Chapter 1 of your AQA A2 Geography textbook includes case studies of particular volcanoes and earthquakes (pages 18–23 and 30–34). This additional resource provides a more general overview of how earthquake and volcano hazards can be managed.

**Hazard management: volcanoes**

**Prediction**

It is easy to locate volcanoes, but it is very difficult to predict exactly when activity will take place, particularly a major eruption. The Colombian volcano, Nevado del Ruiz, came to life in late 1984 with small-scale activity. Vulcanologists knew the danger a major eruption could pose to the surrounding area, but were unable to predict when the major event would take place. Small-scale volcanic activity continued for several months and people were not prepared to evacuate their homes on the basis of this threat. When the violent eruption came on 13 November 1985, almost all the population had remained in the area. Devastating lahars, resulting from melting snow and ice, swept down the valleys, killing over 20,000 people.

A study of the previous eruption history of a volcano is important in prediction, along with an understanding of the type of activity produced. At present, research is being conducted to see if it is possible to predict the time of an eruption accurately using the shock waves that are produced as magma approaches the surface, expanding cracks and breaking through other areas of rock. There was some success in predicting the recent eruption (2000) of Popocatapetl in Mexico, but it remains to be seen if such techniques can be applied to all volcanoes.

**Protection**

With volcanic activity, protection means preparing for the event. Monitoring of the volcano may suggest a time when the area under threat should be evacuated. Such monitoring includes observations of land swelling, earthquake activity, changes in groundwater level and chemical composition, emission of gases, magnetic field studies and the shock wave analysis mentioned above. Several governments of countries in volcanic areas have made risk assessments and from them produced a
A series of alert levels to warn the public. In New Zealand the government has produced a five-stage table that includes the following:

1. Signs of volcanic activity. No significant volcanic threat.
2. Indications of intrusive processes. Local eruption threat.
3. Increasing intrusive trends indicate real possibility of hazardous eruption.
4. Large-scale eruption now appears imminent.
5. Destruction within the permanent danger zone (as identified). Significant risk over a wider area.

Geological studies of the nature and extent of deposits from former eruptions and associated ashfalls, lahars and floods may also provide evidence for hazard assessment. Figure 1 shows the hazards posed by Mt Rainier (Cascade Range, USA), one of the most studied volcanoes in North America.

Following assessments, it is possible to identify the areas at greatest risk, and land use planning can be applied to avoid building in such places.

Once the lava has started to flow, it is possible, in certain circumstances, to divert it from the built environment by:

- Digging trenches (Mt Etna, Sicily)
- Explosive activity (Mt Etna, 1983)
- Artificial barriers, which also protect against lahars (Hawaiian islands)
- Pouring water on the lava front (Haeimaey, Iceland, 1973)

Foreign aid to developing countries suffering volcanic eruptions may be required for considerable periods of time as volcanic events can be prolonged and devastating to the local economy. Such aid is needed for monitoring, evacuation, emergency shelters and food, long-term resettlement of the population and restoration of the economic base and the area’s infrastructure.

### Hazard management: earthquakes

#### Prediction

The prediction of earthquakes is very difficult. Regions at risk can be identified through plate tectonics, but attempts to predict earthquakes a few hours before the event are unreliable. Such prediction is based upon monitoring groundwater levels, release of radon gas and unusual animal behaviour. Fault lines such as the San Andreas can be monitored and local magnetic fields can be measured. Areas can also be mapped on the basis of geological information and studies of ground stability. These can help to predict the impact of earthquakes and can be used to produce a hazard zone map that can be acted upon by local and even national planners.
Close studies of fault lines can sometimes indicate the point along the fault where the next earthquake might be due. A study of the pattern of events along the San Andreas fault between 1969 and 1989 revealed the existence of a ‘seismic gap’ in the area of Loma Prieta. This area suffered an earthquake in October 1989 which measured 7.1 on the Richter scale and was the worst to hit the San Francisco region since 1906. In total, 63 people died and more than 3,700 were seriously injured. Because of the seismic survey, this event was not entirely unexpected, but, like all earthquakes, it was not possible to predict it precisely. Such a system, however, would not work for events such as the one at Northridge, which took place on an unknown fault line.

Prevention
Trying to prevent an earthquake is thought by most people to be impossible. This, however, has not stopped studies into the feasibility of schemes to keep the plates sliding past each other, rather than ‘sticking’ and then releasing, which is the main cause of earthquakes. Suggestions so far for lubricating this movement have focused on water and oil. Some people have even gone as far as to suggest nuclear explosions at depth!

Protection
Since earthquakes strike suddenly, violently and without warning, preparation cannot be put off until the event. Being prepared for an earthquake involves everyone from civil authorities to individuals. In the USA, the Federal Emergency Management Agency’s earthquake program has the following objectives:

➤ to promote understanding of earthquakes and their effects
➤ to work better to identify earthquake risk
➤ to improve earthquake-resistant design and construction techniques
➤ to encourage the use of earthquake-safe policies and planning practices

Protection therefore means preparing for the event by modifying the human and built environments to decrease vulnerability. It also includes attempts to modify the loss by insurance and aid. Some of the means of protection are described below.

Hazard-resistant structures
Buildings can be designed to be aseismic or earthquake-resistant. There are three main ways of doing this:

➤ putting a large concrete weight on the top of a building which will move, with the aid of a computer program, in the opposite direction to the force of the earthquake to counteract stress
➤ building large rubber shock absorbers into the foundations to allow some movement in the building
➤ adding cross-bracing to the structure to hold it together when it shakes

Older buildings and structures such as elevated motorways can be retro-fitted with such devices to make them more earthquake-proof. A comparison between the 1989 Loma Prieta earthquake in California (7.1 Richter) and the 1988 event in
Armenia (6.9 Richter) shows the effects of different types of building structures. In California, with its earthquake-proof buildings, there were only 63 deaths, whereas in Armenia more than 25,000 people died, many inside buildings that collapsed as a result of soft foundations and no earthquake-proofing features. In the town of Leninakan, for example, over 90% of the modern 9–12 storey buildings with pre-cast concrete frames were destroyed.

**Education**

Education is a major way of minimising loss of life in the event of an earthquake. Instructions issued by the authorities explain how to prepare for an earthquake by securing homes, appliances and heavy furniture, and getting together earthquake kits. Schools, offices and factories may have earthquake ‘drills’. Government offices and many companies in Japan observe Disaster Prevention Day (1 September) which marks the anniversary of the Tokyo earthquake.

Following the Loma Prieta earthquake (1989), the American Red Cross issued a list of supplies that people should keep at hand in case of an earthquake. These included:

- water: at least 3 days’ supply for all persons and pets in the house
- a whole range of foodstuffs, particularly canned and high-energy foods
- clothing and bedding
- first-aid kit
- tools and supplies, to include radio, torch, batteries, can opener, matches, toilet paper, small fire extinguisher, pliers, aluminium foil

Figure 2 shows the instructions issued by the metropolitan government of Tokyo advising people what to do if an earthquake occurs in the city.

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**Figure 2**

**Tokyo Metropolitan Government**

**What to do if a big earthquake hits**

The worst shake is over in about a minute, so keep calm and do the following:

1. Quickly turn off all stoves and heaters. Put out fires that may break out. Do not become flustered by the sight of flames, and act quickly to put out the fire.
2. Get under a table or desk to protect yourself.
3. Do not run outdoors where you are liable to be hit by falling objects.
4. Open the door for an emergency exit. Door frames are liable to spring in a big quake and hold the door so tight it cannot be opened.
5. If you are outdoors keep away from narrow alleys, concrete block walls and embankments, and take temporary refuge in an open area.
6. During evacuation from department stores or theatres do not panic. Do as directed by the attendant in charge.
7. If driving in the street, move the car to the left and stop. Driving will be banned in restricted areas.
8. Evacuate to a designated safety evacuation area if a big fire or other danger approaches.
9. Walk to emergency evacuation areas. Take the minimum of personal belongings.
10. Do not be moved by rumours. Listen to local news over the radio.
Fire prevention
‘Smart meters’ have been developed which can cut off the gas if an earthquake of sufficient magnitude occurs. In Tokyo, the gas company has a network transmitting seismic information to a computer which informs employees where to switch off major pipelines, reducing the number of fires.

Emergency services
Use of the emergency services in the event of an earthquake needs careful organisation and planning. Heavy lifting gear needs to be available. Civilians must be given first-aid training as trained medical personnel can take some time to arrive. Much of the preparation in California involves the establishment of computer programs that will identify which areas the emergency services should be sent to first.

Land-use planning
The most hazardous areas in the event of an earthquake can be identified and then regulated. Certain types of buildings such as schools and hospitals should be built in areas of low risk. It is also important to have sufficient open space, as this forms a safe area away from fires and aftershock damage to buildings.

Insurance and aid
In MEDCs, people are urged to take out insurance to cover their losses. This can be very expensive for individuals. Only 7% of the people affected by the Kobe earthquake in Japan (1995) were covered by earthquake insurance.

Most aid to LEDCs has been emergency aid in the few days after the event — providing medical services, tents, water purification equipment, and search and rescue equipment. Aid over the longer term, to reconstruct the built environment and redevelop the economy, is much less readily available.
Introduction

This website contains some examples of the types of questions you will face in the AQA Unit 3 geography examination at A2. You may wish to use these questions as practice questions in your work or for revision. Questions are in bold type. Each one has a mark scheme together with commentary in purple on how best to answer it. Sample student answers to some of the questions, with examiner comments, appear in the *AQA A2 Geography Student Unit Guide: Unit 3* published by Philip Allan Updates.

Before attempting to answer any of the questions, it is important that you understand the processes by which these questions will be marked by the examiner in the ‘real’ examination. Below is a summary of those processes.

**General marking criteria**

**The philosophy**

Marking at AQA is positive rather than negative. This means that examiners credit material you get right, rather than deduct marks for what you get wrong. Examiners do not start with a model answer in their heads, nor do they compare your answer with a model answer. They credit you for the way in which you answer the question set, awarding more marks for the appropriate detail and depth of response that you give.

**Levels marking**

For all questions worth more than 5 marks levels marking is used. For questions with 5–8 marks there is a maximum of two levels; for questions with between 9 and 15 marks there are three levels. For questions with more than 15 marks, including the essays on Unit 3, there are four levels.

Everyone involved in the levels’ marking process (examiners, teachers, students) should understand the criteria for moving from one level to the next — the ‘triggers’. In simple terms, you should know what you must do to take your answer from Level 1 to Level 2, Level 2 to Level 3, and Level 3 to Level 4. Although the precise triggers will vary from question to question, there are general rules you should follow to enable you to make this progression.

In broad terms the levels can be described as follows.

*Level 1: you attempt the question to some extent, giving a basic response*

An answer at this level is likely to:

- display a basic understanding of the topic
- make one or two points without support of appropriate exemplification or application of principle
- give a basic list of characteristics, reasons and attitudes
- provide a basic account of a case study, or provide no case study evidence
- give a response to one command of a question where two (or more) commands are stated, e.g. ‘describe and suggest reasons’
- demonstrate a simplistic style of writing perhaps lacking close relation to the terms of the question
- lack organisation, relevance and specialist vocabulary
- demonstrate deficiencies in legibility, spelling, grammar and punctuation

*Level 2: you answer the question clearly*

An answer at this level is likely to:

- display a clear understanding of the topic
- make one or two points supported by appropriate exemplification
- give a number of characteristics, reasons, attitudes ('more than one')
- provide clear use of case studies
- give responses to more than one command, e.g. 'describe and explain'
- demonstrate a style of writing which matches the requirements of the question
- demonstrate relevance and coherence with appropriate use of specialist vocabulary
- demonstrate legibility of text, and qualities of spelling, grammar and punctuation which enable clarity of meaning

**Level 3: you answer the question very well**
An answer at this level is likely to:
- display a detailed understanding of the topic
- make several points with support of appropriate exemplification
- give a wide range of characteristics, reasons, attitudes etc.
- provide detailed accounts of a range of case studies
- respond well to more than one command
- demonstrate evidence of discussion, evaluation, assessment and synthesis
- demonstrate a sophisticated style of writing incorporating measured and qualified explanation and comment as required by the question
- demonstrate a clear sense of purpose so that the response is seen to closely relate to the requirements of the question with confident use of specialist vocabulary
- demonstrate legibility of text, and qualities of spelling, grammar and punctuation that contribute to complete clarity of meaning

**Level 4: you answer the question with depth, flair, creativity and insight**
In addition to the requirements of Level 3, an answer at this level is likely to:
- provide strong evidence of thorough, detailed and accurate knowledge, and critical understanding of concepts and principles and of specialist vocabulary
- give explanations, arguments and assessments or evaluations that are direct, logical, perceptive, purposeful, and show both balance and flair
- demonstrate a high level of insight, and an ability to identify, interpret and synthesise a wide range of material with creativity
- demonstrate evidence of maturity in understanding the role of values, attitudes and decision-making processes

**Question types**
Unit 3 has a combination of structured questions carrying 25 marks and essay questions carrying 40 marks.

**Structured questions**
Structured questions have a gradient of difficulty. The initial sub-questions are less demanding than the later ones, and therefore carry fewer marks. Thus sub-question (a) often uses command words such as 'comment on', 'describe' or 'outline', while subsequent questions may require explanation, examples and evaluation.

Stimulus materials are used both directly and indirectly. For direct use, OS maps and photographs are provided to assess key skills such as map reading and interpretation. Charts and sketch maps may be supplied to assess your ability to summarise and recognise spatial patterns and trends. For indirect use, stimulus materials are presented as a catalyst for assessing your wider knowledge and understanding of a topic.

**Essay questions**
Essay questions have a number of common features:
- they require description and explanation
- they require some evaluation, assessment or discussion
- they always require detailed exemplification using case studies
- higher levels of response require clear evidence of synopticity

You should reserve 4 or 5 minutes for thinking time and for writing a brief plan of your answer. The plan should outline the general content of each paragraph and the geographical examples you intend to use to support your answer.

Your answer should have three main components: an introduction, a main body and a conclusion.
- The introduction should (a) define any key terms used in the question, and (b) indicate the broad structure of your answer. It should be brief and businesslike: four or five lines should be sufficient.
- The main body is where you develop the list of points in your introduction by means of a series of paragraphs that follow each other in a logical sequence. When discussing or evaluating an issue, and therefore presenting a number of viewpoints, put each idea into a separate paragraph. This will ensure that the reader does not become confused by your argument.
- The conclusion should be a brief summary of the points developed in your answer. Where appropriate, it may need to include some evaluation or overall assessment.

Finally, all questions will cover some aspect of the geographical process summarised in Figure A. It is important to recognise which part of the process the question is asking you about. In general, the sequence of questions in an exam is logical. You may be asked to explain causes, then to describe changes, next to identify problems and finally to suggest solutions.

![Figure A The geographical process](image)

The essays in Unit 3 will be marked using a generic mark scheme. This means that the same general principles will be used to assess your essay, only the context, content and command words will vary. Table A illustrates this mark scheme.

**Table A Essay mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks/40</th>
<th>Assessment criteria</th>
</tr>
</thead>
</table>
| 1     | 1–10     | - The answer shows a basic grasp of concepts and ideas, but points lack development or depth  
|       |          | - Explanations are incomplete, arguments partial and lack coherent organisation or reasoned conclusions  
|       |          | - Examples are superficial  
|       |          | - There is no evidence of synopticity |
| 2     | 11–20    | - The answer is relevant and accurate, and shows reasonable knowledge and critical understanding of concepts and principles with some use of specialist vocabulary  
|       |          | - Arguments are not fully developed and the organisation of ideas and the use of examples and general theories show imbalances  
|       |          | - Some ability to identify, interpret and synthesise some of the material  
|       |          | - Limited ability to understand the roles of values, attitudes and decision-making processes  
|       |          | - Sketch maps/diagrams are not used effectively  
<p>|       |          | - Evidence of synopticity is limited |</p>
<table>
<thead>
<tr>
<th>Level</th>
<th>Marks/40</th>
<th>Assessment criteria</th>
</tr>
</thead>
</table>
| 3     | 21–30    | - Sound and frequent evidence of thorough, detailed and accurate knowledge and critical understanding of concepts and principles, and of specialist vocabulary  
- Explanations, arguments and assessments or evaluations are direct, logical, purposeful and generally balanced  
- Some ability to identify, interpret and synthesise a range of material  
- Some ability to understand the roles of values, attitudes and decision-making processes  
- Examples are developed and sketch maps/diagrams are used effectively  
- There is strong evidence of synopticity |
| 4     | 31–40    | - Strong evidence of thorough, detailed and accurate knowledge and critical understanding of concepts and principles and of specialist vocabulary  
- Explanations, arguments and assessments or evaluations are direct, logical, perceptive, purposeful, and show both balance and flair  
- There is a high level of insight, and an ability to identify, interpret and synthesise a wide range of material with creativity  
- Evidence of maturity in understanding the role of values, attitudes and decision-making processes  
- Examples are well-developed and sketch maps/diagrams are fully integrated  
- The answer is fully synoptic |
Question 1

a Study Figure 1, which shows the global distribution of earthquakes.

![Figure 1 Global distribution of earthquakes](image)

Describe the distribution of the earthquakes and attempt to explain the pattern that is shown. (7 marks)

Mark scheme

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Basic/simple statements with regard to distribution, mainly names of countries or areas affected by earthquakes. Explanation confined to plate boundaries. (1–4 marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2</td>
<td>Wider picture seen, such as the 'Pacific Ring of Fire'. Some reference to the large areas where there are no or few recorded instances. More details on plate boundaries such as the name, the activity taking place there which results in earthquakes and activity within fold mountains. Some attempt to explain why some areas are free/relatively free from earthquakes. (5–7 marks)</td>
</tr>
</tbody>
</table>

As this question is levels marked, you will receive only Level 1 marks if you describe the distribution in piecemeal form, i.e. simply a list of countries/areas. You must describe a wider pattern to reach Level 2. Similarly, explanations must go deeper than simply stating that the earthquakes are on or near plate boundaries. You could state what is happening to cause earthquakes at specific boundaries (must be those shown on the map, not earthquakes in general) such as on the conservative margin in California.

b Describe the effects that a major earthquake can have on the population of an area. (8 marks)

Mark scheme

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Simple statements giving nothing more than a list of the effects. (1–4 marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2</td>
<td>Recognises that effects can be divided into primary and secondary and gives examples of each (accept candidate’s own definition of primary/secondary as long as it is logical). Links are clearly made between primary and secondary hazards, e.g. ground shaking can cause buildings to fall,</td>
</tr>
</tbody>
</table>
breaking gas pipes which could lead to fires breaking out. Several effects can be linked together in a chain; another example could be ground shaking resulting in dams cracking, collapsing and leading to flooding downstream. (5–8 marks)

To reach the higher mark level, you must do more than write a list of effects. With many hazards it is important to recognise that there are both primary effects and later secondary effects, which may last for a considerable period of time after the event. It is also essential to see that one effect may be the cause of another. If you can link the hazards in this way, your mark will be at the top of the range.

c Discuss the effectiveness of the methods used to lessen the impact of earthquakes on the population of an area. (10 marks)

Mark scheme

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Simple statements of methods, in effect little more than a list of the ways people can attempt to lessen the impact. (1–4 marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2</td>
<td>Recognises that there can be categories, or shows the general aim behind the methods. Begins to show how these methods work and how effective they have been, perhaps with some small references to located examples. (5–8 marks)</td>
</tr>
<tr>
<td>Level 3</td>
<td>Shows a clear indication that methods can be divided into categories and discusses the purposes of such attempts. Clearly makes critical evaluations of the methods with details on how they can be made to work. Links methodology and its effectiveness with clear references to located examples. (9–10 marks)</td>
</tr>
</tbody>
</table>

As with (b), text that is effectively a list of methods will receive credit only at the lowest level. The key word in the question is ‘effectiveness’, and you must show to what extent the methods you quote work. Although examples are not mentioned in the question, it is a good idea to link effectiveness to real-world situations. If a particular method was effective/ineffective at a certain event, say so, as this will receive credit at the higher levels.

Question 2

a Study Figure 2 which shows the distribution of tectonic plates and their movements.

**Figure 2 Tectonic plates**

- Convergent (destructive) subduction zones
- Divergent (constructive) sea-floor spreading
- Conservative zones

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