

Edexcel GCSE Geography B

Practical support to help you deliver this Edexcel specification

Edexcel GCSE Geography B offers an issues-based approach to the content and assessment, with the content split by Global and UK scale. As with all GCSEs, the guided learning hours is 120 hours over two years. This document provides a topic guide for teaching Component 1, Topic 1, and can be adapted by centres to fit their own contexts and teaching styles. It has been produced as an example approach and is not intended to be prescriptive. The topic guides indicate resources that you can use to support your teaching. These are only suggestions and you are encouraged to use a wide range of resources to suit the needs of your own students.

The advised teaching time for Topic 1: Hazardous Earth, is 15 guided learning hours; i.e. roughly five hours per enquiry question (EQ). This requires some blending together of the detailed content. In the guidance below, suggestions are made about contextualisation or stretch challenges that may be suitable for more able students, as well as expected lesson outcomes for those less able. Please note that these are suggestions only and not specific syllabus requirements.

The two- and three-year course planners suggest appropriate times to introduce this material. For example, in centres studying over three years, you might want to start the course looking at EQ3 (Tectonic hazards), returning to the topic in the spring term of year 9 to look at EQ2 (Extreme weather events), and revise this content, together with looking at the more abstract ideas in EQ1 (Global climate system), in the Spring Term of year 10. Centres studying over two years might also like to follow this sequence but in year 10 and year 11 respectively.

Each enquiry question is broken down into roughly five one-hour sections, each beginning with a quick overview of the breadth of the enquiry question followed by a more detailed explanation of the key concepts and processes, examples of teaching strategies, guidance on integrating geographical skills, and a summary of the key terminology required. The structure is suggestive, not prescriptive.

Synoptic linkages and case study nesting

It is suggested that you select located examples that complement the megacity and developing country case studies that are studied later in Component 1. For example, located examples set in the Philippines (which could make use of case study material available on the Edexcel website, e.g. 6GE01 produced for AS Geography) would help cover cyclones, tectonics and detail about the hazards found in developing countries. In turn a study of the impacts of both tectonic and climatic hazards on cities like Manila will help students explore its environmental context and the effectiveness of its governance.

Topic Guide for Component 1, Topic 1: Hazardous Earth

Introduction

Quick overview

An understanding of the global circulation of the atmosphere and changing climate. The formation and impacts of extreme weather hazards (tropical cyclones) and tectonic hazards, and the impact on both of developed and developing countries through located examples:

- EQ1: How does the world's climate system function, why does it change and how can this be hazardous for people?
- EQ2: How are extreme weather events increasingly hazardous for people?
- EQ3: Why do the causes and impacts of tectonic activity and management of tectonic hazards vary with location?

The aim of this topic pack is get a big-picture overview of the key tectonic and climatological processes that shape the world and create hazardous situations for people. The ideas studied here help create the global context for other concepts in Component 1 (Topic 2: Development dynamics), Component 2 (Topic 4: The UK's evolving physical landscape) and Component 3 (Topic 7: People and the biosphere).

The three enquiry questions each tell a familiar geographical story: the nature of the physical system, the issues that are created and how people respond differently to the resulting hazard, depending on their level of economic development. This approach is different to GCSE Specification A, where tropical cyclones form one part of weather variability, together with long-term climate change, drought and UK climate. Tectonic hazards do not appear in Specification A.

There are two broad key things to bear in mind:

- 1) Getting the right level of detail about the physical processes that make up the different geographical systems:
 - global atmospheric circulation
 - geological-scale climate change
 - greenhouse effect
 - cyclone formation
 - earth's structure
 - tectonic processes.
- 2) Making sure students know enough about the located examples of hazard events to compare and contrast the preparation and response in both developed and developing/emerging countries.

Enquiry Question 1: The world's climate system

Teaching approach over five hours

Lesson 1 (1hr)	Global atmospheric circulation
Lesson 2 (1hr)	Natural long-term (Quaternary) climate change and record
Lesson 3 (1hr)	Historical climate change and evidence of anthropogenic signature in the UK
Lesson 4 (1hr)	Anthropogenic causes and evidence of enhanced greenhouse effect (with a focus on the emerging, industrialising world)
Lesson 5 (1hr)	Uncertainty of climate change projections

Lesson 1: Global atmospheric circulation

Overview

The first lesson could tackle Key ideas 1.1 a) and b) together so that students understand how high and low pressure areas drive the three atmospheric circulation cells. These atmospheric cells, along with the thermohaline ocean circulation, serve to redistribute heat energy around the world.

- The topic title is 'Hazardous Earth' so more able students might like to consider how hazards and threats vary across different latitudes (e.g. risks created by thunderstorms at the equator versus long-term drought at the tropics versus flooding in the mid-latitudes).
- Less able students could be guided to describe key features of the circulation pattern, using un-labelled arrows on the diagram.

Key concepts and processes

Much of the content for Key ideas 1.1 a) and b) is new to GCSE Geography courses although aspects of it can be found in units from the 2009 Specification B Unit 1, Section A: Battle for the Biosphere and Section C: Extreme Environments. Some of these ideas are quite abstract, however a focus on the step-by-step logic of the physical processes will help students grasp these ideas confidently.

In summary students need to know and understand:

- the physical processes underlying global atmospheric circulation
- how air moves around the world to create three distinctive atmospheric cells
- how atmospheric cells and ocean currents influence global climatic zones.

A useful starting point is the BBC Bitesize video clip on [Global weather circulation](#)

Starting the topic with an appreciation of the global latitudinal budget (see Figures 1 and 2) will help students be clear about the importance of latitude in determining the intensity of solar insolation and temperature. Students need to understand clearly that:

- Firstly, the sun heats the surface of the earth (more so at the equator) and causes heated air to rise, leading to lower pressure at the surface.
- The 3Cs of convection (cools, condenses, clouds form) explains extreme tropical thunderstorms and rainfall at the Equator where convection is greatest.
- Precipitation at the Equator explains why air is devoid of moisture when it cools in the atmosphere and descends above the tropics, creating high pressure at the surface. This creates the risk of drought at this latitude.
- Winds blow from areas of high pressure to areas of low pressure, creating trade winds that converge on the Equator. Some warmer air moves north, meeting cold air from the poles at the mid-latitudes.
- The differences in air density prevent mixing so the warm air rises over the cold air, causing frontal rain.
- At each pole itself, air is at its coldest and descends, creating high pressure zones creating winds that blow towards the lower latitudes.

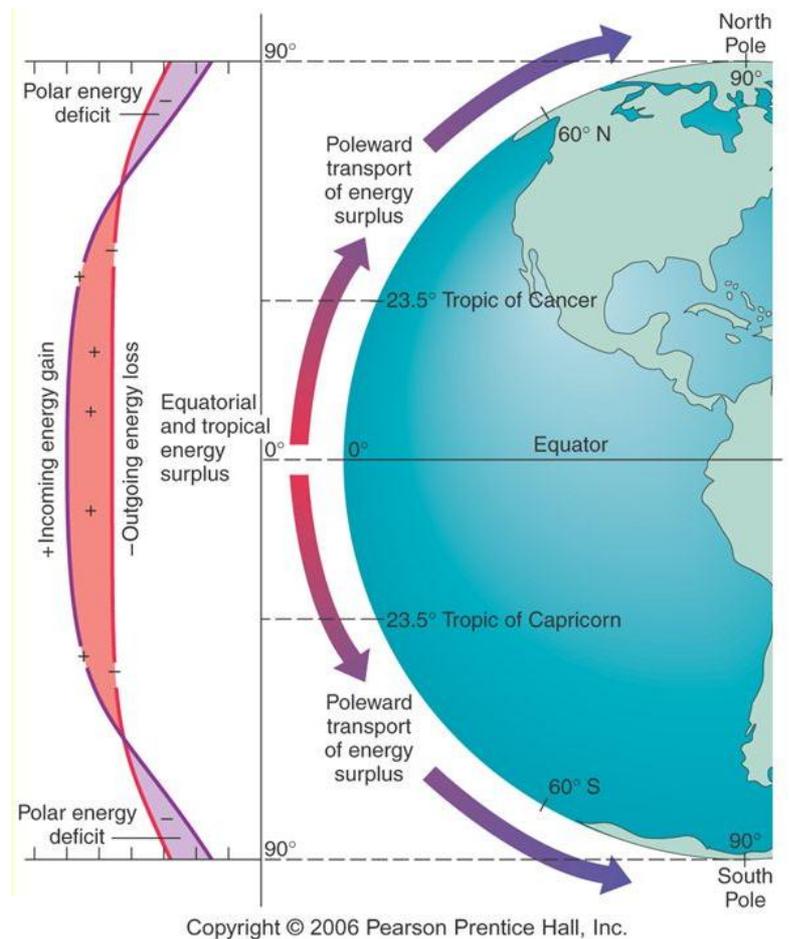


Figure 1

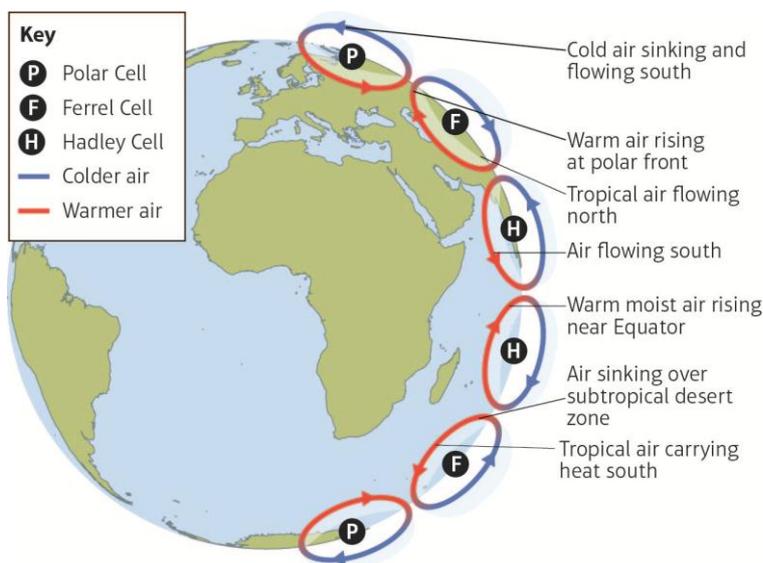


Figure 2

Global ocean currents are also the direct product of this latitudinal pattern, and play a large role in redistributing heat from the Equator to the poles. The circulation is driven by cold water freezing into ice at the poles. This creates denser, saltier sea-water that sinks to the ocean floor. Water flows in behind it at the surface, forming a current. The deep ocean current flows towards Antarctica, then splits off into the Indian and Pacific Ocean where water warms up. The warming makes the water less dense so it loops back up to the surface in the South and North Atlantic Ocean.

Guidance on teaching

Global atmospheric circulation is a seemingly complex but quite logical explanation of different climate regions about the world. Many students confuse the location of deserts and rainforests (thinking the former are at the Equator, whilst not appreciating that rainforests need heat and rain). Starting with this misconception often helps students to develop a logical appreciation of the importance of latitude for temperature and its consequent impact on air-pressure at the Equator, and in turn the rainforest biome. From here on, prior understanding of air pressure from Key Stage 3, including mid-latitude depressions (e.g. storms in the UK) and desert climate can help students piece together the rest of the circulation system, albeit strongly guided by teachers. There can still be a place for 'chalk and talk'!

Linking climate graphs to the different locations is a good way to assess students' understanding of the changes to temperature and rainfall at different locations in the three different cells. But take care as climate graphs will also show seasonal changes in marginal and transitional environments (e.g. the savanna) which might be too confusing for students at this level.

Example strategies for teaching ocean currents include:

- 'Back-to-back' exercise (or drawing by memory) exercise to help students describe the circulation pattern
- Use global satellite imagery of clouds or rainfall to make links to key features of the global circulation diagram (e.g. Figure 8 in the [SAMS pack for Specification A, p.32](#))
- Suggest mnemonics such as the 3Cs (Cools, Condenses, Condensation) and the 3Ds (Density, Descends, Deep), as well as 'Air blows from high to low' rhyme, to help students grasp the terminology and key processes.
- A simple labelling exercise, or Multiple Choice Quiz would be helpful as a recap, perhaps prompted by Figure 8 in the [SAMS pack for Specification A \(p.32\)](#).

Lesson 2: Long-term (Quaternary) climate change and record

Overview

The second lesson could tackle Key idea 1.2a by focusing on long-term climate change. This could be shaped around the context of exploring or explaining the pattern shown in a long-term (Quaternary) climate record such as the Vostok ice core. This creates opportunities to include the integrated skills in your teaching.

- More able students might like to debate the strength of the evidence that climate change is natural problem.
- Less able could use a taboo-style word game to focus on descriptions of the key forcing factors and whether they have a positive or negative impact on climate.

Lesson 3: Historical climate change and evidence of anthropogenic signature in the UK

Overview

The third lesson could tackle Key idea 1.2b by focussing on identifying the more recent human signature of climate change in the context of exploring historical UK climate change. This would include an examination of other historical sources and tree ring data, some of which may date back to Roman times. This could be compared to other global evidence of climate change (e.g. thinning Arctic ice and extreme weather events). Again this creates opportunities to integrate the indicated skills about temperature and sea-level projection graphs.

- More able students have the opportunity to debate whether the UK is going to suffer from climate change as badly as other countries, e.g. within Europe.
- Less able students could focus on the differences between Little Ice Age and Medieval Warm Period using a variety of visual stimuli to show the impact of changing climate.

Key concepts and processes

The natural causes of climate change should be examined at different timescales together with consequent climatological events:

- Geological-scale external forcing mechanisms such as the three types of Milankovitch cycles (eccentricity, tilt and precession) are responsible for defining the scope of the Quaternary.
- Within the Quaternary, the Pleistocene and more recently the Holocene periods major volcanic eruptions, caused global cooling (such as in 1816 – the ‘year without a summer’). Also, 11-year cycle variations in solar output that led to specific events such as the Maunder Minimum and Little Ice Age periods.
- These changes and correlations with the ice age record can be seen through the [Vostok Ice Core record](#).

Students also need to appreciate how UK climate has changed since Roman times. For example, the Roman Warm Period occurred when the warmest moments of all three Milankovitch cycles coincided to produce unseasonably warm climate events, evidenced by distinct tree ring records. The Little Ice Age, following the Medieval Warm Period, can be examined in relation to historical records such as the London Frost Fairs, which were linked to higher volcanic activity and lower solar radiation.

Guidance on teaching

- Playing i-Spy in pairs might help to develop descriptive literacy, particularly if played in two rounds and using descriptive literacy cards, looking first at the historical scale, and then at the geological scale. This helps students appreciate the scale of natural climate change, that human existence can seem insignificant in comparison to geological history, and finally the degree of abnormality in CO₂ concentrations since the industrial revolution.
- SERC provides a useful [step-by-step guide](#) to using satellite images to understand the earth’s atmosphere. The Guardian’s [Satellite Eye on Earth](#) also

provides a weekly collection of recent satellite photos, as well as useful analysis for each image.

- Making sense of the Vostok Ice Core is a critical bit of numerical analysis (Figure 3). Using an idea like 'Grid Thinking' (taken from Mike Fleetham's *Thinking Classroom*) can help break down complex graphs and help students focus on specific aspects. Students roll two dice to establish the co-ordinates of one square to focus their analysis on this area of the graph only.

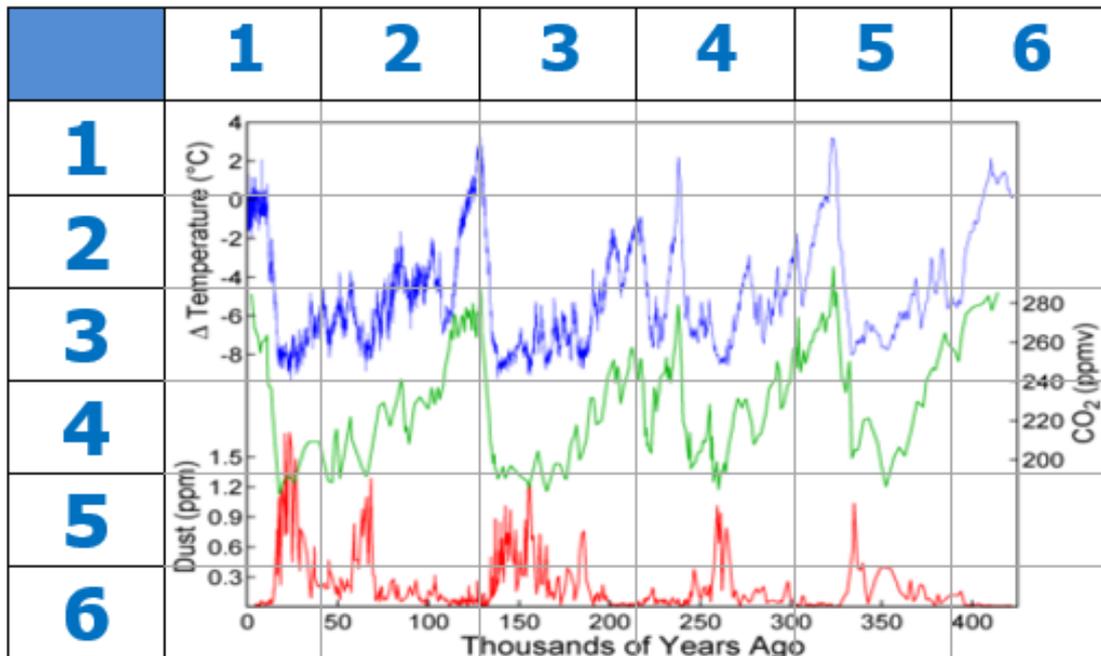


Figure 3

Lesson 4: Enhanced greenhouse effect

Overview

The fourth lesson could tackle Key ideas 1.3 a) and b) with students examining the anthropogenic causes of climate change and consequences on people. They will need to understand the human activities and greenhouse gases that have led to the enhanced greenhouse effect, perhaps by examining evidence to assess its validity.

- More able students might like to consider the context of an emerging country such as China and the contribution it might be making to climate change.
- Less able students could focus on a visualisation game to memorise the key aspects of the enhanced greenhouse effect, including sources of pollution.

Key concepts and processes

Students need to be made aware of rising concern over the enhanced greenhouse effect. They also need to know the difference between incoming short-wave radiation and outgoing long-wave radiation, as well as the role of different greenhouse gases.

There are several opportunities here to develop students' quantitative skills. For example, students could explore IPCC (Intergovernmental Panel on Climate Change) 'forcings charts', the infamous 'Hockey stick' graphs, as well as evidence about the decline in Arctic ice, eustatic sea level rise and thermodynamic ocean expansion. Students could also look at statistical evidence of extreme weather events and how climate change might increase the frequency of these events and therefore the risk to people.

Guidance on teaching

- There are numerous ways to go about evaluating the evidence for and against anthropogenic climate change. A scaffolding technique such as VIPA analysis can be used to consider the **V**alue, **I**mpact, **P**urpose and **A**nanything else that can be said about a range of numerical sources (for example, the data produced in the [5TH IPCC Report, 2014](#). The IPCC [summary of observed changes](#) might also be useful).

Lesson 5: Climate change uncertainty and projections

Overview

The fifth lesson could tackle Key idea 1.3 c), allowing time to develop a clear understanding of the relatively complicated ideas of uncertainty and projections. This lesson could be a form of consolidation or revision, considering the factors that might alter the record of any feature of global climate mentioned in the previous four lessons. These variations can be used to help appreciate the nature of uncertainty.

- More able students might be able to map these uncertainties into the rationale for the adaptation scenarios used in the IPCC report.
- Less able students still need to appreciate the idea of a best or worst case scenario. A scaffolded approach is to link the key factors to a 'living graph' of scenario outcomes.

Key concepts and processes

Students need to appreciate how modelling physical processes and human activity can lead to the creation of global climate models (GCM), which show how sea levels might rise and temperatures might change. Documents like the United Nations Environment Programme (UNEP) 2011 Synthesis report may be useful for teachers as it provides information on the expected impacts of different policy decisions.

Uncertainty broadly results in a series of projections. There are four 'Representative Concentration Pathways' (RCPs). These are different pathways that humans may take in the 21st century: stringent mitigation, very high GHG emissions, and two intermediate pathways. It is useful to note that these have replaced the four 'Special Report Emissions Scenarios' (SRES) from the previous IPCC report. This focus on uncertainties is because of the breadth of different factors, some of which increase global warming, whilst others cause cooling, and not all of them are well understood. This is also true of global processes (e.g. carbon cycle) and future human activity.

Guidance on teaching

The study of weather and climate, including the change in climate from the Ice Age to the present, is part of the statutory KS3 Geography curriculum. However, understanding climate change projections and global climate models can be difficult:

- Ask students to consider a single global atmospheric cell and think about the implications of combining different factors. Human factors are population growth, deforestation, policy direction and action, and the stage of industrial growth. Physical factors are Milankovitch cycles, sunspots, volcanoes, ice melting (with the associated feedback loops) and aerosols.
- Cross Roads Thinking (adapted from Mike Fleetham's *Thinking Classroom*):
 - Ask students to pick two factors, e.g. population change and Milankovitch eccentricity, and write pairs of words to represent two extremes - e.g. 'population rise and population fall'
 - List the possible combinations and consider the implications for temperature or sea-level change: population rise and closest orbit, population rise and furthest orbit, population fall and closest orbit, population fall and furthest orbit
 - Finish by asking about the worst possible combination of factors as well as the best combination, therefore denoting the intermediate scenarios
 - This then links to the four different RCPs (2.6, 4.5, 6.0, 8.5).

Key vocabulary for EQ1

Global atmospheric and oceanic circulation	Natural climate change	Anthropogenic climate change
Heat budget Latitude Insolation Convection Condensation Equator High / low pressure Frontal rain Air circulation Desert Trade winds Hadley cell Ferrel cell Polar cell Mid-latitudes Air density Thermohaline circulation	Geological scale Forcings External Milankovitch Cycles Precession Eccentricity Tilt Quaternary Pleistocene Holocene Sunspot cycle Maunder minimum Little Ice Age Vostok Ice Core Roman Warm Period	Enhanced greenhouse effect Short-wave Long-wave Eustatic Thermal expansion Intergovernmental Panel on Climate Change (IPCC) Albedo Positive feedback Projections Representation Concentration Pathways (RCPs) Tropical cyclones Hurricanes Typhoons

Further reading

- The NOAA website provides information about [Global Ocean Currents](#)
- The UK Met Office website provides information about the [Global Circulation Pattern](#)
- The BBC's *Earth: The Power of the Planet* series has an excellent introduction to [Ocean Currents](#), and more details about their complexity using [rubber ducks](#) lost at sea
- Use these [Global Earth Observatory maps](#) to explore the similarities in patterns for different earth systems and the diffusion of different gases
- Use the [Living Earth app](#) to explore real time satellite data about temperature, wind, cloud patterns and hurricanes
- This [Quantitative data lesson](#) provided by NASA can be used to explore ocean currents and sea surface temperature, as well as providing useful information on the [earth's energy balance](#).

Enquiry Question 2: Extreme weather events (tropical cyclones)

Teaching approach over five hours

Lesson 1 (1hr)	Distribution, formation and characteristics of tropical cyclones
Lesson 2 (1hr)	Physical hazards of tropical cyclones and their impacts on people and their environments in a developed country
Lesson 3 (1hr)	Preparation and response by a developed country
Lesson 4 (1hr)	Physical hazards and their impacts on people and their environments in a developing or emerging country
Lesson 5 (1hr)	Vulnerability and management in a developing/emerging country

Lesson 1: Formation of tropical cyclones

Overview

It is worth planning to cover Key idea 1.4 in one lesson so students understand the causes of tropical cyclone formation, particularly in the context of ideas studied earlier about global atmospheric circulation. Studying the location and frequency of hurricanes in the Atlantic Ocean (particularly the few recent exceptions in the southern hemisphere) will help students explore how tropical cyclone tracks change over time.

A global perspective on tropical cyclone patterns is useful so that students know how locations and tracks differ for hurricanes and typhoons, as well as the impact global warming may have on the severity and frequency of tropical cyclones.

- More able students might like to explore causes of climate variability and changes over time, as well as the Coriolis force in more detail.
- Less able students must be clear about the major factors causing tropical cyclone formation and which aspects could be affected by global warming.

Key concepts and processes

The structure of a tropical cyclone can be taught through a step-by-step explanation of the physical processes:

- Warm oceanic water either side of the Equator begins to evaporate at the surface and air rises through convection, heavy with water vapour.
- This leaves a low pressure area at the surface of the water, which sucks in more air from the surroundings.
- As the air rises it begins to rotate, creating the eye wall, which is where the strongest winds are found.
- When the rising air reaches the top of the cyclone, the air flows away from the centre, leaving a layer of cirrus clouds that continue to spin.
- The air flowing away cools and sinks back to the ocean where the warm ocean water heats the air again, causing it to rise and continuing the cycle.
- The cyclical convection of warm, moist air results in bands of thunderstorm clouds on either side of the eyewall.
- Air that sinks within the eye wall results in high pressure at the centre of the cyclone where calm, cloudless skies are found, known as the eye of the storm.

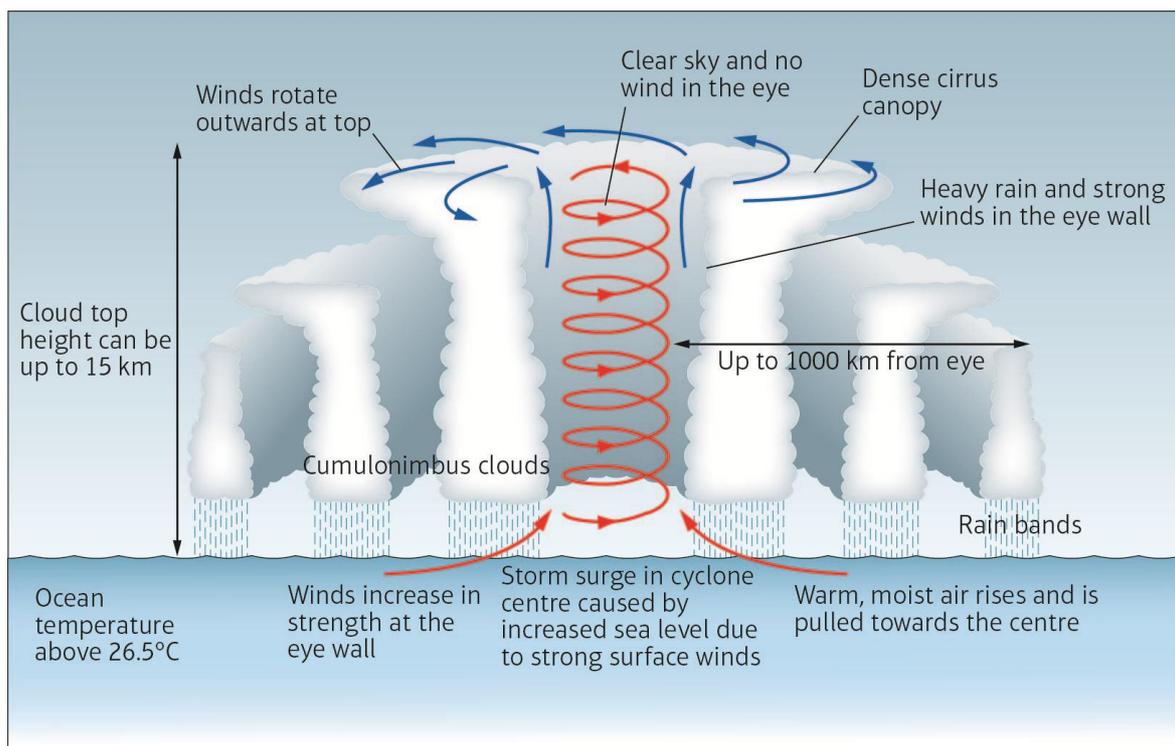


Figure 4

Guidance on teaching

- An opportunity to integrate the use of GIS to track tropical storm formation has been highlighted in the specification. Separate GIS lesson plans and worksheets will be made available on the Edexcel website.
- Coriolis force: there are various videos to illustrate this principle. One particularly good one is from [NOVA PBS](#) and another is used in the [BBC's Orbit: Earth's Extraordinary Journey programme](#)
- A diamond ranking exercise would help assess students' understanding of the different factors: latitude, evaporation, pressure differences, Coriolis force, precipitation, wind, eye wall, sea surface temperature, subtropical ridge. The reasons they give will help you judge their understanding of the links between the key processes.
- Based on an understanding of tropical cyclone formation and structure, students could be challenged to use data from two tropical cyclones and decide whether Atlantic-hurricanes are more or less intense than Pacific-typhoons.

Lessons 2 and 3: Tropical cyclones in a developed country

Overview

These two lessons focus on a tropical cyclone hitting a developed city, e.g. Hurricane Sandy's impact on New York in 2012. This located example is good for helping to appreciate the importance of successful management strategies, including hurricane prediction, as well as the potential economic impacts of strong hurricanes hitting major cities in the developed world (e.g. New York being a global financial hub).

- More able students might consider the role of computer models and engineering management strategies using the statistical probabilities of natural hazards.
- Less able students should understand how a city prepares for tropical cyclones, as well as appreciating that the main costs are economic, rather than social.

Key concepts and processes

The issues surrounding the hazard management of tropical cyclones are similar in nature to tectonic hazards. Satellite tracking and predictions of Saffir-Simpson magnitude of individual events is a critical part of planning, particularly when attempting to predict the impacts of coastal flooding.

Even in the developing world, tropical cyclone forecasting often depends on developed countries. Evacuation measures and preparation are supported by computer-driven models of human behaviour, in contrast to developing or emerging countries where those responsible for governance are often victims themselves. There is a growing use of crowd-source mapping and co-ordinated global humanitarian responses to developing or emerging country hazard events.

Guidance on teaching

- [Storm surge data and Saffir-Simpson magnitude data](#) for Atlantic and Pacific Ocean storms provided by NOAA (e.g. 2015 hurricane season shown here). Students should be able to make sense of the different scales and methods of measuring the physical characteristics of tropical storms.

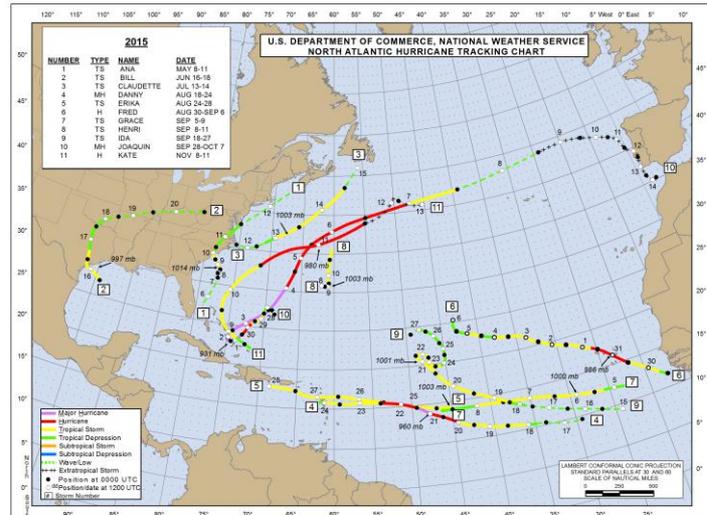


Figure 5

- Hashtag searches are useful for investigating the impact of tropical storm events (e.g. #Sandy). For centres studying the course over three years, there is an opportunity to spend one lesson on this to examine different attitudes towards the hazard event, perhaps between different affected groups: individuals, organisations, NGOs, TNCs and governments.
- Contrasting imagery could be used to catalogue the impacts of events in a developed versus a developing or emerging country.

Hurricane Sandy, which struck New York City in October 2012, is a good located example to showcase the impacts of a tropical storm in the developed world. It highlights how countries respond to challenges created by a globalised world. For this case study, students should familiarise themselves with the following details:

- hurricane characteristics (wind, pressure, rainfall, category)
- prediction of the storm, for example, the role played by European forecasting (based in Reading, UK) in accurately predicting the track
- preparations, including the role of computer modelling, which forecast potential damage to the subway
- the impact on the physical environment, for example, how the storm surge affected the city
- the economic damage in the short term and longer term
- immediate responses to the hazard and long-term future planning.

Lessons 3 and 4: Tropical cyclones in developing or emerging countries

Overview

Students also need to study a tropical cyclone hitting a developing or emerging country, e.g. Typhoon Haiyan's impact on South-east Asia in 2013. This located example can help students appreciate the physical and social vulnerability of these countries, as well as why management is difficult in a different socio-economic context. The two tropical cyclone located examples provide an opportunity for students to explicitly contrast management approaches in different socio-economic contexts, with scope to explore physical hazards and vulnerability in a location of their choice.

- More able students might like to consider how a combination of hazards and vulnerability creates hazard hotspots in particular parts of the world. This is particularly the case when combined with work on development dynamics.
- Less able students should be aware that a hazard created by tropical cyclones has far more devastating consequences in a developing or emerging context.

Guidance on teaching

For this case study, students should familiarise themselves with the following details:

- the typhoon characteristics (wind, pressure, rainfall, category).
- prediction of the storm, particularly the role played by other countries, in contrast to the somewhat less effective prediction by the Filipino government
- the impact on the physical environment, i.e. the storm surge and how this affected the city, particularly Tacloban City
- the huge social damage (loss of life) and long-term economic impacts
- lack of preparations made, leading to socio-political problems encountered during initial aid responses, as well as the humanitarian crisis
- the role of open source mapping and environmental planning for hazard management in the future.

There is a wealth of information published about hazard events. Below are some excellent sources for detail about Typhoon Haiyan but similar sources could be used for the previous located example.

- Summaries of the event from the [Geographical Association](#) and [Royal Geographical Society](#)
- [National Geographic](#) explains the physical characteristics
- [The Economist, November 2013](#) – Physical characteristics, immediate aftermath and long-term responses
- [evaluation of that](#)
- [The work of MapAction](#) in creating open source maps for disasters
- Geofactsheet 318: Super-Typhoon Haiyan

Key vocabulary for EQ2 - The key vocabulary is the same as that used for EQ1.

Enquiry Question 3: Tectonics

Overview

Start with one lesson about the earth's structure and how this drives plate tectonic processes. The second and third lessons then look at plate boundaries and the contrasting hazards found at these boundaries. There is freedom to choose whether to study earthquakes or volcanoes in relation to the impacts and managements of tectonic hazards, and centres must remember that a minimum of two located examples should be used (a developed and a developing or emerging country).

- More able students might explore the subjectivity of classifying one tectonic event as 'worse' than another.
- Less able students would benefit from a framework or table to make sure they have key factual knowledge of the main aspects of two located examples, perhaps highlighting the most significant facts in terms of damage.

Key concepts and processes

Students need to have knowledge and understanding of the following:

- the distinctive layers that make up the Earth's structure and how its core drives convection currents.
- the three types of plate boundary, hotspot theory and volcano types.
- two located examples of impacts and management strategies for **either** earthquakes **or** volcanoes, in both a developed and developing or emerging country.

You could plan a series of examples that cover all three types of plate boundary, whilst also including a tsunami event, to help contextualise the hazards in general. Then more in-depth located detail can be taught about the impacts and management of events for **either** earthquakes **or** volcanoes.

As with tropical cyclones, there is extensive material online about a range of different tectonics events and theory, some of which are highlighted below:

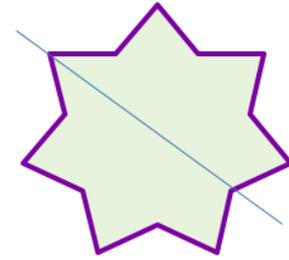
- [Fundamentals of Physical Geography eBook](#)
- BBC *Earth: The Power of the Planet*, [Introduction to the Earth's plates](#)
- BBC World Physical: [Plate tectonics in New Zealand](#)
- Guardian, December 2006 - [Tectonics in Istanbul](#)
- CNRS research into [early warning signs](#) of earthquakes in Turkey
- BBC News, August 1999 - [Turkey's long-term recovery](#)
- The World Bank, October 2013 - [Preparing for bigger earthquakes](#)
- [Geographical Association summary](#) of Japanese earthquake and tsunami in 2011
- The Telegraph, March 2013 - [Tsunami warning system in Japan](#)
- World Vision, September 2011 - [Long-term effects of Japan earthquake](#)

Guidance on teaching

- Often students have covered the theory of plate tectonics in GCSE Science, or in KS3 Geography (although it is not part of the statutory content). Revision of the ideas about plate boundaries and earth's structure can be sufficient.
- Understanding the differences between types of magma and the explanation for shapes of volcanoes can be trickier for students, and the correct analogies about lava flow are essential. If centres can source examples of different rock types to showcase the differences between andesitic and basaltic lava, or differences in lightness and crystal size, this can make the teaching much less abstract.
- For the more adventurous, there are a number of chemistry experiments that help to demonstrate various tectonic processes. The [Royal Society of Chemistry](#) is a good starting point online.
- Comparisons between case studies are sometimes difficult for students, particularly in the less than clear-cut way that real world examples actually operate. A table like the one below would ensure students have collated sufficient case study detail to prepare for the exam.

	Izmit (Turkey, 1999)	Tohoku Tsunami (Japan, 2011)
Primary impacts		
Secondary impacts		
Social impacts		
Economic impacts		
Environmental impacts		
Short-term relief (shelter / supplies)		
Long-term relief (trained services)		
Preparation - warning / evacuation		
Preparation - building design		
Prediction?		

- Alternatively, the star comparison exercise might challenge more able students to find eight different ways to compare the impacts of two contrasting hazards. They could use the categories from the hazard profile chart to prompt their thinking. This is also an exercise in the correct use of comparative vocabulary (the key vocabulary could be displayed around the room to further support students).



MAGNITUDE	Enormous		Small
SPEED OF ONSET	Rapid		Slow
DURATION	Long		Short
AREAL EXTENT	Widespread		Limited
SPATIAL PREDICTABILITY	Random		Predictable
FREQUENCY	Frequent		Rare

Figure 6

- Often questions can be asked about the pattern or distribution of earthquakes and volcanoes. The biggest barrier to students can again be the correct vocabulary, as well as the time taken to apply their knowledge and understanding to unusual patterns. A useful exercise might be to take the following sentence prompts and ask students to annotate a map with them

- In the N/E/W/S (side of)
- Mainly located above / between ... latitude
- Close to...
- Inland / on the coast of
- Unevenly distributed, evenly
- Next to / surrounded by
- (Relatively) biggest area in
- (Relatively) Smallest area in
- Occupies
- Borders
- Not all of...
- Anomalies

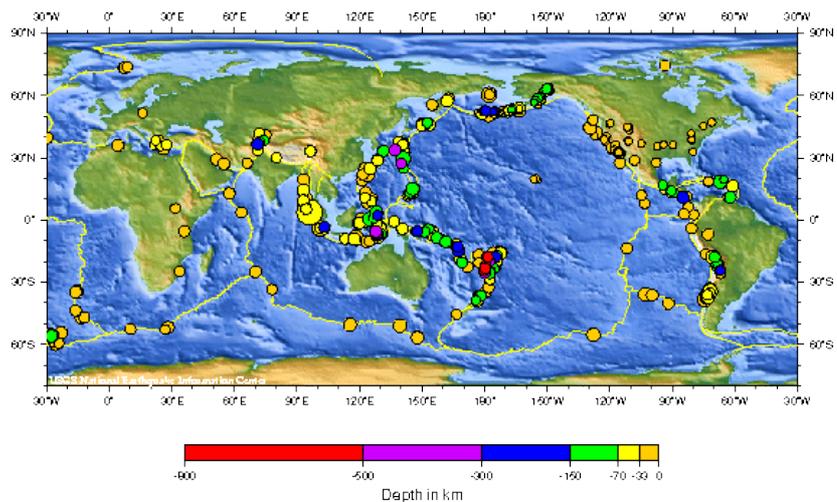


Figure 7

The Science Education Resource Center (SERC) at Carleton College, USA, has a wealth of teaching resources. In particular the ['Using Data in the Classroom'](#) page provides some excellent advice on how to manipulate data to create visualisations. For example, the map above depicts the location and depth of earthquakes occurring over a 30-day period, and was generated by the USGS Earthquake Hazards Program (EHP).

Key vocabulary for EQ3

Earth's layered structure	Plate boundaries, volcanoes and earthquakes	How tectonic hazards affect people
Inner core Outer core Mantle Asthenosphere Lithosphere Continental crust Oceanic crust Convection currents Radioactive decay Plate boundary	Basaltic magma Andesite magma Viscosity Silica content Pyroclastic Hotspots Subduction Ridge Ocean trench Convergent Divergent Conservative Magnitude	Vulnerability Capacity Evacuation Prediction Primary impacts Secondary impacts Preparation Mitigation Response Short-term relief Long-term planning