

**Please note:**

The following teacher lesson plans utilise computer technology. If you are unable to access this technology, we have provided a package of support materials that will assist you still to complete the lessons, and are identified below.

## Lesson 1

What is an earthquake? Why do they happen? Facts and fiction about earthquakes. Earthquakes around the world, in Australia and Victoria.

Outline	Materials	Time	Conclusion
To cover earthquakes, how they happen and where they occur.	<ul style="list-style-type: none"> <li>A video/TV screen</li> <li>An overhead projector/smartboard</li> <li>Computers/iPads for students (they can work individually or in small groups)</li> <li>White board and marker</li> <li>Writing materials</li> </ul> <p><i>Optional</i></p> <p>Photocopy for each student or pair/group</p> <ul style="list-style-type: none"> <li>Students exercise books or Worksheet #1: Five interesting facts</li> <li>Support material #1: Earthquake facts</li> <li>Support material #2: Earthquakes in Victoria</li> </ul>	1 hour	Students will develop their understanding of earthquakes and how they are caused, as well as where earthquakes occur in Australia.

## Introduction

15 minutes

- Introduce the topic of earthquakes with students. Begin by asking what students know about earthquakes, if they have ever felt an earthquake, have they ever seen an earthquake in a movie, what might happen in an earthquake.
- Show students the following video that explains how earthquakes occur: <http://www.sciencekids.co.nz/videos/earth/whatisanearthquake.html> (1.38 minutes in duration).
- Once the video is completed, ask students what they learnt about earthquakes. Discuss what tectonic plates and fault lines are and why there are places in the world that are more likely to have earthquakes. Discuss if they know or noticed from the video which places might be more likely to have earthquakes due to their location in relation to the tectonic plates.
- After the discussion, the video could be shown again to reinforce the learning.

## Activity

30 minutes

- Using the computers, ask students to research more about earthquakes and where in Australia earthquakes have occurred. Explain that they will be working in pairs or in small groups, and they have 30 minutes to discover five interesting facts. They can either work in their exercise books or use *Worksheet #1: Five interesting facts*.
- Examples of interesting facts may include what parts of Australia have had earthquakes? Has there been an earthquake in Australia in the last seven days? Where in the world was the largest earthquake?

- The following websites are good resources (before commencing the research, it might be worthwhile to show the websites on the overhead projector/smartboard and how to navigate around them to avoid confusion).

### 1 Victoria State Emergency Service

<http://www.ses.vic.gov.au/prepare/quakesafe> contains facts, definitions and information on recent Victorian earthquakes, including their magnitude. (Please see *Support material #1: Earthquake facts* and *Support material #2: Earthquakes in Victoria*).

### 2 Earthquakes @ Geoscience Australia

<http://www.ga.gov.au/earthquakes> provides a map of Australia and surrounding region which provides information where earthquakes have occurred in the last seven days and their size.

### 3 United States Geological Survey (USGS)

<http://earthquake.usgs.gov/learn/kids> provides lots of information on earthquakes including factsheets, glossary, FAQ, animations, educational posters, pictures, an opportunity to monitor earthquake activity and lots more.

<http://earthquake.usgs.gov/earthquakes/map> shows the plate outline and recent earthquakes. (If you demonstrate how to change the settings to show the last 30 days, it becomes clear that quakes happen on the tectonic boundaries).

- Encourage students to also locate other web pages if time permits.

## Conclusion

15 minutes

- Remaining in their groups, ask one student from each pair/group to read out the five interesting facts they discovered. Write these facts on the board in dot point form. Before students read out their five facts, they are to make sure they are not repeating a fact that is already on the board.
- Once all groups have reported back, students independently read the facts on the board. Discuss together which fact is most interesting and why.
- To conclude, remind the students of the initial discussion on what they knew about earthquakes and how much they have now learnt.

## Lesson 2

What should people do if there is an earthquake? How can we be prepared? What to do during and after an earthquake. What should an emergency plan and kit include?

Outline	Materials	Time	Conclusion
To cover what to do before, during and after an earthquake.	<ul style="list-style-type: none"> <li>An overhead projector/smartboard</li> <li>Computers/iPads for students working in pairs/small groups</li> <li>Poster paper</li> <li>Writing materials</li> </ul> <p><b>Optional</b> Photocopy for each student or pair/group of students:</p> <ul style="list-style-type: none"> <li><i>Support material #3: Earthquakes around the world</i></li> <li><i>Support material #4: Learn about the SES</i></li> <li><i>Support material #5: What to do in an Earthquake</i></li> </ul>	1 hour	Students will identify what to do to be prepared for an earthquake and what to do if they are in an earthquake. Students will display these findings in a poster or digital presentation.

## Introduction

15 minutes

- Revise what was learnt and discussed in **Lesson 1: What is an earthquake and why do they occur?**
- Ask students what damage might occur in an earthquake? For example buildings/structures/roads can be damaged, power, water and telephones may not work. (*Support material #3: Earthquakes around the world* provides some examples that could be discussed).
- Ask students if they have heard of the SES (Victoria State Emergency Service) and that this organisation helps people when there are floods, storms, tsunamis and earthquakes in Victoria. (Students could either visit [www.ses.vic.gov.au](http://www.ses.vic.gov.au) or use *Support material #4* to learn more about SES).
- Using *Support material #5: What to do in an Earthquake*, place a copy on the overhead projector/smartboard or photocopy and distribute to each student.
- As a class read through the information and discuss the following:
  - Items in the Home Emergency Kit and why they might be important to have.
  - What to do during an earthquake inside and outside.
  - What to expect after an earthquake.
- Ask students if this is important information that everyone should know in case they are in an earthquake. Why?

## Activity

30 minutes

- In pairs or small groups, students are to create a poster or digital presentation outlining what to do in an earthquake to inform the school community. (*If creating a digital presentation, students could use PowerPoint, iMovie or other programs*).

- Emphasise to students the importance of including lots of information in their poster/presentation. Earthquakes are events that can have devastating outcomes for people and it is important that their posters/presentations treat earthquakes as serious events.
- As students are creating their posters/presentations, spend time with each group to make sure they are including the important information.

## Conclusion

15 minutes

- Each group is to present their work to the class. As each group presents, discuss what was effective about their poster/presentation, what did they find interesting.

### *Please note:*

- If students run out of time while creating their posters/presentations, they may require additional time.
- If possible, students can show their posters/presentations to other classes or parents to help inform the wider community.

## Extension idea

- Students have learnt what earthquakes are and what causes them and what to do if they are in an earthquake. To bring all this information together, students could write a diary entry pretending they are in an earthquake. They could include the lead up to the earthquake, write about their feelings and senses (what they can see, hear and touch during the earthquake) and what happened after the earthquake, what did they find?



## Worksheet #1

# Five interesting facts

Grades 5 & 6

	Interesting fact
#1	
#2	
#3	
#4	
#5	

# Earthquake facts

Grades 5 & 6

## What is an earthquake?

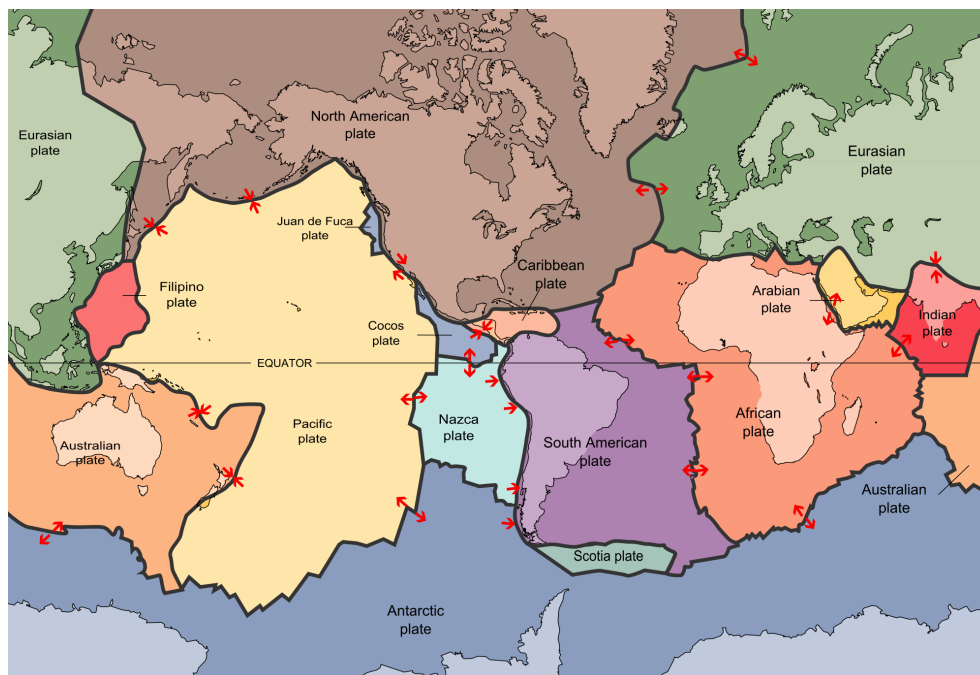
An earthquake is the shaking and vibration at the surface of the Earth caused by energy being released along a fault plane, at the edge of a tectonic plate or by volcanic activity.

## What causes earthquakes?

Earthquakes are caused by the movement of Earth's outer layer (the crust and a portion of the upper mantle). The outside layer of Earth is split into **tectonic plates** which are moving slightly due to the movement of magma in the layer below. This causes plates to squeeze together, move apart and slide alongside each other.

## Earthquakes are classified into two types:

- **Interplate earthquakes** – these earthquakes occur on tectonic plate boundaries where the tectonic plates are moving towards each other or sliding alongside each other. Interplate earthquakes are common for countries such as Japan, New Zealand and the west coast of the United States which are located on tectonic plate boundaries. Large earthquakes are usually interplate earthquakes.
- **Intraplate earthquakes** – these earthquakes occur in the middle of tectonic plates on fault zones where the pressure of the tectonic plate being squashed and forced to move builds up and is released through the cracks in rocks associated with fault zones, resulting in an earthquake. As Australia is located in the middle of a tectonic plate, we are less susceptible to larger earthquakes; however damaging earthquakes can still occur on fault zones.



*This image shows the tectonic plate boundaries on Earth's outer layer. Earthquakes commonly occur on tectonic plate boundaries, particularly where two plates are moving towards each other such as the Australian plate and the Pacific plate.*

## Earthquake magnitude

The size of an earthquake is referred to as its magnitude on a scale from 1 – 10. Magnitudes as low as 1 are measured in mines due to rock bursts and the maximum magnitude possible is less than 10. For every unit increase in magnitude, there is roughly a thirty-fold increase in the energy released. For instance, a magnitude 2.0 earthquake releases about 30 times more energy than a magnitude 1.0 earthquake, while a magnitude 3.0 earthquake releases 900 times (30x30) more energy than a magnitude 1.0.

In Australia, seismologists (people who study earthquakes) prefer the use of the **moment magnitude scale**, which calculates the magnitude of an earthquake based on physical properties such as the area of movement (slip) along the fault plane.

The table below outlines expected impacts of earthquakes. Damage to buildings will depend on how they were built. For locations near the centre of the earthquake the following impacts may occur:

Magnitude (Moment Magnitude)	Description of effects
8.0 and over	◀ Magnitude 9.0 Japan 2011
	◀ Causes extensive damage, waves seen on the ground's surface, objects thrown into the air.
	◀ Causes significant damage, most buildings collapse.
7.4 - 7.9	
7.0 - 7.3	◀ Magnitude 7.1 Christchurch 2010
	◀ Serious damage to buildings, bridges twist, walls fracture, many buildings collapse.
6.2 - 6.9	◀ Significant building damage, houses move on their foundations, chimneys fall, furniture moves.
5.5 - 6.1	
	◀ Magnitude 5.6 Newcastle 1989
	◀ Some damage to buildings, plaster cracks, bricks fall, chimneys damaged.
4.9 - 5.4	◀ Magnitude 5.4 Moe 2012
	◀ Felt by everyone, dishes break and doors swing, unstable objects overturn.
4.3 - 4.8	
	◀ Magnitude 4.6 Korumburra 2009
	◀ Felt by many people, windows rattle, dishes disturbed, standing cars rock.
3.5 - 4.2	◀ Felt by people who are indoors and some outdoors. Hanging objects may swing.
Less than 3.4	◀ Usually felt by only a few people near the earthquake's origin. These sized Earthquakes are common in Australia and cause little to no damage.



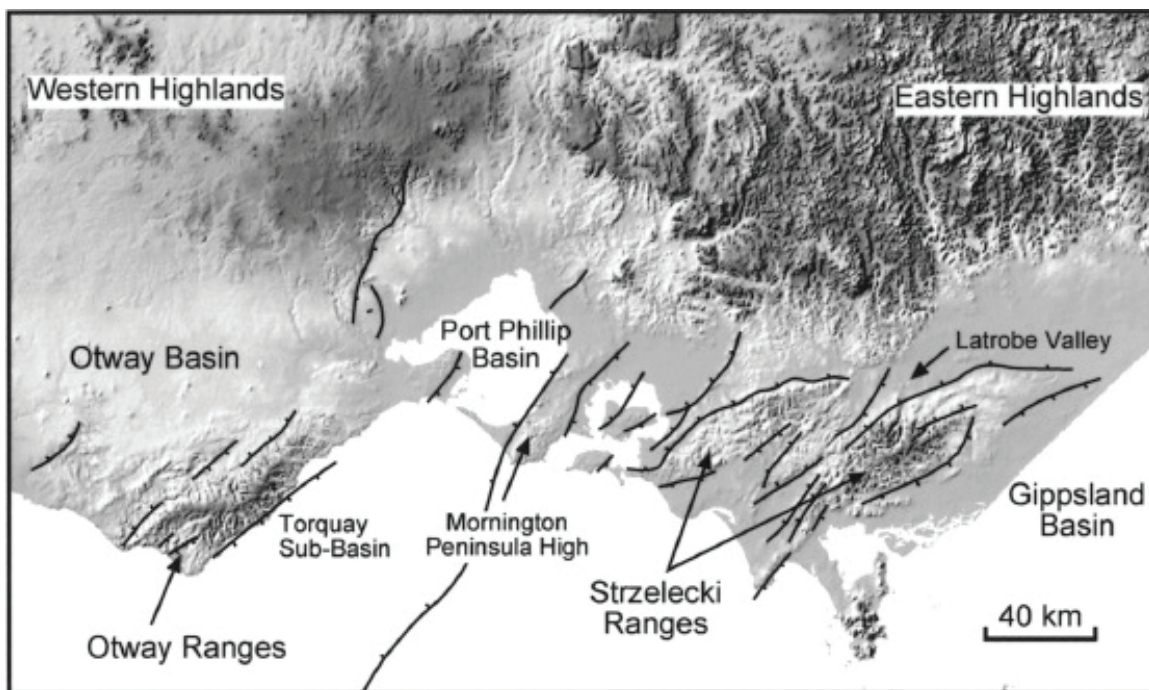
# Earthquakes in Victoria

Grades 5 & 6

## Do earthquakes happen in Victoria?

Earthquakes can and do happen in Victoria. Earthquakes in Victoria occur due to the build up of stress in rocks along fault planes in the region. A fault plane is a weak point within a tectonic plate where the pressure can be released. There are a number of fault planes that have been identified in Victoria, including the Strzelecki Ranges, Mornington Peninsula and in the Otway Ranges. In addition, fault planes can be created over time or may have not been identified.

The image below shows some of the known fault planes in Victoria:



## Recent Victorian Earthquakes

On 19 June 2012, a magnitude 5.4 earthquake occurred in the state's southeast at 8:53pm. The earthquake epicentre was 16 kilometres southwest of Moe and was the strongest earthquake recorded since the 1982 Wonnangatta Valley earthquake and was felt across the state including in Melbourne and as far away as Wodonga. Since this large earthquake in June, there have been over 200 aftershocks with the largest recorded at magnitude 4.3 on Friday, 20 July.

In August 2000, a magnitude 5.0 in Boolarra caused minor damage and was felt throughout Gippsland and in 2009, Korumburra experienced two earthquakes within two weeks of each other on the 6 March and then the 18 March. Both earthquakes were recorded at a magnitude 4.6.

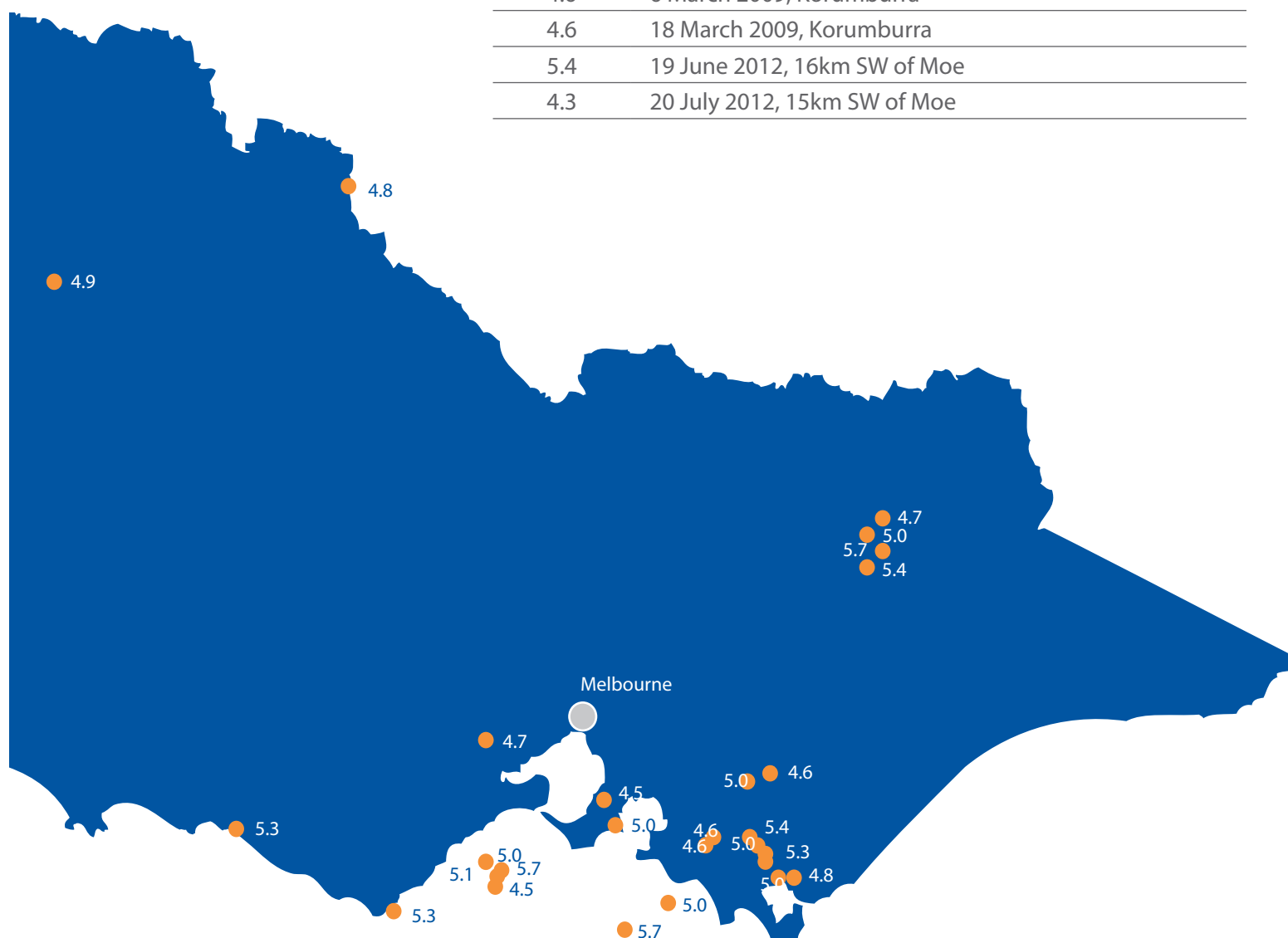
Recent earthquakes remind us that Earthquakes can and do occur in Victoria and occur without warning.



In addition to recent earthquakes, Victoria has had a number of earthquakes since records began.

The map and table on this page show some dates, sizes and locations of significant earthquakes in and around Victoria.

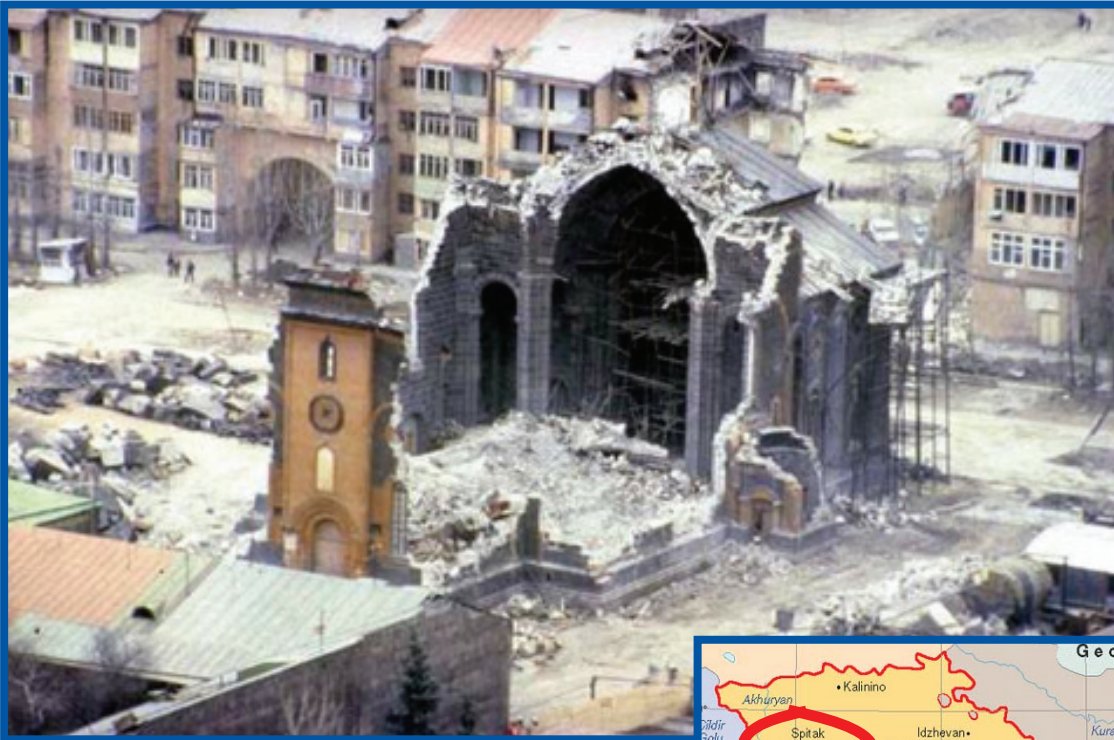
Magnitude	Date and Location
5.3	14 July 1903, Warrnambool
5.0	10 April 1904, Eastern Highlands (south of Mount Beauty)
4.7	29 January 1960, Mount Feathertop
4.8	14 June 1963, Welshpool
5.7	4 May 1966, Mount Hotham
5.3	20 June 1969, Boolarra
5.0	23 June 1969, Boolarra
4.7	2 December 1977, near Mount Anakie
5.4	21 November 1982, Wonnangatta Valley
5.4	21 November 1984, South of Bright
4.9	23 December 1987, near Nhill
5.0	25 September 1996, Mount Baw Baw
5.0	29 August 2000, Boolarra South
4.6	6 March 2009, Korumburra
4.6	18 March 2009, Korumburra
5.4	19 June 2012, 16km SW of Moe
4.3	20 July 2012, 15km SW of Moe



## Support material #3

# Earthquakes around the world

Grades 5 & 6



### Three World Examples

#### Collapse of Masonry Church

On December 7 1988, a magnitude 6.9 earthquake shook northwestern Armenia (located in Eurasia), and was followed four minutes later by a magnitude 5.8 aftershock. The earthquakes and aftershocks affected an area 80 km in diameter. This earthquake devastated the cities of Spitak and Leninakan. This photo illustrates the collapse of an old stone masonry Armenian church in Leninakan. Churches are vulnerable to earthquake damage because of their high, unsupported roofs.

Photo Credit: C.J. Langer, U.S. Geological Survey

Source: [http://embc.gov.bc.ca/em/hazard\\_preparedness/earthquake\\_photos.html](http://embc.gov.bc.ca/em/hazard_preparedness/earthquake_photos.html)



### Three World Examples Damage to School Classroom

This earthquake occurred on May 2 1983 in Central California USA, 20.8 km from Coalinga affecting an area of 205,000 square kilometres with an estimated \$31 million in damages. The most serious damage occurred in the eight-block downtown commercial district, but residences were also heavily damaged. More than 800 single-family houses were destroyed or incurred major damage. The majority of the 94 injuries occurred in residential sections of the city.



Photo Credit: Earthquake Engineering Research Institute  
Source: [http://embc.gov.bc.ca/em/hazard\\_preparedness/earthquake\\_photos.html](http://embc.gov.bc.ca/em/hazard_preparedness/earthquake_photos.html)





Photo Credit: National Geophysical Data Center  
 Source: <http://www.ngdc.noaa.gov/hazardimages/picture/show/25>

### Three World Examples Leaning Apartment Houses

A magnitude 7.4 earthquake on June 16 1964 in Niigata (Japan), destroyed over 3,000 houses and damaged almost 10,000 structures. This is an aerial view of leaning apartment houses in Niigata produced by soil liquefaction and the consequence of poor foundations. Most of the damage was caused by cracking and unequal settlement of the ground.

## Two Australian Examples

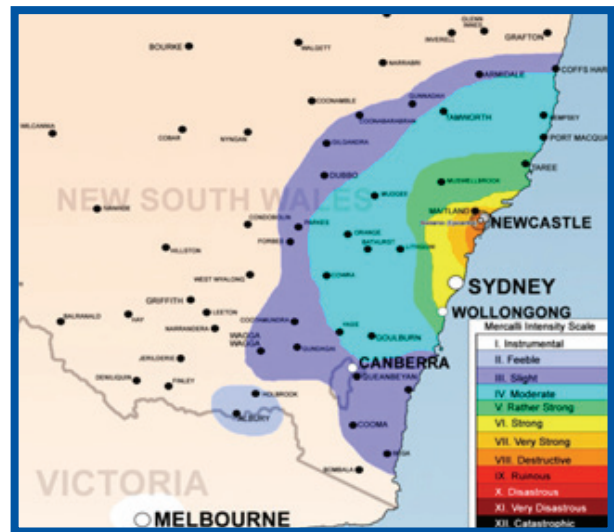
### Newcastle, New South Wales

In Newcastle on 28 December 1989, one of the most disastrous earthquakes ever to hit Australia occurred reaching a magnitude 5.6 with an epicentre about 15 km south of the Newcastle central business district. Only one aftershock, magnitude 2.1, was recorded.

It injured more than 160 people, decimated 35,000 homes, which resulted in 1,000 people being displaced and a \$4 billion damage bill.

The effects were felt over an area of around 200,000 square kilometres, with isolated reports of movement in areas up to 800 km away. In total 50,000 buildings were damaged and 300 had to be demolished.

This destruction and distress resulted in one of Australia's worst natural disasters, despite the earthquake registering magnitude 5.6 on the Richter scale. Many people questioned how a supposedly moderate earthquake caused so much damage.



Sources:

- [http://www.google.com.au/imgres?imgurl=http://www.australiangeographic.com.au/assets/images/blogposts/10615/newcastle-earthquake.jpg&imgrefurl=http://www.australiangeographic.com.au/journal/on-this-day-in-history-newcastle-earthquake-strikes.htm&h=325&w=620&sz=175&tbid=Ofawj4J0RPbCM:&tbnh=90&tbnw=172&pr ev=/search%3Fq%3DNewcastle%2B1989%2Bearthquake%26tbm%3Disch%26tbo%3Du &zoom=1&q=Newcastle+1989+earthquake&usq=\\_ra2pfiNciFzPQqxCxYbUehdB-Rg=& docid=o9qhqkOnN9F3BM&sa=X&ei=jhkDUvStAuFiAeby4HwCg&ved=0CD4Q9QEwAg &dur=868](http://www.google.com.au/imgres?imgurl=http://www.australiangeographic.com.au/assets/images/blogposts/10615/newcastle-earthquake.jpg&imgrefurl=http://www.australiangeographic.com.au/journal/on-this-day-in-history-newcastle-earthquake-strikes.htm&h=325&w=620&sz=175&tbid=Ofawj4J0RPbCM:&tbnh=90&tbnw=172&pr ev=/search%3Fq%3DNewcastle%2B1989%2Bearthquake%26tbm%3Disch%26tbo%3Du &zoom=1&q=Newcastle+1989+earthquake&usq=_ra2pfiNciFzPQqxCxYbUehdB-Rg=& docid=o9qhqkOnN9F3BM&sa=X&ei=jhkDUvStAuFiAeby4HwCg&ved=0CD4Q9QEwAg &dur=868)
- <http://www.australiangeographic.com.au/journal/on-this-day-in-history-newcastle-earthquake-strikes.htm>



## Two Australian Examples

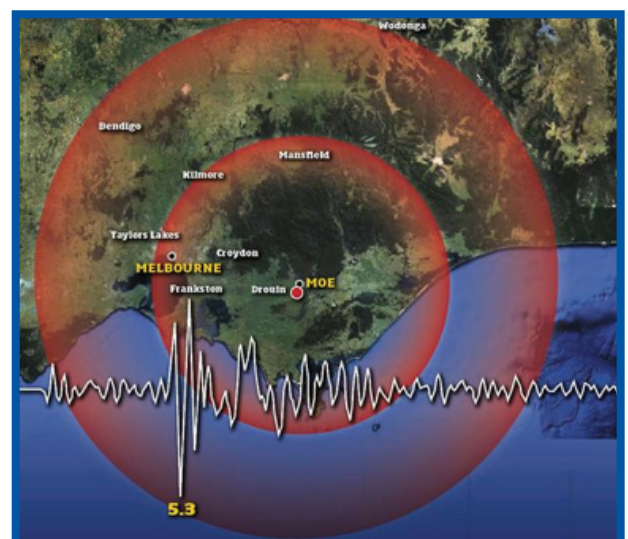
### Moe, Victoria

The most recent earthquake to affect Australia occurred on 19 June 2012, 10 km southwest of Moe and 130 km southeast of Melbourne, with a magnitude of 5.4.

The earthquake was felt right across Victoria, with reports of it being felt from as far away as Deniliquin in NSW, around 330 km from the epicentre.

There were over 300 aftershocks recorded, the largest of which was a magnitude 4.4 recorded on the 20th of July 2012.

The Moe earthquake was the largest earthquake recorded in Victoria since the magnitude 5.7 Mt Hotham earthquake in May 1966. From 2009 there has been an exceptionally high occurrence of seismicity related to significant earthquakes recorded in Gippsland, Victoria.



Sources:

- <http://www.ga.gov.au/hazards/earthquakes/earthquake-basics/historic.html>
- <http://resources2.news.com.au/images/2012/06/20/1226402/667666-earthquake-map.jpg> (map)
- <http://images.theage.com.au/2012/06/20/3388624/earthquake-729-420x0.jpg>



## Support material #4

# Learn about the SES

Grades 5 & 6

### About SES

Victoria State Emergency Service or SES is a volunteer-based organisation that provides emergency assistance to Victorian communities 24 hours a day, seven days a week.

The underlying purpose of SES is to both prepare Victorians for natural hazards and emergencies as well as provide a timely and effective emergency response to residents who require assistance.

SES is in charge of organising and leading the emergency response during floods, storms, earthquakes and tsunamis in Victoria. SES is also responsible for road crash rescue in country areas and parts of the Melbourne fringe.

They also assist the Victoria Police in search and rescue operations, and play an important support role during major bushfire responses.

SES is also in charge of educating and informing the community about natural hazards and what to do in an emergency. This is done through the FloodSafe, StormSafe, QuakeSafe and TsunamiSafe programs as well as Driver Reviver. In addition to these programs, SES also assists local councils and communities plan for emergencies by providing advice, information and training.

### History of SES

Victoria SES began in 1950 as the Victoria Civil Defence Organisation. The purpose was to establish a group of dynamic and willing volunteers who could be activated quickly in the event of war.

By 1962, after a disastrous fire in the Dandenong Ranges, the Victorian premier decided that we needed a plan to manage peacetime disasters such as bushfires, floods etc.

In 1975 the Civil Defence Organisation was renamed Victoria State Emergency Service to conform with Emergency Services in the other Australian states. At this time there were about 100 SES units located around Victoria.

SES was formally re-established as a general emergency management agency with the Victoria State Emergency Act in 1981.

On 1 November 2005, SES became an independent Statutory Authority. As a Statutory Authority, SES is governed by a board, which is accountable to the Minister for Police and Emergency Services.

### Volunteers

SES is a volunteer based organisation with about 5,500 members based all over Victoria.

SES volunteers are men and women of different ages and backgrounds. Most SES volunteers have full time jobs and give their time for free to help out other Victorians during emergencies.

SES volunteers are trained in leadership, communication, problem solving, personal organisation and physical fitness. These skills allow them to deal with many different types of emergencies in the community.



# What to do in an Earthquake

Grades 5 & 6

## Preparing for earthquakes

Earthquakes cannot be predicted so it's important to be prepared and know what to do if an earthquake happens in your area. Victoria State Emergency Service (SES) is a volunteer based emergency service. In a large scale earthquake, SES assistance may not be immediate and you should be prepared to be self-sufficient.

Earthquakes can cause disruption to essential services including power, water and telephones. Your best protection is to have an Emergency Kit ready which includes the following:

### Items to keep in your kit:

- A copy of your Home Emergency Plan-including essential contacts
- A battery operated or wind up radio and spare batteries if needed
- A battery operated or wind up torch and spare batteries if needed
- Important papers such as wills, passports and insurance documents
- First aid kit
- Rubber and strong leather gloves
- Non-perishable food and drinking water for at least three days in case you become isolated.



## During an earthquake

There is no accepted method to predict an earthquake so it's vital to know what to do during an earthquake as you will not receive any warning. How you should react in an earthquake depends on where you are at the time:

### If you are indoors during an earthquake:

## DROP COVER HOLD ON

- Drop to the ground; take cover by getting under a sturdy table or other piece of furniture; and hold on until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.
- Do not use a doorway except if you know it is a strongly supported, load-bearing doorway and it is close to you. Many inside doorways are lightly constructed and do not offer protection.
- Stay inside until the shaking stops and it is safe to go outside. Do not exit a building during the shaking.
- Do not use elevators.

### If you are outdoors during an earthquake:

- Move away from buildings, streetlights, and power lines.
- Once in the open, stay there until the shaking stops. The greatest danger exists directly outside buildings, at exits and alongside exterior walls.

### If you are in a moving vehicle during an earthquake:

- Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and power lines.
- Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.

## After an earthquake

- Expect aftershocks.
- Keep your radio tuned to your emergency broadcaster and follow instructions by emergency services.
- Watch for hazards and check for injuries or damage.
- Turn off electricity, gas and water.
- Avoid driving unless for emergency.

### If you are trapped under debris:

- Do not light a match.
- Stay as still as possible and cover your mouth with a handkerchief or clothing.
- Tap on a pipe or wall so rescuers can locate you. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.

## Contacts

After an earthquake, please do not phone emergency numbers for general information and advice. Call only if you require emergency assistance. Earthquake contacts are outlined in the table below:

<b>Life-threatening emergency</b> Police/Fire/Ambulance	Triple Zero (000)
<b>Emergency assistance</b> State Emergency Service	132 500 <a href="http://www.ses.vic.gov.au">www.ses.vic.gov.au</a>
<b>Earthquake information line</b> Geoscience Australia	1800 655 739
<b>Report an earthquake</b> Geoscience Australia	<a href="http://www.ga.gov.au/earthquake">www.ga.gov.au/earthquake</a>