental fragility?

Resources

- Watch the 1 minute video Planet Earth, Deserts - Death Valley in bloom (BBC).
- Watch the 15 minute video on The Desert Biome (Geodiode) – information on desert soils and vegetation.
- Read the article Desert: Mission: Biomes (NASA) – with climate data and images.
- Read the article Hot Deserts - resources on desert climates (Royal Meteorological Society).
- Watch the 1 minute video How does atmospheric pressure affect weather? (Met Office).
- Read the article Climate data for cities worldwide (Climate data).

Desert systems

Specification content

3.1.2.1 Deserts as natural systems

- Systems in physical geography: systems concepts and their application to the development of desert landscapes – inputs, outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium.
- Water balance and aridity index.

Links with other units

3.1.1. Water and Carbon Cycles

3.1.1.1. Systems in physical geography: systems concepts and their application to the water and carbon cycles inputs – outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium.

Learning outcomes

This lesson will help students to understand:

- What is the desert landscape system and how it relates to other Earth systems.
- What are the inputs, outputs, stores and flows/transfers of desert systems.
- How positive and negative feedback change desert systems and the concept of dynamic equilibrium.
- What the water balance is and how this affects deserts.
- How the aridity index can be used to tell us the characteristics of desert regions.

Suggested timing

1 hour

Possible teaching and learning activities

- Note: This lesson will depend on units already studied. For example, if Water and Carbon Cycles have already been taught then there is no need to cover the basics on systems again.
- Students to think of different Earth systems. Recap what they know about systems. Draw a simple systems diagram based on a simple activity such as making a cup of tea – consider the inputs, stores, processes and outputs.
- Give students a list of desert system key terms and ask them to sort into inputs, stores, processes and outputs. Compare a desert system to another Earth system e.g. glacial system.
- Consider how desert systems interact with other Earth systems.
- Model examples of positive and negative feedback loops in desert systems. Ask students to come up with their own examples. Good starting points: Increased carbon emissions, increasing cloud cover, vegetation removal or afforestation projects.

- Research an example of human intervention that is affecting the desert system and write out a feedback loop. Examples could include the Great Green Wall in the Sahel, climate change impact on Iraq.
- Discuss the desert water cycle and how this links to the aridity index. Define PET and ET. Use research to find aridity values for deserts around the world. Use these values to categorise different examples.
- Use a water balance graph from a desert area to discuss the water balance. Students annotate the graph to describe and explain key features.

Resources

- Read the article analyzing_a_feedback_mechanism – (NOAA) problem solving activity on feedback loops.
- Read the article The Great Green Wall (National Geographic).
- Read the article Iraq: Climate crises deepen struggle of farmers (Red Cross).
- Read the article Water Balance on planet Earth (Story map).
- Read the article World aridity values (World atlas of desertification).

Energy sources and sediment in hot deserts

Specification content

3.1.2.2 Systems and processes

- Sources of energy in hot desert environments: insolation, winds, runoff.
- Sediment sources, cells and budgets.

Learning outcomes

This lesson will help students to understand:

- What the sources of energy in deserts are.
- How insolation is generally high in hot desert landscapes and the impact of this on weathering, evapotranspiration and its contribution to local winds.
- Wind is an important source of energy both in terms of large trade winds and local winds.
- Despites its scarcity, water is a powerful source of energy in landscape development.
- Sources of sediment include mass movement, weathering, erosion and transport from rivers and winds.
- How sediment cells operate in desert environments and the concept of sediment budgets.

Suggested timing

1 hour

Possible teaching and learning activities

- Referring back to factors causing aridity, discuss the sources of energy found in deserts.
- Use images or a video of desert landscapes to identify the sources of energy found in deserts.
- Students work in threes, each person taking one source of energy. They research the nature of the energy source and peer teach the other members of their group.
- Further research on the importance of seasonal and/or local winds such as the Simoom in Jordan, Kharif in Somalia or the Harmattan in the Sahara.
- Use precipitation data from deserts to compare mean rainfall and storm precipitation. Use the data to discuss the importance of water as an energy source.
- Give students key sources of sediment in desert landscapes: mass movement, weathering, erosion and transport from rivers and winds. Get them to match these to images or maps to explain how each one is a source.
- Give students the following headings for sediment cells and ask them to use knowledge and understanding from this lesson and previous lessons to explain each one: Inputs, transfers, sediment sinks and outputs.
- Outline the basic concept of a sediment budget. Use different scenarios in groups to discuss how different factors might affect the sediment budgets might impact a desert landscape e.g. desert winds, intense precipitation storm.

Resources

- Watch the 1 hour video Deserts of Southern Utah (YouTube) – can be used as a discussion starting point.
- Read the article Harmatta and other desert winds (SKYbrary).
- Explore the interactive map Earth: map of wind, weather, and ocean conditions (Nullschool).
- Read the article Hot Deserts (Geological Society).
- Read the article Hot Deserts (Storymaps) – useful diagrams and information on sources of energy.

Weathering and mass movement in desert landscapes

Specification content

3.1.2.2 Systems and processes

- Geomorphological processes: weathering, mass movement.
- Distinctively arid geomorphological processes: weathering (thermal fracture, exfoliation, chemical weathering, block and granular disintegration).

Learning outcomes

This lesson will help students to understand:

- How geomorphological processes of weathering and mass movement operate in desert landscapes.
- The different types of weathering affecting desert landscapes: thermal fracture, exfoliation, chemical weathering, block and granular disintegration.
- How the weathering processes interact with the landscape to cause mass movement in deserts.

Suggested timing

1 hour

Possible teaching and learning activities

- Recap key terminology: weathering, erosion, transport, deposition.
- Students to consider how desert processes might differ from river or coastal processes. How might this impact on weathering, erosion, transport and deposition.
- Give students a definition of weathering and ask them what factors in deserts might impact on weathering processes. Do a simple mix and match exercise for types of weathering found in deserts using key terms and definitions: Thermal Fracture, Exfoliation, Granular disintegration, frost shattering, block separation, salt crystallisation, chemical weathering.
- Give students blank diagrams of weathering processes in hot deserts and ask them to conduct research to annotate them to explain each process. This could be done as group exercise and shared with the class.
- Use images of different desert landscapes and ask students to identify which weathering processes would dominate in the landscape and reasons why.
- Class discussion on why biological weathering of limited importance in hot desert landscapes.
- Using an image as a prompt, teach the concept of mass movement and ask students to discuss why it might be an important process in hot deserts.
- Student research on examples of mass movement in desert landscapes.

Resources

- Read the article What is mass movement? (Internet Geography) – types of mass movement with useful diagrams and video clips.
- Read the article Weathering (National Geographic).
- Watch the 2 minute video Exfoliation: Onion Skin Weathering explanation (YouTube).

Role of wind and water in desert landscapes

Specification content

3.1.2.2 Systems and processes

- Geomorphological processes: weathering, mass movement, erosion, transportation and deposition.
- The role of wind – erosion: deflation and abrasion; transportation; suspension, saltation, surface creep, deposition.
- Sources of water: exogenous, endoreic and ephemeral; the episodic role of water; sheet flooding, channel flash flooding.

Learning outcomes

This lesson will help students to understand:

- How wind can erode, transport and deposit sediment in desert landscapes.
- There are two main types of wind erosion – deflation and abrasion.
- Wind transportation occurs in three main ways: surface creep, saltation and suspension.
- The reasons why wind can deposit sediment.
- The role of water in landscape formation.
- The different sources of water in desert landscapes: Exogenous, endoreic, ephemeral and episodic flash floods.

Suggested timing

1 hour

Possible teaching and learning activities

- Class discussion on how wind will erode sediment in desert landscapes. Ask students to think about grains of sand – consider how they have become so rounded.
- Teach the concepts of deflation and abrasion. Ask students to find images which show evidence of these types of erosion.
- In small groups discuss the factors that will affect rate of erosion. Students should consider strength of wind, geology, landforms, landscape, relief etc.
- Draw diagrams to represent the types of transportation by wind.
- Show a newspaper story or image of sand deposited in the UK from the Sahara. Students to discuss why sand is deposited. Conduct research into local sand deposits and sand deposited huge distance from the source.
- Recap erosion, transport and deposition by water. Ask students to discuss how these might be different in desert environments.
- Give students definitions of four sources of water in deserts – ask them to match to key term. Find examples of each type of water sources for a specified desert.
- Show an image of an alluvial fan and ask students to discuss how it might have formed. Where did the sediment come from and why has it been deposited.
- Research an example of an episodic flash flood and document through images or text the impact it had on the desert landscape.

- Group or paired discussion to assess relative importance of water and wind erosion – this will be useful to return to after landforms have been studied. Discussion point about climate change and how this might affect wind and water erosion in desert landscapes.

Resources

- Read the article Deserts – wind erosion in deserts (including landforms) (University of Massachusetts).
- Watch the 1 minute video What is Saharan Dust? (Met Office).
- Watch the 5 minute video Desert wind erosion and deposition (YouTube).
- Watch the 2 minute video Sahara desert flash flood (YouTube).

Aeolian landforms in hot desert landscapes

Specification content

3.1.2.2 Systems and processes

- Geomorphological processes: weathering, mass movement, erosion, transportation and deposition.
- The role of wind – erosion: deflation and abrasion; transportation; suspension, saltation, surface creep, deposition.

3.1.2.3 Arid landscape development in contrasting settings

- Origin and development of landforms of mid and low latitude deserts: aeolian – deflation hollows, desert pavements, ventifacts, yardangs, zeugen, barchans and seif dunes.
- The relationship between process, time, landforms and landscapes in mid and low latitude desert settings: characteristic desert landscapes.

Learning outcomes

This lesson will help students to understand:

- How processes of weathering, erosion, transport and deposition form desert landforms.
- How aeolian processes lead to the formation of desert landforms: deflation hollows, desert pavements, ventifacts, yardangs, zeugen, barchans and sief dunes.
- The connection between different desert landforms and desert landscapes.
- How desert landforms change over time.

Suggested timing

2 hours

Possible teaching and learning activities

- Read the introduction to John Steinbeck's 'Grapes of Wrath', ask students to discuss why the area was prone to soil erosion.
- Recap aeolian processes and introduce images of desert landscapes. Ask students to describe the landforms present. Return to these images at the end and ask them to name the landforms.
- Teach the formation of sand dunes – Barchan and Seif dunes. Draw a sequence of diagram to show their formation and show how Seif dunes might form from Barchan dunes.
- Students could research other classification of sand dunes. Research examples of dune systems and compare these in terms of characteristics. Investigate how sand supply and wind variability impact dune formation.
- Give students a table with images of different landforms. Around the classroom place notes on formation and ask students to match these up with their images and complete the table showing an image with notes on formation.

- Group presentations on different landforms – students teach the rest of the class how their landforms are formed, considering weathering, erosion, transport and deposition where applicable.
- Investigate how dune migration can impact human settlements using a specific example as evidence.
- Fieldwork opportunity: visit a sand dune system and investigate aeolian processes. For example measure the height of sand dunes, wind speeds, size of deposited particles and wind-blown particles.

Resources

- Read the article Dune Types; Great Sand Dunes (USA National Park).
- Watch the 8 minute video How Are Sand Dunes Formed? (YouTube).
- Read the article Ar Rub' al Khali Sand Sea, Arabian Peninsula (NASA).
- Read the article Star Wars home of Anakin Skywalker threatened by dune (BBC news).
- Watch the 1 minute video The Big Hollow and the Power of Wind Erosion (YouTube).
- Read the article Ecosystems fieldwork techniques (Royal Geographical Society) – Instructions for sand dune profiling.

Water formed landforms in hot desert landscapes

Specification content

3.1.2.2 Systems and processes

- Geomorphological processes: weathering, mass movement, erosion, transportation and deposition.
- Sources of water: exogenous, endoreic and ephemeral; the episodic role of water; sheet flooding, channel flash flooding.

3.1.2.3 Arid landscape development in contrasting settings

- Origin and development of landforms of mid and low latitude deserts: water – wadis, bahadas, pediments, playas, inselbergs.
- The relationship between process, time, landforms and landscapes in mid and low latitude desert settings: characteristic desert landscapes.

Learning outcomes

This lesson will help students to understand:

- How processes of weathering, erosion, transport and deposition form desert landforms.
- How fluvial processes lead to the formation of desert landforms: wadis, bahadas, pediments, playas, inselbergs.
- The connection between different desert landforms and desert landscapes.
- How desert landforms change over time.

Suggested timing

2 hours

Possible teaching and learning activities

- Recap sources of water and discuss how these might lead to the formation of landforms.
- Show a sketch of landforms formed by water and ask students to suggest how they might have formed.
- For each landform students should find an image and an example. Annotate the image to explain how it formed. For each type of landform discuss the relative importance of weathering, erosion, transportation and deposition.
- Use simple sketches to describe how wadis develop into alluvial fans which can then become bahadas.
- Compare a storm hydrograph of a wadi to a British storm hydrograph – explain why they differ (consider absence of base-flow and steepness of rising and falling limbs).
- Explain how a pediment is similar and different to a Bahada. Draw simple diagrams to show how a pediment forms due to weathering and sheetwash. Research alternative theories on how pediments form.
- Investigate the concept of ‘badlands’. Introduce with two images of South Dakota Badlands and Matmata, Southern Tunisia. Make notes on main features, noting similarities and differences.

Resources

- Read the article Geology Deserts PowerPoint including a sketch of landforms dormed by water (Lakehead).
- Read the article A Hydrological and Geomorphometric Approach to Understanding the Generation of Wadi Flash Floods (MDPI) – Very scientific report into flash flooding in a Wadi but has useful hydrographs and maps.
- Watch the 1 video Spectacular flash flood in Oman (YouTube).
- Read the article Desert Geological Terms: Unique Rock Formations and Definitions (Desert USA).

The development of characteristic desert landscapes

Specification content

3.1.2.3 Arid landscape development in contrasting settings

- Origin and development of landforms of mid and low latitude deserts: aeolian – deflation hollows, desert pavements, ventifacts, yardangs, zeugen, barchans and sief dunes; water – wadis, bahadas, pediments, playas, inselbergs.
- The relationship between process, time, landforms and landscapes in mid and low latitude desert settings: characteristic desert landscapes.

Learning outcomes

This lesson will help students to understand:

- The uniqueness of desert landscapes due to the interaction between rocks and the processes operating on them.
- The important drivers in desert systems responsible for the formation of desert landscapes.
- Deserts are dynamic and constantly changing and essentially a snapshot in time.
- A model used to describe how desert landscapes change over time.

Suggested timing

1 hour

Possible teaching and learning activities

- Use images of different desert landscapes to identify landforms and processes operating in the image. Discuss what these might have looked like in the past. Use knowledge of processes to suggest why landscapes might have changed.
- Find images of deserts in the past and present to compare and contrast landforms and how they have changed over time.
- Explain why it is difficult to assess the processes responsible for the formation of landscapes and the complexity of the interactions of processes. Show an image of the Grand Canyon and ask students to research how it formed and explain why we don't know for certain.
- Research Lester King's model: Arid cycle of erosion. Apply the model to an image of a desert in the past and present. Discuss in pairs the limitation of such a model.
- Class discussion on King's model. Refer back to a desert system and feedback – to what extent does King's model reflect positive and negative feedback.

Resources

Watch the 4 minute video Grand Canyon Geology (National Park USA).

Case study of a hot desert: landforms and processes

Specification content

3.1.2.6 Case studies

Case study of a hot desert environment setting to illustrate and analyse key themes set out above and engage with field data (exemplifying field data may be gathered in settings that experience some of the aeolian processes associated with mid and low latitude desert environments such as coastal dunes).

Learning outcomes

This lesson will help students to understand:

- How to apply theoretical knowledge of processes and landforms to a case study.
- Use quantitative and qualitative data to analyse desert characteristics.
- The processes operating in the desert landscape chosen.
- The nature and characteristics of landforms in the case study area.
- How the case study area has changed over time.

Suggested timing

2 to 3 hours

Possible teaching and learning activities

- This lesson could be taught as a whole class activity choosing the same case study area or as group work where students investigate different case-studies and present their findings to the class as an academic poster or media presentation.
- Examples of case study areas could include: Namib Sand Sea, Rub' al Khali (Empty Quarter), Arabian Peninsula, Mojave National Preserve, USA.
- Location – use maps to describe the location of the case study area. Annotate map to explain the causes of aridity in the area.
- Research processes operating in the landscape: weathering, mass movement, wind and water erosion, transportation and deposition. Find specific details on local winds and water sources including maps and images where appropriate.
- Using images of the landscape, describe the characteristics of the landforms. Classify landforms by method of formation.
- Investigate how the landscape has changed over time, researching example of natural processes causing change and human interaction resulting in change. Include evidence of change through maps and photos and/or fieldwork data where possible.
- Suggest alternative possible futures for the landscape – for example impacts of tectonic plate movement where applicable or climate change. Draw a flow diagram to show a feedback cycle for the chosen case study area.
- Fieldwork opportunity: Visit a sand dune system and investigate aeolian processes. For example measure the height of sand dunes, wind speeds, size of deposited particles and wind-blown particles.

Resources

- Read the article Namib Sand Sea (UNESCO).
- Read the article Empty Quarter Desert (Saudipedia).
- Read the article Our Dynamic Desert – Mojave National Preserve (USGS).
- Read the article Ecosystems fieldwork techniques – (RGS).
- Read the article Method for Low Energy Coasts (FSC).

Desertification: Changing extent of deserts over last 10,000 years

Specification content

3.1.2.4 Desertification
The changing extent and distribution of hot deserts over the last 10,000 years.

Links with other units

3.1.1. Water and Carbon Cycles
3.1.1.1. Systems in physical geography: systems concepts and their application to the water and carbon cycles inputs – outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium.

3.1.1.4 Water, carbon, climate and life on Earth
The key role of the carbon and water stores and cycles in supporting life on Earth with particular reference to climate. The relationship between the water cycle and carbon cycle in the atmosphere. The role of feedbacks within and between cycles and their link to climate change and implications for life on Earth.

Learning outcomes
This lesson will help students to understand:
- What desertification means and how there are a range of definitions.
- The extent of deserts today.
- Where deserts were found 10 000 years ago and how that extent has changed over time.
- The impact of the global wetter period 8000 years ago.
- How the extent of the Sahara has changed over time.
- Carbon and water cycles can be used to explain the changing extent and distribution of deserts.

Suggested timing
1 hour

Possible teaching and learning activities
- Ask students to define desertification. Discuss the range of different definitions from ‘the advance of deserts’ to more complex ideas such as UNESCO’s definition of ‘the persistent degradation of dryland ecosystems by human activities and climate change’.
- Discuss why there is a range of definitions. Students could research different definitions and decide on an overall best fit definition.
- Refer back to maps of deserts used in earlier lessons. In groups students discuss why this distribution might have changed in the past.

- Use a range of maps (going back at least 10 000 years). It is useful to look at the last glacial maximum and the extent of deserts at that point. Discuss why there were more desert areas during ice-ages.
- Look at a map of 8000 years ago and discuss reasons for wetter period and the impact this had on the distribution and extent of desert areas.
- Use the water and carbon cycles to explain why distribution and extent of deserts changes over time.
- Focus on the Sahara (or a different desert) and research maps that show changing extent. Research the characteristics 8000 years ago compared to present conditions. Annotate maps to explain why these changes occurred.

Resources

- Explore the maps Global land environments during the last 130,000 years (ESD).
- Read the article Sahara Desert Was Once Lush and Populated 8000 years ago (LiveScience).
- Watch the 3 minute video David Attenborough Explains Desertification (YouTube).
- Explore the maps The Sahara Desert Today Vs 8,000 Years Agos (Brilliant Maps).
- Read the article The Greening of the Sahara: Past Changes and Future Implications (Science Direct).

Causes of desertification

Specification content

3.1.2.4 Desertification

The changing extent and distribution of hot deserts over the last 10 000 years. The causes of desertification – climate change and human impact; distribution of areas at risk.

Learning outcomes

This lesson will help students to understand:

- The areas at risk from desertification.
- Natural causes of desertification: climate change.
- Human causes of desertification: population pressure, overgrazing, overcultivation, agriculture pressures, energy demands, tourism.
- The relative importance of different causes of desertification.

Suggested timing

2 hours

Possible teaching and learning activities

- Recap how the Sahara has changed over the past 10 000 years and the reasons for this. Use maps of the Sahara and Sahel regions at different time periods, including future projections. Students annotate these to describe the changes and suggest impacts on the physical characteristics, ecosystems and human populations.
- Study global maps showing areas undergoing desertification and at risk of desertification. Plot these areas onto a blank world map. Students can annotate the map to analyse the key characteristics of these areas. This map could be used to add information on causes with visual images and evidence of desertification.
- Teach the natural causes of climate change – focus on climate change: higher temperatures and unpredictable rainfall. Ask students to draw flow charts to show how climate change leads to desertification, using evidence to support.
- Find images of observable change.
- Divide class into groups and give each group a human cause of desertification. Each group should research how it leads to desertification, completing a flow chart. Find a specific example for each cause of desertification – this could be from one region or global examples.
- Ask students to complete a ranking exercise to rank causes of desertification from most important to least importance. Justify their top two and bottom two choices, using evidence and examples in support.

Resources

- Watch the 2 minute video Desertification Causes and Effects (YouTube).
- Read the article Is the Sahara Desert Growing? (Earth.org).
- Read the article Climate Change in Africa 2022: Impacts, Adaptation and Vulnerability (IPCC report).
- Read the article Causes and Effects of Desertification on Us (Greentumble).
- Read the article From the Dust Bowl to the Sahel (NASA).
- Read the article A first look at historical land cover changes over the Sahel (Vito).

Impacts of desertification

Specification content

3.1.2.4 Desertification

The changing extent and distribution of hot deserts over the last 10 000 years. The causes of desertification – climate change and human impact; distribution of areas at risk; impact on ecosystems, landscapes and populations. Predicted climate change and its impacts; alternative possible futures for local populations.

Learning outcomes

This lesson will help students to understand:

- The impact of desertification on ecosystems – reduced biodiversity, increased salinity, removal of topsoil, loss of water sources.
- The impact on the natural landscape.
- Impacts on the local population and global population.
- How climate change might affect areas at risk of desertification.
- Mitigation strategies used to protect the natural environment and local populations.
- Alternative possible futures for areas at risk of desertification.

Suggested timing

3 hours

Possible teaching and learning activities

- Model feedback cycles which show the causes and impact of desertification on ecosystems. Students could work in groups and design their own feedback cycles, each group having an initial prompt such as Increased wind erosion, Increased irrigation, loss of nutrients, overgrazing etc.
- Use a world map to annotate examples of the impact on desertification. This could be done as a group exercise giving each group a different continent to research and present findings to the rest of the class.
- Use data on drought or land degradation to study different graphical presentations. For each one discuss evaluate its use.
- Give students images of dryland areas and ask them to predict how the physical landscape might change in the future. Identify which desert landforms and processes might become more common and/or dominate areas at risk.
- Choose one local population in the Sahel and research the impacts climate change has already had and what might happen in the future.
- Study the American Dustbowl of the 1930s – research the causes and explain how this can be used today to predict what might happen to vulnerable areas.
- Give students a list of impacts on people and ask them to classify into economic, health, political, and social impacts. Class discussion on the most important impact and least important impacts.

- In groups research mitigation strategies used to combat the risk of desertification in different regions. Each group could research a different region e.g. Sahel, USA, Southern Europe, India, Central Asia.
- Focus on the Great Green Wall in the Sahel. Produce a report covering its key characteristics, how it aims to reduce risk of desertification and an evaluation of its effectiveness.
- Research the Millenium Ecosystem Assessment by the UN and the four scenarios they suggested. How might this apply to areas at risk of desertification?
- Research project to study the threat from climate change for example, increased droughts in the Sahel and its impact on people living in Chad. Students can use images to show recent impact and then predict future impacts with a variety of scenarios in the Sahel. Present how local people are impacted and research strategies being used to manage these. This could be used to create a large display showing observable changes and ideas of prospective change.

Resources

- Read the article Proportion of total land area under drought (UNCCD).
- Read the article Desertification: Sahel case study (DGB Group).
- Read the article Explainer: Desertification and the role of climate change (Carbon Brief).
- Read the article Climate change and the crisis in the Horn of Africa (Climate Migration). Website with lots of articles about population displacement due to climate change and desertification. Contains articles and video links.
- Read the article Great Green Wall Initiative (UNCCD).
- Watch the 12 minute video How the UN is Holding Back the Sahara Desert (YouTube).
- Read the article Of Deserts and Decolonization: Dispelling Myths About Drylands | The MIT Press Reader (The MIT Press Reader).

Case study: Desertification at a local scale

Specification content

3.1.2.4 Desertification

The changing extent and distribution of hot deserts over the last 10 000 years. The causes of desertification – climate change and human impact; distribution of areas at risk; impact on ecosystems, landscapes and populations. Predicted climate change and its impacts; alternative possible futures for local populations.

3.1.2.6 Case studies

Case study at a local scale of a landscape where desertification has occurred to illustrate and analyse key themes of desertification, causes and impacts, implications for sustainable development. Evaluation of human responses of resilience, mitigation and adaptation.

Links with other units

This depends on the case study chosen. For the Burkina Faso case study suggested below, there are clear links to Water and carbon cycles and also Population and Environment.

3.1.1 Water and carbon cycles

3.1.1.4 Water, carbon, climate and life on Earth

The key role of the carbon and water stores and cycles in supporting life on Earth with particular reference to climate. The relationship between the water cycle and carbon cycle in the atmosphere. The role of feedbacks within and between cycles and their link to climate change and implications for life on Earth.

3.2.4 Population and the environment

3.2.4.2 Environment and population

Soil problems and their management as they relate to agriculture: soil erosion, waterlogging, salinisation, structural deterioration. Strategies to ensure food security.

3.2.4.6 Global population futures

Health impacts of global environmental change: climate change – thermal stress, emergent and changing distribution of vector borne diseases, agricultural productivity and nutritional standards.

Learning outcomes

This lesson will help students to understand:

- The causes of a desertification in the area studied.
- The impacts of desertification in the area on the natural environment and the local population.
- The challenges and opportunities for living in an area that has undergone desertification.

- How humans are able to adapt to these opportunities and challenges in order to develop sustainable futures.
- Management strategies used to minimise threat of desertification.
- Alternative futures for the case study area.

Suggested timing

3 to 4 hours

Possible teaching and learning activities

Choose a suitable location to study. The chosen case study should not be too large scale (e.g. choose an area or region of a country). You could conduct this as group research projects and students could study different areas and present their finding to the rest of the class. The resources below are for Northern Burkina Faso in the areas of Soum and Séno.

- **Location background:** Use atlas maps and GIS to locate the case study area. Use a base-map to annotate factors causing desertification and background context which can be added to throughout the lesson. Research the characteristics of the human population and land-use in the case study area.
- **Desert processes and landforms:** Use maps and images to identify the main characteristics of the physical landscape. Link these to desert processes. Consider the relative importance of these processes in the formation of the landscape.
- **Causes of desertification:** Investigate the natural and human causes of desertification. These could be furthered classified by root cause and/or ranked by importance
- **Opportunities for human occupation and development:** Research the opportunities found in the areas. These could be classified into social, economic and environmental opportunities.
- **Challenges for human occupation and development:** Give students a range of images showing the challenges of living in the area. Decide which challenges are directly related to the impacts of desertification. In pairs investigate one of these challenges in more detail and present these to the class. Students can add these to their base maps.
- Focus on one challenge in depth for example food security. Research how this impacted people and the natural environment.
- **Responses to desertification:** Find out how local people have responded to the challenges and opportunities. For example, consider migration, conflict, resource development and government intervention.
- Investigate how the local population have adapted to life in the 21st Century. Important to consider a variety of viewpoints from different groups e.g. gender, age. For example consider access to education and technological developments.
- **Managing desertification:** Research strategies used to manage the challenges caused by desertification. Students can then categorise these into whether they show resilience, mitigation or adaptation. Use class discussion to evaluate the strategies. Consider ranking different strategies according to effectiveness. Discuss the challenges of doing such an exercise.

- Research traditional and sustainable approaches where possible. Contrast these strategies with those used elsewhere globally and in a similar region. Consider the reasons for difference in the approaches used.
- Using different stakeholders, identify how different viewpoints might determine strategies used in the case study area. Use this as a tool to discuss how there might be differences in human ability to use resilience, mitigation and adaptation as a response to the challenges in the area.
- **Future challenges:** Research how climate change might impact the area. For example consider how increasing temperatures could affect the human population.

Resources

- Read the article Food and Agriculture Organization of the United Nations – Burina Faso (UN).
- Read the article Burkina Faso – the challenges of desertification (UN).
- Read the article Preventing desertification in Burkina Faso (AFR100).
- Read the article Burkina Faso (ELD).
- Watch the 4 minute video Action Against Desertification: Burkina Faso (YouTube).
- Watch the 3 minute video Meet Yacouba Sawadogo, The Man Who Stopped The Desert In Burkina Faso (YouTube).
- Watch the 2 minute video Conserving soil and water in Burkina Faso (YouTube).