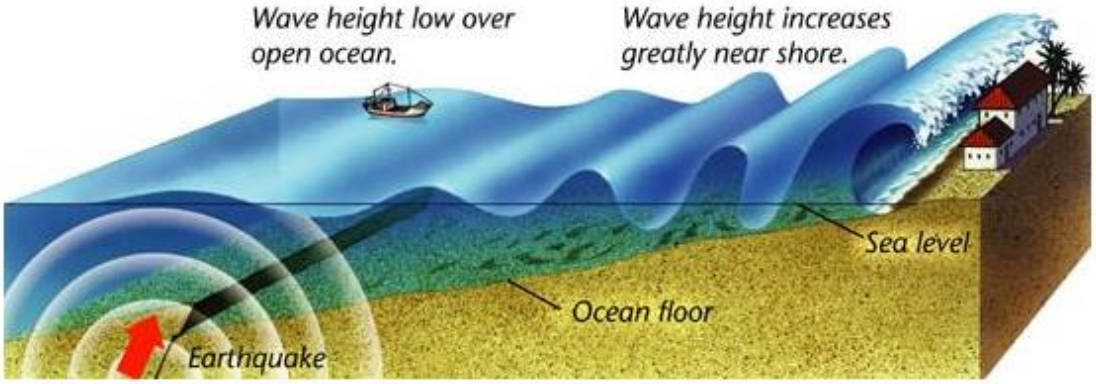
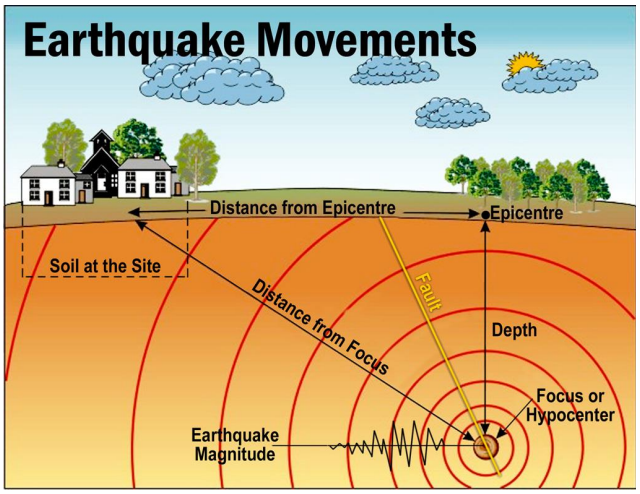
GEOGRAPHY

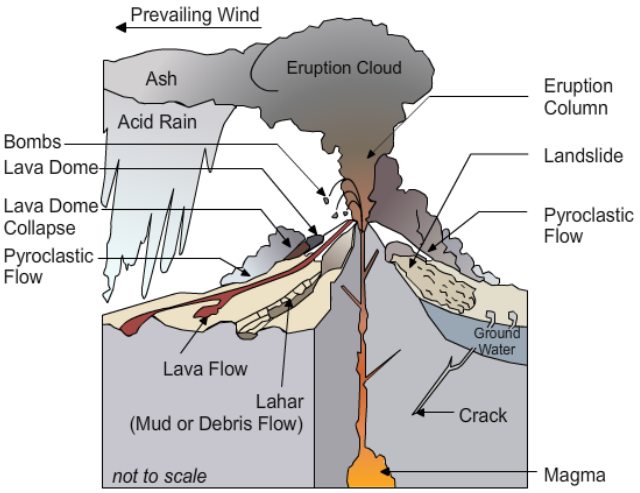
A Level

A2 Unit 4
Section A

Tectonic Hazards







A. Prickett
Whitmore High School

Section A: Tectonic Hazards

Refer to your year 12 Tectonic hazards booklet for main facts. Additional information is shown below in **bold**.

Focus	Geographical content	Revision
4.1.1 Tectonic processes and hazards	• Earth structure including core, mantle and crust and the boundaries between them • Mechanisms of plate movement • Plate distribution and the processes operating at different margins • Global distribution of tectonic hazards • Characteristics of the physical hazard profile that influence its impact including magnitude (as measured on Mercalli and Richter scales and Volcanic Explosivity Index (VEI), predictability, frequency, duration, speed of onset and areal extent	
4.1.2 Volcanoes, processes, hazards and their impacts	• Types of volcano including shield, composite and cinder and types of volcanic eruption including explosive and effusive • Volcanic processes and the production of associated hazards including pyroclastic flows, lava flows, ash falls, lahars, jökulhlaups, volcanic landslides and toxic gases • **Environmental,** demographic, economic and social impacts of volcanic hazards on people and the built environment including primary and secondary effects • **Use examples of at least two contrasting contexts** to demonstrate the varied degree of risk and impacts	
4.1.3 Earthquakes, processes, hazards and their impacts	• Earthquake processes and the production of associated hazards including ground shaking, liquefaction and landslides • **Environmental**, demographic, economic and social impacts of earthquake **and tsunami** activity on people and the built environment including primary and secondary effects • **Use examples of at least two contrasting contexts** to demonstrate the varied degree of risk and impacts • **Use examples of at least two contrasting contexts to demonstrate the varied degree of risk and impacts of tsunami activity**	
4.1.4 Human factors affecting risk and vulnerability	• Economic factors including level of development and level of technology • Social factors including the population density, population profile (age, gender) and levels of education • **Political factors including the quality of governance** • Geographical factors including rural / urban location, time of day and degree of isolation	
4.1.5 Responses to **volcanic** hazards	• Monitoring, predicting and warnings of volcanic eruptions and earthquakes • **Mitigating volcanic hazards and modifying the event, vulnerability and loss** • Short-term and long-term responses to the effects of volcanic hazards (the hazard management cycle)	
4.1.6 Responses to **earthquake** and **tsunamis**	• Monitoring, predicting and warnings of volcanic eruptions and earthquakes • **Mitigating volcanic hazards and modifying the event, vulnerability and loss** • Short-term and long-term responses to the effects of earthquake and **tsunami** hazards (the hazard management cycle)	

INTRODUCTION

Building on AS Unit 1 knowledge

The work form this unit and background work from AS unit 1 will be assessed in the form of an essay. In the unit 4 exam you will be given the choice of two essays. You must answer one of these two which will be worth 20 marks. A sample paper is shown below:

Unit 4 – Contemporary Themes in Geography

Make the fullest possible use of examples in support of your answers.

Section A

*Answer **one** question.*

Theme 1: Tectonic Hazards

1. Analyse why processes associated with earthquake activity often result in hazards. [20]

OR

2. Analyse why the impacts of volcanic activity vary. [20]

In addition to this you may be asked to refer to work related to tectonics in the 21st century challenges section of the unit 3 paper. This section asks you to bring together all of your geographical knowledge in order to construct an essay. See below:

Unit 3: Section C – 21st Century Challenges (synoptic exercise)

*Answer question 9 **or** question 10*

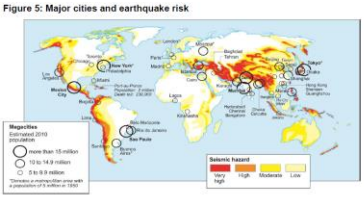
You are advised to refer to figures 5, 6, 7 and 8 and make the fullest possible use of examples in support of your answers. Study **Figures 5, 6, 7 and 8**

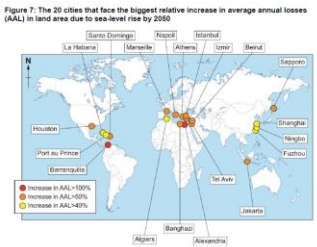
Either

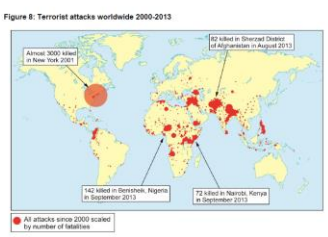
9. Describe and assess the severity of the different risks that cities increasingly face. [26]

Or

10. To what extent can large megacities be successfully managed to reduce their vulnerability to different risks? [26]







4.1.2 Volcanic processes, hazards and their impacts

The Impacts of Volcanic Eruptions

We are going to look in detail at two contrasting case studies that illustrate the varying degree of risk and impacts.

For each event you will need to look at the:

- **Environmental** effects – how is the landscape affected?
- **Demographic** effects – how is the population affected?
- **Social** effects – how are people's lives affected?
- **Economic** effects – how are jobs and money affected?

The two main events that we will study in detail are:

Mount Pinatubo, Philippines 1991
Nevado del Ruiz, Colombia 1985

Firstly: For each event you will need to gather the following basic factual information:

Location	Date	Type of volcano/eruption
Cause	Time	Tectonic setting
Recovery	Cost	Primary and secondary hazards
Responses	Casualties	Short and long term effects

The extent of any prediction, protection and preparation taking place

Secondly: Try to assess the effects on a variety of scales:

- Local (the immediately affected area)
- Regional (the wider are in that country)
- Global (across the world)

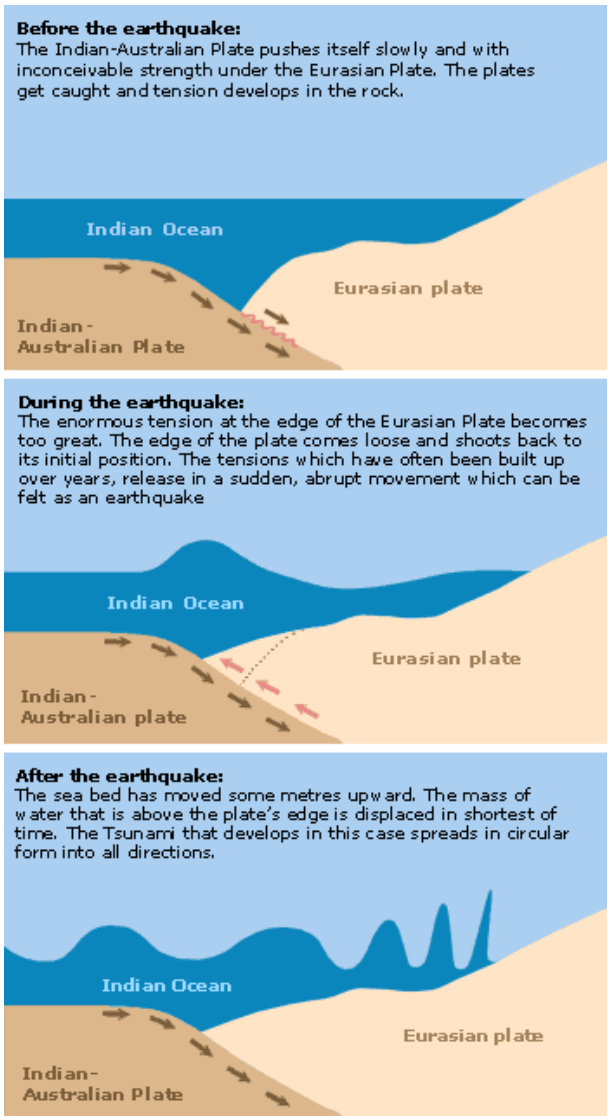
Finally: Attempt to compare and contrast your two case studies to illustrate the varying degree of risk and severity of the impacts. What factors affected each of these?

Remember these case studies will need to be in the depth required to write about in a twenty-mark essay.

4.1.3 Earthquakes, processes, hazards and their impacts

Tsunamis

The term *tsunami* from the Japanese and means "Big wave in the port". The term was coined by fishermen who returned to their ports in the evening after their villages and cities had been devastated by a giant wave although they had not seen any waves on the open sea.
Tsunamis form when huge masses of water are suddenly displaced due to earthquakes on the sea bed, volcanic eruptions above and under water, landslides or meteorite impacts. About 86% of all tsunamis result from so-called seaquakes. If a trough of a tsunami wave approaches the land first, the water will be pulled back into the sea by enormous currents. Vast stretches of the seabed are often drained as happened during the December 2004 tsunami.
The destruction is caused by two mechanisms: the smashing force of a wall of water travelling at high speed, and the destructive power of a large volume of water draining off the land and carrying debris with it.



The total destruction along the coast of Banda Aceh province in Indonesia after the December 2004 tsunami.

The Impacts of Earthquakes and Tsunamis

We are going to look in detail at two contrasting case studies that illustrate the varying degree of risk and impacts from **both** earthquakes and tsunamis.

For each event you will need to look at the:

- **Environmental** effects – how is the landscape affected?
- **Demographic** effects – how is the population affected?
- **Social** effects – how are people's lives affected?
- **Economic** effects – how are jobs and money affected?

The four main events that we will study in detail are:

Kobe earthquake, Japan 1995
Haiti earthquake 2010
Indian Ocean tsunami 2004
Tohoku earthquake and tsunami, Japan 2011

Firstly: For each event you will need to gather the following basic factual information:

Location	Date	Magnitude and duration of event
Casualties	Time	Primary and secondary hazards
Recovery	Cost	Short and long term effects
Responses	Cause	Tectonic setting

The extent of any prediction, protection and preparation taking place

Secondly: Try to assess the effects on a variety of scales:

- Local (the immediately affected area)
- Regional (the wider are in that country)
- Global (across the world)

Finally: Attempt to compare and contrast your various case studies to illustrate the varying degree of risk and severity of the impacts. What factors affected each of these?

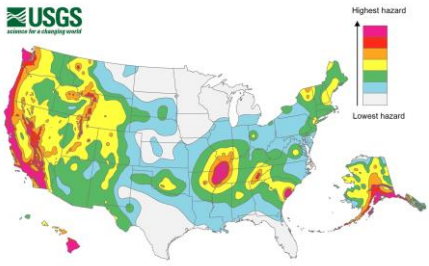
Remember these case studies will need to be in the depth required to write about in a twenty-mark essay.

4.1.4 Human factors affecting risk and vulnerability

Political Governance (related to how a country is organised or run)
The organisation and governance of a country has a huge bearing on its ability to cope with tectonic hazards. The lack of strong central control and organisation from a government produces a weak organisational structure and response to a hazard. A lack of financial institutions inhibits both emergency response and disaster management. A strong central government can lead to rapid response and post event recovery.

In LEDCs: Hazard preparation is often ignored and a lack of economic development does not allow an active response to take place. As a result, in places like **Haiti** little leadership or control is taken when events occur. Haiti has had a chaotic political history and as a result has not had strong government or leadership for many years. Haiti is also very poor and has little money to spend on earthquake protection, monitoring or relief. There is little local, regional or national co-ordination of emergency services and schools and hospitals are poorly prepared.

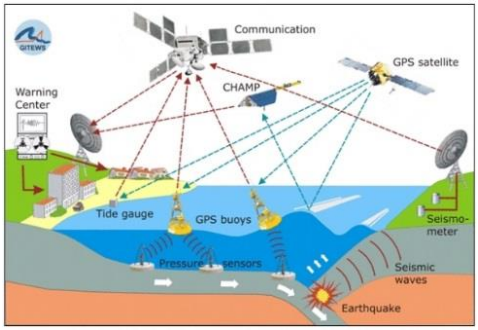
IN MEDCs: In the **USA** it is estimated that (directly and indirectly) over $9.5 billion is spent each year on earthquake monitoring, education, aid, relief and research. This is co-ordinated by the central (federal) government and at state and city level. In 2016 there were 119 earthquakes over 6 on the Richter scale recorded in the USA. However, in the last 100 years there have been just over 750 deaths due to earthquakes. This is in part due to FEMA (Federal emergencies management agency) which is a government run organisation in charge of planning for, managing and monitoring hazards across the country.



4.1.5/6 Responses to tectonic hazards

Tsunami - Monitoring, prediction and warning

Tsunamis are possibly the most **predictable** of tectonic hazards. If a large underwater earthquake occurs with vertical uplift of the sea floor, then a tsunami will be generated. The time delay between the earthquake and the tsunami reaching land allows for warnings to be given. GPS buoys in the sea can pick up small changes in surface waves and when linked to seismometers can help to give computer predictions of tsunami height.



GPS buoys send signals to warning sirens or direct to mobile phones alerting people of the imminent danger

People and property in coastal areas can also be **protected** from some of the worst effects with some simple measures:

Tsunami shelters provide limited protection from smaller waves for those who can't evacuate

Tsunami walls and closable sluice gates can offer protection for some, but not all parts of the coast

People can also be **prepared** for the threat through education, drills and the designating of safe areas with road signs and maps.

Mitigating volcanic hazards and modifying the event, vulnerability and loss

In your year 12 unit 1 booklet you will find details on the various methods of prediction, protection and preparation for both earthquakes and volcanoes as well. In this unit we will focus on the response to the hazard. MEDCs tend to have to an active response to a hazard event. An **active response** to a hazard involves the following things (as defined by K. Smith):

1. Prevent or Modify the event

These management strategies aim to control the physical process involved, and therefore, modify and prevent the hazardous event, in one of two ways:

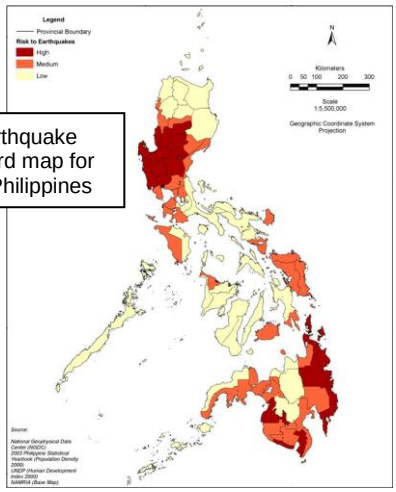
- Hazard prevention and environmental control. Ideally, the event would be prevented from occurring. This is currently unrealistic. Environmental control aims to suppress the event by diffusing energy over a greater area or period of time to prevent the event occurring. Lava flows may be diverted or controlled by a range of methods, e.g. barriers, channels, bombing the flows or the spraying of water.
- Hazard resistant designs aim to protect people and structures from the full effects of earthquakes and tsunamis. The focus is on the building design and engineered solutions e.g. tsunami walls or aseismic building designs. Buildings can be designed to withstand hazards, and most public structures, e.g. roads, dams, bridges, will have some hazard resistant features incorporated.

2. Modify the vulnerability

This aims to change human attitudes and behaviour towards the behaviour towards hazards, either before the event, or after it. Thus making the people less vulnerable to the event.

- Prediction and warning. If a hazard is predicted, action can be taken to lessen its impact on people and property. Insurance companies spend large amounts of money in order to adjust their premiums to cover losses. Between 1990 and 2015, 28 of 30 of Lloyd's (the world's largest insurance underwriter) most expensive losses were natural disasters. The Tohoku earthquake and tsunami in 2011 resulted in £24 billion in claims. Companies can thus set higher premiums in higher risk areas. Warnings inform people of impending hazards. They rely on adequate monitoring and evaluation of the data, then the effective dissemination of the information via various information services.
- Community preparedness: This involves prearranged measures and procedures which aim to reduce the loss of life and minimise damage.

This includes such measures as public education and awareness programmes, computer modelling of events, evacuation procedures and provision of emergency shelters, food and medical supplies. Effective use of this has saved many lives over the years, including in the Mount Pinatubo volcanic eruption in 1991, where an emergency plan was successfully implemented to save thousands of lives.



Earthquake hazard map for the Philippines

- Land use planning which aims to prevent hazardous areas being occupied by new settlements. The success of this strategy depends on accurate knowledge of frequency, nature, and location of hazards. This can be partly achieved through the accurate use of hazard maps.

3. Modify the loss

The most passive response is to simply accept the losses incurred. This is rarely acceptable, especially after higher magnitude events. More commonly, the strategy is to share the losses. This can be achieved in two ways; aid and insurance.

- Aid is provided at many levels for relief, rehabilitation and reconstruction purposes. High magnitude events are often declared disaster areas, and the losses shared nationally. At the international level, politics and pride often interfere with aid being asked for or given. In such situations, the United Nations is often involved, or charitable non-governmental organisations (NGOs), e.g. the Red Cross are involved in aid. Often, sudden disasters generate more aid donations than slow onset hazards, such as droughts.
- Insurance is a key strategy in the MEDCs. The principle is that people join with a financial organisation to spread costs. An individual needs to act by purchasing a policy, and paying an annual premium. Insurance companies need to identify key areas of risk and hazards in order to secure their business. In 1994, Californian insurance companies collected $500 million in premium payments, but paid out $11.4 billion in claims resulting from the Northridge quake. Insurance for high risk area may not be available, or come with stipulated conditions, e.g. buildings must have certain construction techniques employed. It encourages people to take preventative measures for themselves.

http://www.pupilvision.com/uppersixth/hazards.htm

Hazard management cycle