Scheme of work: Hazards

Introduction

This scheme of work (SOW) offers a route through the AS and A-level Geography (7036 and 7037) specification, with a core focus on Physical Geography, optional topic Hazards.

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: 3.1.5 Hazards

Introduction of Hazards

Specification content

3.1.5.1 The concept of hazard in a geographical context
Nature, forms and potential impacts of natural hazards (geophysical, atmospheric and hydrological).

Learning outcomes

This lesson will help students to understand:

- How a hazard can be defined.
- Examples of different types of natural hazards, including: geophysical, atmospheric and hydrological.
- The terms 'risk' and 'vulnerability' with reference to natural hazards. The components of risk; vulnerability and exposure, plus risk drivers and how a hazard can become a disaster.

Suggested timing

1 hour

Possible teaching and learning activities

- Students could begin by naming the hazards they are aware of, including those previously studied, but also drawing on those they may be aware of from current affairs and news media.
- Recent/current news could contain examples of hazards, so there may be an opportunity to identify 'Geography in the news', especially if teaching is occurring at a time of year that might coincide with broadly seasonal events such as tropical storms or wildfires in different hemispheres. These could be used as introductions to begin discussions about what a hazard is, types of impacts, suggesting why impacts might vary etc. Students could study photographs and identify the visible evidence that a hazard has occurred.
- Identify the categories of geophysical, atmospheric and hydrological. Students could then categorise hazards they have identified into these classifications. There may be opportunities for discussion of any hazards that could be linked to more than one category.
- Students could research definitions of hazard, risk and disasters, including those from agencies such as the UN.
- Introduce the concepts of risk and vulnerability. This could be explored through various models such as the Disaster Crunch model (adapted from Pressure and Release; slide 17 from the GEO slides), the Degg Model (Redfern). The World Risk Report refers to these concepts and identifies the most at-risk countries.

- Using the UNDDR Prevention web link below, students could research and identify the 'Risk Drivers' outlined on the web page and identify which might apply to locations they may be aware of. (This could also/alternatively be used alongside the recent examples and case studies).
- Case study and recent example locations and characteristics *could* be introduced at this stage, to provide real context for identifying and comparing risk and vulnerability. Students could briefly research one of these locations individually or in groups to identify and assess the human factors leading to vulnerability in these areas.

Resources

- Read Global Disaster Alert and Coordination System to view a live map of recent events.
- Read Dimensions of natural disasters | Geography Education Online The presentation includes some excellent resources and slides that could be used or developed into different learning activities for this lesson and the following one.
- Read Understanding Disaster Risk (PreventionWeb – UN).
- Read The Disaster Crunch Model: Guidelines for a Gendered Approach - Oxfam Policy & Practice – additional/extension reading which highlights the differing vulnerability and needs of different groups, especially women. This could be adding an additional dimension to recent examples and case studies.

Hazard perception and responses to hazards

Specification content

3.1.5.1 The concept of hazard in a geographical context

Hazard perception and its economic and cultural determinants. Characteristic human responses – fatalism, prediction, adjustment/adaptation, mitigation, management, risk sharing – and their relationship to hazard incidence, intensity, magnitude, distribution and level of development.

Learning outcomes

This lesson will help students to understand:

- The factors influencing the perception of natural hazards.
- Three key responses to natural hazards: fatalism, adaptation and fear.
- How these responses might be related to hazard characteristics.

Suggested timing

2 hours

Possible teaching and learning activities

- Students could be presented with an account or fact file of a hazardous event and asked what they might do if they were in the location at the time. This could be done through their own personal perception (for example, as a tourist caught in an earthquake or tropical storm event) and then asked to suggest how their perception might be different if it were occurring in their home city/town/village.
- This could lead on to an introduction about perception and the factors, characteristics and lived experiences that might lead to differences. (Read the article Characteristic Human Responses to Hazards (Tutor2u) the concept of positionality from Changing Places, that might help students to identify factors affecting perception and responses to hazards).
- Opportunity to ask students to define and explain the three key responses to natural hazards: fatalism, adaptation and fear. Students could suggest and identify places where certain responses might be evident, suggesting potential differences between urban and rural, link back to the factors affecting perception of hazards. Students should be aware that within one location, all three responses might be present in different parts of a community.
- The key terminology of hazard incidence, intensity, magnitude, distribution could then be defined using Hazards and disasters – risk assessment and response (The Geographer online) and for each one, students could suggest how these factors might determine the characteristic human responses.

Hazard Management

Specification content

3.1.5.1 The concept of hazard in a geographical context

- The Park model of human response to hazards.
- The Hazard Management Cycle.

Learning outcomes

This lesson will help students to understand:

- The key ideas relating to the management of natural hazards at different scales.
- How to explain the Park model and the Hazard Management Cycle.

Suggested timing

1 hour

Possible teaching and learning activities

- Students could be given a brief scenario/fact file of a location that experiences a specific hazard or multiple hazards. They are then to assume the role of the local council and national agency tasked with managing the risk of a hazard. They could come up with a list of questions and information they require and then a list of actions that could be taken to prepare the area, and its inhabitants, for a potential hazard event.
- Prior to introducing the Park model and the Hazard Management Cycle, students could suggest general categories to identify the stages of hazard management that might be required.
- Introduce the Park model; students could produce a diagram of this, identifying the stages and suggesting the actions that might take place during each stage.
- Introduce the Hazard Management Cycle; students could complete similar activities for this.
- For both these models, students could use a summary of a case study to enable them to apply 'real' examples to these models.
- Students could identify similarities and differences between the models and suggest strengths and weaknesses of each.

Resources

- Read the article Hazard Models – The Park Model (Tutor2u).
- Read the article Park's Model made SIMPLE (The geography teacher).
- Read the article The Hazard Management cycle (Tutor2u)
- Read the article The Hazard Management Cycle made SIMPLE (The geography teacher).
- Read the article Play and learn to stop disasters (UNDRR) UN disaster management game; could be used to support learning of risk management in hazardous environments.

The structure of the Earth, plate tectonic theory and plate movement

Specification content

3.1.5.2 Plate tectonics

Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea-floor spreading.

Learning outcomes

This lesson will help students to understand:

- The sources of energy within the Earth, and the structure of the planet.
- The internal structure and characteristics of the Earth at different depths from the surface; oceanic and continental crust, lithosphere, asthenosphere, mantle, outer and inner core.
- The concept of Plate Tectonic Theory and the origin of the Earth.
- The characteristics and origin of continental and oceanic crust.
- The development of theories into the drivers of plate movement, including the sources of the Earth's internal heat energy.
- How the theories of gravitational sliding, slab push, ridge pull, convection currents and seafloor spreading support our understanding of crustal movements.

Suggested timing

2 hours

Possible teaching and learning activities

- Students could start by attempting to recall/suggest the structure and characteristics of the Earth from crust to core. They could be provided with a list of familiar and less familiar terms such as lithosphere, asthenosphere etc. to prompt and challenge them.
- They could then watch the Time for Geography clip: Structure of the Earth to identify the different characteristics of layers within the Earth.
- They could then research these and produce a series of fact files and/or a detailed annotated cross section diagram of the Earth, with detail about all the layers, including continental and oceanic crust.
- Students could read through the 'Pioneers of Plate Tectonics' information from the Geological Society to understand the evolution of the theory over time; this may be useful to their general understanding of scientific discovery and research.
- Building on their knowledge of the structure of the Earth and of the general concept of the crust being diving into plates, students could work with maps showing plate margins and direction of movement. Activities could include colour coding margins, annotating direction and/or rate of movements and identifying general patterns of volcanic and seismic activity.
- Students could then research the theories behind the movement of the plates.

- Convection is likely to be the most familiar concept from prior learning, so this could be covered first, but students could then be introduced to the more recent development of theories that suggest this is not a single driving force.
- Gravitational sliding, Ridge push, slab pull and sea-floor spreading could be introduced via reading of resources, modelling, diagrams etc. Students could suggest how the processes operate together to move the plates of the crust.

Resources

- Read the article Plate Tectonics (The Geological Society).
- Watch the 12 minute video: APES Unit 4: Plate Tectonics Review (Earth Science Classroom) (First five minutes is a general introduction/review).
- Read the article Core (National Geographic) which introduces the heat and energy sources.
- Watch the 8 minute video How Does Plate Tectonics Work? (Earth Science Classroom) (does only mention convection as driver).
- Watch the 3 minute video How do Tectonic Plates Move? (Tutor2u).
- Watch the 1 minute video Slab Pull Demo | How Tectonic Plates can PULL on Each Other to Speed SUBDUCTION (using paper clips) (Science Classroom).
- Read the article Plate Tectonics: Influence of Gravity on Plate Movement (Tutor2u).
- Watch the 4 minute video Marie Tharp: Uncovering the Secrets of the Ocean Floor - with Helen Czerski Sea floor spreading highlighting the achievements of women in science (links to seafloor spreading). (The Royal Institution).

Plate margins and associated hazards and landforms

Specification content

3.1.5.2 Plate tectonics

Destructive, constructive and conservative plate margins. Characteristic processes: seismicity and vulcanicity. Associated landforms: young fold mountains, rift valleys, ocean ridges, deep sea trenches and island arcs, volcanoes. Magma plumes and their relationship to plate movement.

Learning outcomes

This lesson will help students to understand:

- The processes that occur at constructive margins leading to the divergence of oceanic crust and divergence of continental crust.
- How movements lead to the formation of rift valleys and ocean ridges.
- How movements link to seismic and volcanic hazards.
- The processes that occur at different types of destructive margins: oceanic and continental crust, oceanic and oceanic crust and continental and continental crust.
- How these movements lead to the formation of young fold mountains, deep sea trenches and island arcs and volcanoes.
- How conservative margins link to seismic processes and why vulcanicity is not a characteristic process at these margins.
- How these margins/faults can be found alongside constructive margins.
- How magma plumes originate within the mantle.
- How hot spots are created and lead to the formation of volcanic activity on land and volcanic island chains, showing the relationship to plate movement.

Suggested timing

3 to 4 hours

Possible teaching and learning activities

Constructive plate margin:

- Students begin by looking at the map showing the ocean depths and bathymetry. Using the satellite view on Google Maps and zooming out to a global scale shows this well. Starting in the Atlantic, they could track the margin between the Eurasian and North American Plates; African and South American plates, describing the topography and visible characteristics.
- Watch the Time for Geography video clips Divergent (constructive) plate boundaries (5 minutes) and Conservative (transform) plate boundaries (4 minutes) and the Geological Society animations to explain the movement and processes Divergent Plate Boundaries and Conservative Plate Boundaries (1 minute each).
- Students draw a cross-section diagram of the Mid Atlantic Ridge, with annotations explaining the transform faults and links to seismic and volcanic activity.

- Similar diagram could be produced for the African Rift valley, with examples of the key volcanic landforms. Watch the 7 minute video Continental Rifting and Rift Valley Formation (Earth Science Classroom) which explains this process very well.
- Students create a poster/single page summary for this margin, with key processes, landforms and examples.
- Students begin a summary table for each margin (with rows for future additions) identifying the movement, processes, landforms, hazards including volcanic eruption types and earthquake depths etc., and examples of locations.

Destructive plate margin:

- Students could identify the location of destructive margins on a map and find examples of convergence of different types of crust.
- They could be challenged to explain why subduction might occur, by recapping the characteristics of continental and oceanic crust.
- Whiteboard/tablet/paper sketches could be used by students to suggest what might happen in the three different crust combinations.
- Students introduced to the 'mystery' of fossils of sea creatures in the Himalayas and aim to explain this. The Geological Society animation will support this.
- All margin variations can be supported with diagrams and examples.
- Students create a poster/single page summary for this margin, with key processes, landforms and examples.
- Information could be added to the summary table created for the previous margin and students could begin to identify any common and contrasting processes and landforms.

Conservative plate margin:

- Students refer back to satellite view on Google Maps and identify the transform faults alongside the Mid Atlantic Ridge.
- Students study a map of global plate margins and identify areas where plates appear to be moving alongside each other.
- Watch the 2 minute video and sketch a diagram identifying an example of a conservative margin.
- Students create a poster/single page summary for this margin, with key processes, landforms and examples.
- Students complete their summary table of margins, and practice explaining the processes and outlining the differences between the processes and landforms found at each margin.

Magma plumes:

- Studying a map of plate margins and volcanic activity, students could look for examples of volcanoes that are not located near a plate margin.
- They could then watch the Hawaiian Islands - Plate Margins (Geological Society) animation of Hawaii and look at the same are on Google maps satellite view. They could trace the chain along to Midway Atoll and beyond and explain how this illustrates plate movement.
- Students could produce detailed annotated maps/cross-sections through the island chain of Hawaii and remnant seamount chains to help explain hot spots and their relationship to plate movement.
- They could summarise the formation of a volcanic island chain such as Hawaii either as a paragraph, a cartoon-strip/storyboard series of diagrams, or a flow diagram.

Resources

- Read the article Landforms associated with plate tectonics (Geography Education Online) introduction with summary of each margin and other landforms.
- Watch the 12 minute video APES Unit 4: Plate Tectonics Review (Earth Science Classroom) (from five minutes, the focus is on all plate margins).
- Read the article Fossils of Mount Everest (volcano café).
- Read the article Reading around tectonic processes and landforms (Geography Education Online) Some of the linked articles may be useful as extension reading.
- Watch the 11 minute video What Is A Transform Plate Boundary? (Earth Science Classroom).
- Watch the 12 minute video What Is A Volcanic HOTSPOT? (Earth Science Classroom).
- Watch the 2 minute video How Did Hawaii Form? (Scientific American) – also links forward to lava and eruption characteristics in the next lesson.

Volcanic hazards

Specification content

3.1.5.3 Volcanic hazards

- The nature of vulcanicity and its relation to plate tectonics.
- Spatial distribution, magnitude, frequency, regularity and predictability of hazard events.

Learning outcomes

This lesson will help students to understand:

- The spatial distribution of volcanic activity globally in relation to plate margins and hot spots.
- The relationship between volcanic eruption characteristics, magma and tectonic setting.
- How magnitude of volcanic eruptions can be measured and its relationship to frequency.

Suggested timing

2 hours

Possible teaching and learning activities

- Students could begin by identifying all they already know about volcanic eruptions. This could include famous contemporary and historic events and critical comments, and questions about portrayal of volcanic activity in various media.
- Look at the maps of plate margins, and summary tables, and identify where volcanic eruptions occur.
- Introduce the idea that magma, and therefore lava characteristics can be linked to the tectonic setting and plate margin. Students to watch the 5 minute video (Earth Science Classroom) to understand the different types of magma, and how this relates to eruption characteristics and type of volcanic cone created.
- Introduce the VEI measurement of eruptions, which can then be linked to eruption type, frequency and magma.
- Students could create paper or digital (text boxes on a PowerPoint slide) sorting cards, each with a volcano/eruption type and move them around in order according to most to least explosive, silica content/lava viscosity, frequency of eruption etc.
- At this stage, students could begin to research the named example of a volcano that will be used as an example of a recent event and identify the characteristics of the volcano and its setting.

Resources

- Read the article volcanoes (Geological Society) Clear overview introducing the topic of volcanoes that could be used as starting point for this lesson.
- Watch the 5 minute video Defining Magma, Lava Types, Eruptions & The VEI Scale (Earth Science Classroom).
- Read the article Types of volcano (British Geological Survey).
- Watch the 13 minute video Volcano Types (Earth Science Classroom).

- Watch the 9 minute video Tectonics, lava and different types of volcano (Time for Geography).
- Watch the 4 minute video The size of volcanic eruptions (Time for Geography).

Volcanic hazards and their impacts

Specification content

3.1.5.3 Volcanic hazards

The nature of vulcanicity and its relation to plate tectonics:

- Forms of volcanic hazard:
  - nuées ardentes
  - lava flows
  - mudflows
  - pyroclastic and ash fallout
  - gases/acid rain
  - tephra.
- Impacts:
  - primary/secondary
  - environmental
  - social
  - economic
  - political.

Learning outcomes

This lesson will help students to understand:

- how volcanic eruptions create primary hazards in the form of nuées ardentes, lava flows, pyroclastic and ash fallout, gases and tephra.
- how volcanic eruptions can lead to secondary hazards such as mudflows, flooding, tsunamis, acid rain and climate change.
- the characteristics of these hazards, and the primary impacts they can cause.
- impacts of volcanic hazards can be classified by primary/secondary, environmental/social/economic/political, and that they might vary in scale and temporality.

Suggested timing

2 hours

Possible teaching and learning activities

- Give the students a list of the hazards mentioned above to establish what they already know, or think they know about the hazards. Can they define them all and suggest how they are linked to volcanic eruptions?
- Hazards could be sorted into primary and secondary to identify the direct impacts of an eruption and the hazards that can occur following the ejection of material.
- Students could then use videos such as the VolFilm playlist (14 videos) and text resources to outline each hazard, identifying the processes causing each, the characteristics and the brief potential impacts (more detail on impacts can be added next lesson).
- Students could then discuss and evaluate which hazards are more localised or widespread in potential scale, temporal scale, potential for management such as mitigation of the

hazard etc. They could suggest which ones are more/less hazardous to people, property/infrastructure, farmland etc.
- This could lead into a summary of the hazards produced in the recent example being studied.
- Students could use online resources and/or videos to identify the Impacts. Impacts can be classified as immediate and longer term, social, economic and environmental. When summarising impacts, one approach might be to identify any responses that address the impact. Alternatively, some might prefer to complete the impacts and subsequently outline the responses separately.

Resources

- Watch the 6 minute video Volcanic hazards (Future Learn) introduces hazards and classifies them into Primary and Secondary.
- Read the article Volcanic hazards (British Geological Survey) includes embedded VolFilm videos.
- Watch the 14 videos VolFilm playlist Educational films about hazards (lava, pyroclastic flows, lahars, volcanic gases, ashfall) with first had 'experience' videos from local people in Montserrat and Ecuador who tell their stories of witnessing eruption impacts.

Responses to volcanic hazards

Specification content

3.1.5.3 Volcanic hazards

Short and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.

Learning outcomes

This lesson will help students to understand:

- responses can be immediate and longer term, linking into management of future events.
- the varying aspects of contemporary risk management applied to volcanic hazards: preparedness, mitigation, prevention and adaptation, and how these are evolving with developing technology and research.

Suggested timing

2 hours

Possible teaching and learning activities

- Responses can be categorised by scale (individual/community/local, regional, national, international). This could also link to perceptions/characteristic human responses to hazards. Some responses might be responses to the monitoring and warning of the threat/risk, and therefore occur prior to an eruption. All responses could be classified by temporal scale, starting with those occurring immediately during/after the eruption if not before.
- Each response or management strategy could be categorised as: preparedness, mitigation, prevention and adaptation. Students could discuss what each of these means in the context of different scenarios, based on volcanoes in differing locations.
- Students could identify the limitations and challenges of risk management of volcanoes in different settings. Depending on the example chosen, there may be a range of actions in place, or less comprehensive management prior to the recent event being studied.

Resources

- Read the article Comprehensive monitoring provides timely warnings of volcano reawakening (U.S. Geological Survey) outlines methods used to monitor volcanoes in the USA.
- Read the article Volcanoes in Iceland: Predict Eruption (Glacierheli.is)
- Watch the 3 minute video Volcano Monitoring in Aotearoa New Zealand (GNS Science)
- Read the article Managing volcanic hazards (LEARNZ).
- Watch the 3 minute video Monitoring volcanoes from space (European Space Agency).

Example of recent volcanic event

Specification content

3.1.5.3 Volcanic hazards

Impacts and human responses as evidenced by a recent volcanic event.

Learning outcomes

This lesson will help students to understand:

- the processes leading to a recent volcanic event, and the nature of the hazards that occurred.
- the impacts of a recent volcanic event on the local area in terms of social, economic and environmental.
- how different groups, such as the local community, local and national organisations, and potentially overseas governments and/or NGOs responded to the event.

Suggested timing

1 hour

Possible teaching and learning activities

- Although the focus is on the impacts and responses, students could begin by creating a short **fact file of key information** about the volcano and its location in order to provide context.
- This might be presented in a template that could be used for the other hazard examples (seismic event, wildfire and two tropical storms). Students could use a teacher-created format or present their work in a format of their choosing, utilising appropriate subheadings provided. **Locational context** might include country and/or region data; GDP/HDI, population characteristics, land use, monitoring, etc. The volcano could be classified by tectonic setting, cone type, eruption history and eruption characteristics for the specified eruption.
- Depending on the chosen example, students could use online resources and/or videos to identify the Impacts. Impacts can be classified as immediate and longer term, social, economic and environmental. When summarising impacts, a logical approach might be to identify any responses that address the impact. Alternatively, some might prefer to complete the impacts and subsequently outline the responses.
- Responses can be categorised by scale (individual/community/local, regional, national, international), and include whether these were formal or informal led by government agencies or NGOs. This could also link to perceptions/characteristic human responses to hazards. Some responses might be responses to the monitoring and warning of the threat/risk, and therefore occur prior to an eruption. All responses could be classified by temporal scale, starting with those occurring immediately during/after the eruption if not before.
- Students could then sketch out a Park Model and Hazard Management Cycle and annotated the relevant responses for the example studied.
- Responses could be evaluated, and effectiveness assessed.

Resources

Taal, Philippines (2020) *which could be used in conjunction with case study of a multi hazardous environment.*

- Watch the 1 minute video Taal volcano: thousands flee as ash and lightning fill the sky – video (The Guardian).
- Watch the 6 minute video Massive eruption of Philippines Taal Volcano imminent (DW News) from prior to the eruption, with local experiences and observations about responses, including evacuations, resilience of Filipino people, linked to fatalism and the frequency of hazards in the country.
- Read the article Report on Taal (Philippines) — June 2020 (Smithsonian Institution).
- Read the article TAAL VOLCANO ERUPTION 2020 (Reliefweb).
- Watch the 2 minute video Taal volcano eruption poses deadly dilemma for people living in its shadow (CNN World).

Semeru, Indonesia (2022)

- Read the article Global Volcanism Program (Smithsonian Institution).
- Read the article Mount Semeru: Indonesia raises alert to highest level as volcano erupts on Java island (BBC News).
- Read the article A Deadly Day on Mount Semeru (Earth observatory).
- Read the article Rebuilding from ashes: Recovering in the wake of Mount Semeru volcano eruption (ReliefWeb).

Nyiragongo, Democratic Republic of the Congo (2021) *which could be used in conjunction with the case study at a local scale.*

- Watch the 5 minute video Thousands flee erupting Mt. Nyiragongo volcano in DR Congo | DW News (DW News).
- Read the article In 2021, a deadly volcano erupted with no warning. Here's why (Science News).
- Read the article Our Response to the Eruption of the Nyiragongo Volcano – May to Dec 2021 (The Congo Tree) – Community level responses.
- Read the article UNICEF immediate responses.
- Read the article Nyiragongo volcano eruption: the aftermath (UNICEF).
- Read the article Slow aid response frustrates Congolese made homeless by volcano (The New Humanitarian).

Seismic hazards

Specification content

3.1.5.4 Seismic hazards

The nature of seismicity and its relation to plate tectonics. Spatial distribution, randomness, magnitude, frequency, regularity, predictability of hazard events.

Learning outcomes

This lesson will help students to understand:

- how and where earthquakes occur at different depths.
- the properties of seismic waves and how these can be detected and measured.

Suggested timing

2 hours

Possible teaching and learning activities

- Students could begin by referring back to their work on plate margins and identify the range of locations in which earthquakes occur. Students could then look at the website USA National Science Foundation map of earthquake depths, and identify the relationship between depths and plate margins. They should be able to classify shallow, intermediate and deep focus earthquakes.
- Provide students with a list of key terminology, such as seismic waves, epicentre, focus, seismogram/graph, seismometer, etc. and they could research and write clear definitions for these (individually/pairs/groups).
- Give students a series of statements in in incorrect order, and they could sort these to create a clear sequence for the processes that lead to an earthquake.
- Introduce the idea of the waves, and their propagation; watch the 2 minute video Types of seismic waves and how they are recorded (Britannica). Students could use a slinky spring to demonstrate and replicate these movements to each other.
- Students could read about the measurement of earthquakes, and summarize the scales, comparing them and suggesting why the MMS is now the most used scale.
- At this stage, students could begin to research the seismic event that will be used as an example of a recent event and identify the characteristics of the tectonic setting, magnitude and depth.

Resources

- Read the article EARTHQUAKES a useful overview introducing some key concepts for this topic (GeolSoc).
- Read the article How Often Do Earthquakes Occur? (SAGE).
- Read the article Earthquakes (British Geological Survey).
- Read the article What causes earthquakes? (British Geological Survey).
- Read the article How are earthquakes detected? (British Geological Survey) and watch the 5 minute embedded video about the MMS for measuring earthquakes.

- Watch the 16 minute video How Do Scientists' Measure Earthquakes? (Earth Science Classroom) – with MMS from 14 minutes.

Seismic hazards and their impacts

Specification content

3.1.5.4 Seismic hazards

Forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides.
Impacts: primary/secondary; environmental, social, economic, political.

Learning outcomes

This lesson will help students to understand:

- the processes that lead to the primary and secondary hazards associated with seismic activity.
- the link between local geography and secondary hazards.
- the immediate impacts these hazards have on the landscape.
- that the impacts of volcanic hazards can be classified by primary/secondary, environmental/social/economic/political, and that they might vary in scale and temporality.

Suggested timing

2 hours

Possible teaching and learning activities

- Students will understand the sequence of events leading to an earthquake, and the characteristics of seismic shockwaves from the first lesson in this section. They could identify the impacts these might have on different areas. Watch the 6 minute video Anatomy of an earthquake: What happens when seismic hazards meet populations? (NERCscience) outlines this clearly, by recapping the processes and the role of seismic waves in creating a significant hazard.
- Secondary hazards of earthquakes (tsunamis, liquefaction and landslides) can then be researched through texts and video clips. For each one, students could identify the specific physical geography that might make each of these a risk. Where appropriate, the recent example being studied, and/or either of the Case Studies could be used to exemplify these hazards. For each hazard, students could practise explaining the processes in sequence, linking a seismic event to the secondary hazard.
- Tsunamis: students could watch the 3 minute video 120 Years of Earthquakes and Their Tsunamis: 1901-2020 (YouTube) to get a sense of the scale of these events. They could research key facts about the Indian Ocean tsunami of December 2004 to illustrate the scale of these hazards. They could find out the arrival times in different locations and compare to the Tohoku earthquake and subsequent tsunami.
- Liquefaction: students could watch a video, and research examples such as Christchurch and Tohoku where this occurred.
- This could lead into a summary of the hazards produced in the recent example being studied.
- Students could use online resources and/or videos to identify the Impacts. Impacts can be classified as immediate and longer term, social, economic and environmental. When

summarising impacts, one approach might be to identify any responses that address the impact. Alternatively, some might prefer to complete the impacts and subsequently outline the responses separately. Students could read the article What to Expect in a Big Urban Earthquake (USGS) is a comprehensive summary of potential impacts with timescales, including vulnerable groups, and summary of characteristic human responses.
- Students could begin to evaluate the role of human factors such as land use, infrastructure in determining severity of impacts. Architectural design/older buildings, impact on water/gas/electrical supply infrastructure etc. are likely to be significant in some locations studied.

Resources

- Read the article How shallow, deep earthquakes differ (Phys.org) – summarises the increased hazard risk from shallow focus earthquakes.
- Watch the 5 minute video Causes of Tsunamis (Time for Geography).
- Read the article TSUNAMIS (GeolSoc) – factsheet.
- Watch the 3 minute video 120 Years of Earthquakes and Their Tsunamis: 1901-2020 (YouTube).
- Watch the 5 minute video Liquefaction In Action (Geoscience Australia) – First two minutes explains and demonstrates the process clearly.
- Read the article How do earthquakes affect people? (British Geological Survey).
- Read the article How Could a Major Earthquake Affect Urban Infrastructure? (Caltech science exchange) – general overview on impact on infrastructure.

Responses to seismic hazards

Specification content

3.1.5.4 Seismic hazards

Impacts: primary/secondary; environmental, social, economic, political. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.

Learning outcomes

This lesson will help students to understand:

- responses can be immediate and longer term, linking into management of future events.
- the varying aspects of risk management applied to seismic hazards; preparedness, mitigation, prevention and adaptation.
- that earthquakes cannot be predicted.

Suggested timing

2 hours

Possible teaching and learning activities

- Responses can be categorised by scale (individual/community/local, regional, national, international). This could also link to perceptions/characteristic human responses to hazards. All responses could be classified by temporal scale, starting with those occurring immediately during/after the seismic event.
- Students could watch videos and read about the development of earthquake early warning systems, and how this technology is being used in areas such as Japan, USA and increasing number of seismically active locations.
- Read a range of resources identifying the community and infrastructure preparedness and adaptation, and identify how each strategy can contribute to the prevention and mitigation of some impacts.
- Each response or management strategy could be categorised as: preparedness, mitigation, prevention and adaptation. Students could discuss what each of these means in the context of different scenarios, based on differing locations.
- Students could identify the limitations and challenges of risk management of seismic events in different settings. Depending on the example chosen, there may be a range of actions in place, or less comprehensive management prior to the recent event being studied. The Tohoku earthquake and tsunami could be used to illustrate both the effectiveness and challenges of earthquake and seismic management.

Resources

- Read the article Can you predict earthquakes? (U.S. Geological Survey).
- Read the article Tsunami early warning systems (UN International Strategy for Disaster Reduction).
- Watch the 2 minute video Here's how the Shake Alert earthquake notification system is being revamped (CBS News).

- Read the article Earthquakes — Emergency preparedness in New Zealand (Get Ready).
- Read the article This is how we can make buildings earthquake-proof (PreventionWeb).

Example of a recent seismic event

Specification content

3.1.5.4 Seismic hazards

Impacts and human responses as evidenced by a recent seismic event.

Learning outcomes

This lesson will help students to understand:

- the processes leading to a recent seismic event, and the nature of the hazards that occurred.
- the impacts of a recent seismic event on the local area in terms of social, economic and environmental.
- how different groups, such as the local community, local and national organisations, and potentially overseas governments and/or NGOs responded to the event.

Suggested timing

1 hour

Possible teaching and learning activities

- Although the focus is on the impacts and responses, students could begin by creating a short fact file of key information about the seismic event and its location in order to provide context.
- This might be presented in a template that could be used for the other hazard examples (volcanic eruption, wildfire and two tropical storms). Students could use a teacher-created format or present their work in a format of their choosing, utilising appropriate subheadings provided. Locational context might include country and/or region data; GDP/HDI, population characteristics, land use, monitoring, etc. The tectonic setting (plate margin context) of the seismic event should be identified, along with key information about the vent including epicentre, date, time, MMS magnitude, focus depth etc.
- Depending on the chosen example, students could use online resources and/or videos to identify the Impacts. Impacts can be classified as immediate and longer term, social, economic and environmental. When summarising impacts, a logical approach might be to identify any responses that address the impact. Alternatively, some might prefer to complete the impacts and subsequently outline the responses.
- Responses can be categorised by scale (individual/community/local, regional, national, international). This could also link to perceptions/characteristic human responses to hazards. All responses could be classified by temporal scale, starting with those occurring immediately during/after the eruption if not before.
- Students could then sketch out a Park Model and Hazard Management Cycle and annotated the relevant responses for the example studied.
- Responses could be evaluated, and effectiveness assessed.

Resources

Turkey 2023: *Impacts and management of a very strong earthquake in a large country.*

- Read the article Turkey earthquake: Where did it hit and why was it so deadly? (BBC News).
- Read the article Infrastructure damage highlights severe impact of Turkey and Syria earthquakes (New Civil Engineer).
- Read the article A look at events surrounding the devastating earthquake that hit Turkey and Syria a year ago (AP News).
- Read the article Uncertainty surrounds Turkish post-quake rebuild – despite bold promises (The Guardian).
- Read the article Still in ruins: the 2023 Turkish earthquake – then and now (The Guardian).
- Read the article Turkey-Syria earthquake 2023 (The Guardian) – reports on this earthquake, including some video clips.

Jamaica 2023: event and impacts *Example of impacts and contemporary management of a moderate earthquake in a small country.*

- Read the article Jamaica Earthquake 30 October 2023 (CCRIF).
- Watch the 6 minute video Tectonics and Earthquakes of Jamaica (2020) (IRIS Earthquake Science).
- Watch the 5 minute video Jamaica rocked by massive earthquake (Jamaica Gleaner).
- Read the article M5.6 earthquake in Jamaica' Hope Bay leads to building collapse and emergency service strain - The Watchers (The Watchers).
- Read the article Over 30 students taken to hospital following Jamaica earthquake (Caribbean National Weekly).

Jamaica 2023: responses (videos) (YouTube)

- Watch the 3 minute video Earthquake Disaster Risk Management- First Responders
- Watch the 4 minute video Earthquake Disaster Risk Management-Electricity and Telecommunications | (Jamaica – update on the electricity and telecommunication response to the 2023 earthquake).
- Watch the 3 minute video Earthquake Disaster Risk Management-KSAMC |
- Watch the 2 minute video Earthquake Disaster Risk Management - Health and Education

Storm hazards

Specification content

3.1.5.5 Storm hazards

The nature of tropical storms and their underlying causes. Spatial distribution, magnitude, frequency, regularity, predictability of hazard events.

Learning outcomes

This lesson will help students to understand:

- the atmospheric and ocean conditions that lead to storm formation
- where and when storms occur globally
- how storms are measure and compared.

Suggested timing

2 hours

Possible teaching and learning activities

- Students may have previous knowledge of storms, so they could start by picking out facts that they remember. They could be presented with some isolated terminology or numbers and could attempt to assign meaning and context to them (e.g. typhoon, Coriolis force, 26.5°C, 5°-20°, low pressure, storm surge, rotation, etc.)
- Students could research and note down and explain the conditions that lead to formation of storm, and how the storm develops.
- They could identify the areas globally where they occur on a map, and note the different names given in different regions.
- Draw and annotate a diagram showing the structure of a storm, with detail ab out height, speeds, characteristics of eye/ eye wall etc.
- Introduce the Saffir-Simpson scale, which will give context to the examples when studied, and any data that includes differentiation by category. Students could read the article Why we need a better way to measure hurricanes (BBC) to evaluate this scale and link forward to the hazards presented.
- Students could look at the website Tropical Cyclone Climatology (noaa.gov) – Plenty of data from NHC in the USA on frequency over timescales, including return periods. They could analyse some of the data and use this to summarise the frequency and regularity of tropical storms in the USA.

Resources

- Watch the 2 minute video How do hurricanes form? (BBC Weather) – brief overview of formation.
- Watch the 15 minute video The Formation Of Tropical Cyclones (Earth Science Classroom) with some detailed explanation.
- Watch the 6 minute video Structure Of A Tropical Cyclone (Earth Science Classroom).
- Read the article Tropical cyclone (World Meteorological Association) – includes some facts and figures about storms globally.

- Read the article Hurricane Season (Royal Geographical Society) – Autumn 2024 report, with reference to Hurricane Beryl in July 2024.
- Read the article Hurricanes (BBC News) – Autumn 2024.
- Read the article Global extreme events: Tropical storms (Met Office) – links to climate change and increasing intensity.

Storm hazards and their impacts

Specification content

3.1.5.5 Storm hazards

Forms of storm hazard: high winds, storm surges, coastal flooding, river flooding and landslides. Impacts: primary/secondary, environmental, social, economic, political.

Learning outcomes

This lesson will help students to understand:

- the range of hazards created by a tropical storm, and the spatial scales affected.
- that the impacts of tropical storms can be classified by primary/secondary, environmental/social/economic/political, and that they might vary in scale and temporality.
- factors making some areas more vulnerable to the impacts of storms.

Suggested timing

2 hours

Possible teaching and learning activities

- Students could be introduced to the named examples they will be using. Text or video resources will likely include examples of impacts.
- Students could then make notes on the direct primary hazards, of strong winds, high rainfall/river flooding and storm surges/coastal flooding, plus the secondary hazards of landslides.
- Students could read the links from the organisations below and identify and categorise the general impacts of storms.
- Students could study areas which experience storms, and use Google maps satellite view to look for the physical and human characteristics that make some areas more/less vulnerable in terms topography, land use, population density etc. This could be linked to the examples being studied, the main Hazards Case studies, if appropriate, or look more broadly at different areas.

Resources

- Read the article Cyclone Hazards and Safety (National Oceanic and Atmospheric Administration) – identifies primary hazards associated with storms.
- Watch the 1 minute video Storm Surge Fast Draw (NOAA).
- Read the article Tropical Storm (Save the Children UK) – impacts of tropical storms, with focus on children and, with examples.
- Read the article Tropical Cyclones (CISA) includes critical infrastructure impacts.
- Read the article Impacts of tropical cyclones on food security, health and biodiversity (PubMed Central).

Responses to tropical storms

Specification content

3.1.5.5 Storm hazards

Short and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.

Learning outcomes

This lesson will help students to understand:

- the role of technology in monitoring storms as they develop and pose a risk to communities.
- responses can be immediate and longer term, linking into management of future events.
- the range of risk management strategies applied to tropical storms: preparedness, mitigation, prevention and adaptation.

Suggested timing

1 hour

Possible teaching and learning activities

- Students could begin by reading through the summary of general approaches to forecasting read the article Tropical cyclone forecasting (Met Office).
- Using the website NOAA Hurricane forecasting information, students could the produce a flow diagram of hurricane forecasting and monitoring in the USA. They could watch the videos about how aviation and information/communications technology is used to support preparedness via warnings.
- Adaptations could be identified in areas at risk, and students could explain how preparedness and adaptation can be used to mitigate the impacts such as storm surges.
- General responses post-event can be summarised, but these can be explored in more depth when studying the recent examples.

Resources

- Read the article Hurricane Monitoring Information for Georgia, North Carolina, and South Carolina (U.S. Geological Survey) – focus on hydrological hazards.
- Read the article Immediate and Long-term Responses to Weather Hazards (Tutor2u) – summarises the general responses to storms.
- Watch the 2 minute video Hurricane Hunters Fly Into the Eye of a Monster (NOAA).
- Watch the 2 minute video NHC hurricane hunters ready for hurricane season with new technology (GulfCoast News).
- Watch the 1 minute video NHC Hurricane Preparedness Videos : Day 5 — The Forecast Process (National Weather Service).
- Read the article Mozambique takes strides towards Early Warnings for All (World Meteorological Organisation) – a good example of preparation in a contrasting location.

Examples of recent tropical storms in contrasting areas of the world

Specification content

3.1.5.5 Storm hazards

Impacts and human responses as evidenced by two recent tropical storms in contrasting areas of the world

Learning outcomes

This lesson will help students to understand:

- The processes leading to two recent tropical storms, and the nature of the hazards that occurred.
- The impacts of a recent tropical storm event on the local area in terms of social, economic and environmental.
- How different groups, such as the local community, local and national organisations, and potentially overseas governments and/or NGOs responded to the events.
- How the contrasting human and/or physical characteristics of two locations can lead to storm hazards, impacts and responses.

Suggested timing

2 hours

Possible teaching and learning activities

- Although the focus is on the impacts and responses, students could begin by creating a short fact file of key information about the locations to provide context. This should highlight the contrasting nature of the locations, whether this be differing regions/oceans, or locations that contrast socially/economically within the same broad region of the world.
- This might be presented in a template(s) like that used for the other hazard examples (volcanic eruption, seismic event and wildfire). Students could use a teacher-created format or present their work in a format of their choosing, utilising appropriate subheadings provided. Locational context might include country and/or region data; GDP/HDI, population characteristics, land use, preparedness, seismic history, etc.
- Depending on the chosen examples, students could use online resources and/or videos to identify the Impacts. Impacts can be classified as immediate and longer term, social, economic and environmental. When summarising impacts, a logical approach might be to identify any responses that address the impact. Alternatively, some might prefer to complete the impacts and subsequently outline the responses.
- Responses can be categorised by scale (individual/community/local, regional, national, international). This could also link to perceptions/characteristic human responses to hazards. Some responses might be responses to the monitoring and warning of the threat/risk, and therefore occur prior to an eruption. All responses could be classified by temporal scale, starting with those occurring immediately during/after the eruption if not before.

- Students could then sketch out a Park Model and/or Hazard Management Cycle and annotated the relevant responses for the examples studied.
- Responses could be evaluated, and effectiveness assessed.
- Students could then compare the events and suggest reasons for any significant contrasts in the impacts and management of these events.

Resources

Hurricane Beryl July 2024 *(Atlantic, major hurricane with a range of potential locations; several small islands. Beryl could be used with a specific focus on one country or region affected).*

- Read the article Hurricane Season (Royal Geographical Society) – introduction to the 2024 North Atlantic hurricane season, with a summary of Hurricane Beryl, and links to further resources on this storm.
- Watch the 16 minute video Hurricane Beryl [2024] case study (YouTube) – clear summary tracking the formation, and the impacts across all areas in the path of the storm.
- Read the article Hurricane Beryl: For hard-hit islands, preparation paid off with rapid response. But recovery is complicated by widespread damage. (IFRC) – focus on several Caribbean islands.
- Read the article Hurricane Beryl: Jun 2024 (ReliefWeb) – includes links to individual country response plans and reports.
- Read the article Storm Beryl kills eight and cuts power for millions (BBC News) – USA; Texas and Louisiana.

Trami: Philippines 2024 *(Pacific Ocean: tropical storm with significant hazards on highly populated Luzon island; could be used alongside case study of a multi-hazardous location).*

- Read the article Tropical Storm Trami: More than 20 dead in Philippine floods (BBC News).
- Read the article Dozens dead in floods and landslides after tropical storm Trami hits the Philippines (The Guardian).
- Read the article Philippines: Severe Tropical Storm Trami (Kristine) Humanitarian Snapshot, as of 5 November 2024 (United Nations Office for the Coordination of Humanitarian Affairs) – OCHA
- Read the article The Philippines is prone to extreme weather. But few expected Tropical Storm Trami to be this devastating (CNN).
- Read the article More than 120 killed and dozens injured after Tropical Storm Trami batters Philippines (Sky News).

Wildfires

Specification content

3.1.5.6 Fires in nature

Nature of wildfires. Conditions favouring intense wildfires: vegetation type, fuel characteristics, climate and recent weather and fire behaviour. Causes of fires: natural and human agency.

Learning outcomes

This lesson will help students to understand:

- The natural and human causes of fires
- The conditions that facilitate fires, and how intense wildfires develop and behave.

Suggested timing

2 hours

Possible teaching and learning activities

- Give students a list of interesting facts about fires taken from the Wildfire FAQs.pdf (Natural History Museum of Utah) factsheet or similar. Some could be tweaked/reworded to be incorrect, and students could look for the incorrect statements. Alternatively, present the students with 5-10 true facts and get students to identify the most surprising ones.
- Students could begin by suggesting what might cause a fire, and the 'ingredients' needed for a fire to start (the fire triangle).
- Students could look at the website Fire map (NASA Earth Observatory), and identify the widespread nature of fires. They could look at this in conjunction with other maps, such as vegetation/biomes etc. to determine if any pattern exists. They might identify areas where fires are not present. The text below the map gives a brief introduction to general points about fires.
- Select a graphic from the website Wildfires (Our World in Data) and identify areas by continent, or vegetation type which have the greatest areas of land affected by wildfires. Students could work in groups and each analyse and present a summary of different graphics.
- Students should watch the 5 minute video 'Causes and conditions that favour intense wildfires (Time for Geography).
- They could then research the role of vegetation type, fuel characteristics, climate and recent weather, and fire behaviour.

Resources

- Read the article Wildfires (Geography Education Online) good resources and information for all sections of the wildfires topic.
- Watch the 4 minute video El Nino: What is it? (Met Office) – explains the meteorological conditions that can link to heatwaves, and subsequently increased fire risk.

Impacts of, and responses to wildfires

Specification content

3.1.5.6 Fires in nature

Impacts: primary/secondary, environmental, social, economic, political. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. Impact and human responses as evidenced by a recent wildfire event.

Learning outcomes

This lesson will help students to understand:

- That the impacts of fires can be classified by primary/secondary, environmental/social/economic/political, and that they might vary in scale and temporality.
- Responses can be immediate and longer term, linking into management of future events.
- The varying aspects of risk management applied to wildfires; preparedness, mitigation, prevention and adaptation.

Suggested timing

2 hours

Possible teaching and learning activities

- Students could begin by identifying the likely impacts of a fire in a specified location (such as the named example, or another location where fire is a known hazard) by studying a map and suggesting impacts that could be classified as social, economic and environmental. They could build upon this by identifying the temporal scale in the context of recovery/rebuilding/regrowth.
- Students could then use the links from the article Wildfires (Geography Education Online) slide 9 to summarise the general impacts and the impact on health and consider which populations and communities might be more vulnerable to these impacts.
- Slide 9 could be used as a stimulus to consider wider impacts linked to soil erosion, linking to water supplies, agriculture and ecosystems.
- This will lead into a discussion about how some of these impacts could be mitigated against. Students could be guided through the resources about management at different scales (individual/community, local/regional/national agencies), and could use the HMC model to identify examples of preparation, response, mitigation and recovery.
- Opportunity for students to create presentations or posters informing people of actions that can be taken, alongside information about what agencies such as governments and emergency responders will do in the event of a fire.

Resources

- Read the PowerPoint Wildfires (Geography Education Online) – slides 10 and 11 includes prevention and suppression.
- Read the article Fighting Fire with Tech (National Geographic).

- Read the pdf Hazards and threats inside the home wildfires – homeowners checklist kitchen living room hallway bedroom Los Angeles County advice to residents.

Example of a recent wildfire event

Specification content

3.1.5.6 Fires in nature

Impact and human responses as evidenced by a recent wildfire event.

Learning outcomes

This lesson will help students to understand:

- The processes leading to a recent wildfire event, and the nature of the hazards that occurred.
- The impacts of a recent wildfire event on the local area in terms of social, economic and environmental.
- How different groups, such as the local community, local and national organisations, and potentially overseas governments and/or NGOs responded to the event.

Suggested timing

1 hour

Possible teaching and learning activities

- Although the focus is on the impacts and responses, students could begin by creating a short fact file of key information about the fire and its location in order to provide context.
- This might be presented in a case study template that could be used for the other hazard examples (volcanic eruption, seismic event and two tropical storms). Students could use a teacher-created format or present their work in a format of their choosing, utilising appropriate subheadings provided. Locational context might include country and/or region data; GDP/HDI, population characteristics, land use, monitoring, etc. The fire location could be classified by climatic setting, season, vegetation and characteristics of the fire.
- Depending on the chosen example, students could use online resources and/or videos to identify the Impacts. Impacts can be classified as immediate and longer term, social, economic and environmental. When summarising impacts, a logical approach might be to identify any responses that address the impact. Alternatively, some might prefer to complete the impacts and subsequently outline the responses.
- Responses can be categorised by scale (individual/community/local, regional, national, international). This could also link to perceptions/characteristic human responses to hazards. Some responses might be responses to the monitoring and warning of the threat/risk, and therefore occur prior to an eruption. All responses could be classified by temporal scale, starting with those occurring immediately during/after the eruption if not before.
- Students could then sketch out a Park Model and Hazard Management Cycle and annotated the relevant responses for the example studied.
- Responses could be evaluated, and effectiveness assessed.

Resources

Australian wildfires, summer 2019-2020 *Could focus on one state.*

- Read the article Australian wildfires (RGS) – includes lesson ideas linked at the end of the articles.
- Read the article 2019-2020 Bushfires (Country Fire Authority) – with a focus on the state of Victoria.
- Read the articles In-depth: Australian bushfires (WWF-Australia) and Recovery Collection: Australia: Black Summer Bushfires 2019-2020 (IRP) – summary of impacts, with some responses identified.
- Read the article Ten impacts of the Australian bushfires (UNEP)
- Listen to the 31 minute podcast Australian wildfires: What is the Southern Annular Mode and Indian Ocean Dipole? (RGS)
- Listen to the 28 minute podcast Australian wildfires: Why live in fire prone areas and how do people cope? (RGS)

Case study guidance

The following guidance is to provide you with support in selecting your case studies.

- The impacts and human responses of **five recent events** are required as part of the specification content: a recent volcanic event, a recent seismic event, two recent tropical storms in contrasting areas of the world and a recent wildfire event.
- It is an acceptable approach to have overlap between the required five recent events and the **two case studies.** However, you may also choose different examples for each with no overlap.

Specification content

- Case study of a multi-hazardous environment beyond the UK to illustrate and analyse the nature of the hazards and the social, economic and environmental risks presented, and how human qualities and responses such as resilience, adaptation, mitigation and management contribute to its continuing human occupation.
- Case study at a local scale of a specified place in a hazardous setting to illustrate the physical nature of the hazard and analyse how the economic, social and political character of its community reflects the presence and impacts of the hazard and the community's response to the risk.

What we mean by 'multi-hazardous environment beyond the UK'

This case study can be located anywhere in the world outside of the UK. It must be affected by more than one of the hazards listed in the subject content.

What we mean by 'local scale of a specified place'

This case study is not for a hazard local to the student's Centre or home area; this case study can be located anywhere globally, the term 'local' is stipulating the size of the area studied. In terms of the size of 'local scale', it is useful to bear in mind that students should be able to walk around (or imagine walking around) the chosen location in a few hours and refer to one identifiable hazard/event.

What we mean by 'recent events'

Whilst there is no set criteria for what makes an event 'recent', we advise that it should be within the last 10 years, or at least within the lifetime of the students you teach. Whilst students would not be penalised for using examples outside of this time period, it is worth noting that more recent examples offer a contemporary look into the impacts, responses and mitigations that have developed over time. Therefore, this could self-penalise students if they cannot apply more contemporary knowledge to any questions that would require this when posed in the examination.

Possible headings for students to use when looking at 'recent events'

Context:

- Global, regional and national location
- General country data (GDP per Capita, HDI, population characteristics)
- Regional/local information for the areas affected: population density (if available), land use, rural/urban settlement pattern, relevant economic activity/infrastructure.
- Tectonic setting for seismic and volcanic events (plate margins, movement, volcanic activity).
- Climatic and seasonal setting for tropical storms and fires, but potentially relevant for tectonic hazards in terms of secondary hazards and responses.
- Topography of the area, including surface features such as vegetation coverage where relevant.

Key information about the event and the hazards presented:

- Summary of the event: timeline, areal extent etc.
- Characteristics of the primary and secondary hazards presented, which might include:
- **Volcanic eruption:** lava characteristics, tephra, nuee ardentes, volcanic landslides, ash fallout etc.
- **Seismic event:** focus, epicentre, MMS magnitude, duration, secondary hazards such as liquefaction, landslides, tsunami etc.
- **Tropical storms**: sizes of storms, rainfall data, wind speeds, storm surges, flooding, landslides etc.
- **Fire:** intensity and spread, specific to hazard type; e.g. lava/ash/ nuées ardentes etc., or liquefaction, landslides etc.

Impacts:

- Primary/Immediate
- Secondary/longer term
- Social, economic, environmental, political

Reponses:

- Individual/community/local, regional, national, international where relevant.
- Some responses might be responses to the monitoring and warning of the threat/risk, and therefore occur prior to an eruption or storm, or when a fire has begun (such as evacuations).
- Immediate, shorter-term responses
- Longer term responses.

Evaluation and reflection:

- Responses could be evaluated, and effectiveness assessed.
- Students could then sketch out a Park Model and Hazard Management Cycle and annotated the relevant responses for the example studied.

Multi-hazardous environment beyond the UK

Specification content

3.1.5.7 Case studies

Case study of a multi-hazardous environment beyond the UK to illustrate and analyse the nature of the hazards and the social, economic and environmental risks presented, and how human qualities and responses such as resilience, adaptation, mitigation and management contribute to its continuing human occupation.

Learning outcomes

This lesson will help students to understand:

- The physical characteristics of the chosen location that make it prone to two or more hazards, making it 'multi-hazardous'.
- The nature of the hazards presented, and their underlying causes.
- The ways in which hazards are managed through preparedness, adaptation and mitigation.
- The social, economic and political characteristics of the location that contribute to the resilience of the population, and any other characteristic human responses.

Suggested timing

2 hours

Possible teaching and learning activities

- Introduce the location to students. This could take the form of some key facts for the students to guess, if they have not been made aware previously of the chosen location. Alternatively, students could reflect on anything they know about the location, especially if one of the 'recent examples' has come from this location.
- **Background to the location: Human Geography profile**: country and/or region data; GDP/HDI, economic data such as trade/exports etc., population characteristics (density and distribution), land use etc. This could be researched through country profiles such as the CIA World Factbook, Britannica etc.
- **Physical geography profile: The nature of the hazards, and their underlying causes, with specific examples of events.** Students could locate the chosen area globally in terms of climate (if tropical storms and/or fires are hazards present) and/or in terms of tectonic setting if volcanoes and/or seismic hazards are present. Topography is likely to be relevant to many hazards, including secondary hazards.
- **The social, economic and environmental risks posed** (linking nature of hazards with vulnerability and human factors). This could include analysis of data about the hazards present; frequency, economic costs etc. Students should identify an example(s) of each type of hazard identified.
- Consider the connections between the hazards and the human characteristics and activities in the area; does human occupation exacerbate the risks and increase the likelihood of hazards becoming disasters?

- **Responding to and living with the hazards:** Read the resources provided and identify examples of responses to specific hazard events in the location.
- Resilience, adaptation, mitigation and management: Students could use examples of wider scale management, potentially from within the country, or from overseas where appropriate/relevant.
- **Evaluation:** students will have the opportunity to evaluate the responses and identify the ways in which communities are supported, and the ways in which some might still be vulnerable.

Resources

Haiti: *(main focus on tropical storms and earthquakes, with landslides as linked secondary hazards).*

- Read the articles Global development (The Guardian) and Haiti: Vulnerability (Climate Change Knowledge Portal).
- Read the article Haiti (Think Hazard).
- Read the article A look into poverty and disaster preparedness in Haiti (World Bank blog).
- Read the article Why-is-haiti-vulnerable-to-natural-hazards-and-disasters? (The Guardian).
- Read the article Tectonic hazards in the Caribbean: hazard, vulnerability, impact and risk (GEO) – focuses on tectonics, includes references to Haiti or watch the 57 minute YouTube video.
- Read the article Tropical Storm Grace's heavy rains pour misery on Haiti earthquake survivors (The Guardian).

Philippines: *(could study Luzon Island specifically, and focus mostly on two hazards, for example volcanoes and tropical storms and their associated hazards of lahars and landslides).*

- Read the article Philippines: Vulnerability (Climate Change Knowledge Portal).
- Read the article Philippines - interactive map and resources for hazards (Think Hazard).
- Read the article Waiting for the 'big one' – natural hazards in the Philippines: A UN Resident Coordinator blog (UN).
- Read the article The Philippines (The ASEAN Magazine)– overview of hazards, with examples, and reference to disaster response.
- Read the article Philippines: 10 Million Affected by Never-Ending Storms (ReliefWeb).
- Read the article The Philippines brace for more storms amid devastating typhoon season (UN News).
- Read the article Active volcanoes and eruptions in the Philippines (Worlddata).
- Read the article Mayon: Thousands evacuated as Philippine volcano oozes lava (BBC News).
- Read the article Background Paper PH-11: Disaster Risk Management in the Philippines (World Bank) – long, but pages 6-10 contain a useful summary of hazards and management.
- Additional resources on Taal volcano linked in the 'recent example of a volcanic eruption' section.

Case study at a local scale

Specification content

3.1.5.7 Case studies

Case study at a local scale of a specified place in a hazardous setting to illustrate the physical nature of the hazard and analyse how the economic, social and political character of its community reflects the presence and impacts of the hazard and the community's response to the risk.

Learning outcomes

This lesson will help students to understand:

- The hazards present in the specified place.
- How social, economic and political character of the place and its population is influenced by the presence of the hazard.
- How the social, economic and political character of the place influences how the hazard is experienced and managed

Suggested timing

2 hours

Possible teaching and learning activities

- This may focus on a location already studied in the context of a recent event or could be used in isolation.
- Introduce the location and the hazard; students could explore the area via Google Maps/Google Earth/Google Streetview. A basic Google search could determine if the hazard comes up in the first few search results, which could immediately suggest an impact on the character.
- Watch a video about the place, potentially from a visitor's perspective to gain a sense of place before investigating the character of the place.
- Students should create a fact file about the location, with local information where available, and country background context to identify wider influences such as GDP, HDI etc.
- **The nature of the hazard:** summarise the physical processes leading to the location being hazardous. This could include reference to previous events that might have affected the character of the area and the contemporary responses.
- **Character of the place reflecting the presence of the hazard:** read about life in the location and identify references to a specific event, or the ongoing presence of a hazard, possibly through awareness of future risk in the community. Students could discuss how the character of the place could be linked to the hazard. This might be through longer term impacts following hazard events.
  Using the resources available, students should evaluate the extent to which the social/economic/political character of the places has helped or hindered the community's ability to respond to the hazard. This could focus on the most recent event experienced,

and/or identify developments between events. They could consider which factors have most influenced the responses and suggest how this might change in the future.
- Evaluate the overall link between the hazard and the character of the place.

Resources

Christchurch, NZ *(earthquake hazard).*

- Read the article Christchurch | New Zealand, Earthquake, Map, Population and Facts (Britannica).
- Watch the 6 minute video All in One Day! TOP 10 Things to do in Christchurch (2024) (YouTube).
- Read the article Before and after: how the 2011 earthquake changed Christchurch (The Guardian).
- Read the article The Christchurch earthquake - February 2011 - thorough overview of the earthquake and the rebuilding process (published 2024, following a visit in 2020)
- Read the article New Zealand Red Cross earthquake response and recovery (Australian Disaster Resilience Knowledge Hub).
- Read the article Christchurch five years on: have politicians helped or hindered the earthquake recovery? (The Conversation).
- Watch the 8 minute video Beyond The Rubble: The Christchurch Earthquake Recovery with Brenden Winder (YouTube) – discusses the earthquake, aftermath and community responses.
- Watch the 11 minute video The $42BN Plan to Rebuild the World's Unluckiest City (YouTube) – rebuilding Christchurch after the 2011 earthquake.

Goma, Democratic Republic of the Congo *(volcanic hazard).*

- Read the article Goma - Students (Britannica Kids).
- Watch the 4 minute video Goma: how is life between an active volcano and a lake? (DW Africa) – from a local point of view.
- Watch the 8 minute video A Day in Goma City in Congo CD (Ugandan travel vlogger Eunice Tess visits Goma).
- Read the articles Goma a large selection of videos and links related to Goma and Nyiragongo (BBC News).
- Watch the 2 minute video monitoring Nyiragongo (BBC News).
- Watch the 2 hour video Expedition Volcano (ERA) Episode 1 includes some excellent sections from the city, making clear links between the presence of the volcano and daily life in Goma, including the challenge of effective sanitation systems due to the local geology (Dailymotion).
- Read the article Under the volcano: a year after Mount Nyiragongo's eruption, people of Goma start to rebuild their lives (The Guardian) – information about the recovery process following the 2021 eruption
- Read the article Outrunning the world's fastest-flowing lava and rebuilding Goma | Natural History Museum (Natural History Museum).