Earthquake lesson plan

In this lesson, students develop their understanding of the causes of earthquakes and how they are measured.

Students investigate the impact of earthquakes on environments and people, including the 1989 Newcastle earthquake. Students explore earthquake frequency around the world and identify protective actions to prepare for and respond to an earthquake.

Australian Curriculum: Science, Geography
UPPER PRIMARY / LOWER SECONDARY

ITEMS

- Teacher lesson plan
- Student assignments
- About earthquakes
- Real life stories
- Earthquakes: Be prepared
- Related links

Australian Institute for Disaster Resilience

Contents

Earthquake lesson plan

Objectives

Participating in this lesson will enable students to:

- explain how an earthquake occurs and is measured
- identify ways to protect themselves during an earthquake
- research and present evidence of the impacts of earthquakes on people and the environment.

REQUIRED RESOURCES

- 'Investigating earthquakes' activity sheet
- 'My earthquake project' activity sheet
- Internet access

Learning areas

YEAR 6 SCIENCE

ACSSU096	Sudden geological changes and extreme weather events can affect Earth's surface
ACSHE098	Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions
ACSHE100	Scientific knowledge is used to solve problems and inform personal and community decisions

YEAR 8 GEOGRAPHY

ACHGK042	Causes, impacts and responses to a geomorphological hazard
ACHGS055	Develop geographically significant questions and plan an inquiry
ACHGS056	Evaluate sources for their reliability and usefulness and select, collect and record relevant geographical data and information
ACHGS057	Represent data in a range of appropriate forms
ACHGS058	Represent spatial distribution of different types of geographical phenomena
ACHGS059	Interpret geographical data and other information using qualitative and quantitative methods
ACHGS060	Apply geographical concepts to draw conclusions
ACHGS061	Present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose
ACHGS062	Reflect on their learning to propose individual and collective action in response to a contemporary geographical challenge

Lesson steps

Investigating earthquake activity

In pairs or small groups, students to use the 'Investigating earthquakes' activity sheet to find out more about earthquakes in general and the quake that devastated Newcastle in 1989.

Additional material from Geoscience Australia: www.ga.gov.au

My earthquake project

Provide students with a 'My earthquake project' activity sheet. Students will research the San Andreas Fault and earthquakes in Armenia and Kobe. They will investigate how earthquakes occur; the way earthquakes are measured; and the geology of their home or school location. Students are to create a presentation that will be presented to the class and which includes the location of major earthquakes, survival stories, interesting earthquake facts and earthquake management strategies.

Additional material from Geoscience Australia – Earthquakes: Teacher notes and student activities

About earthquakes

Earthquakes are unpredictable and can occur at any time. At least one earthquake occurs somewhere in the world each day. Some are slight tremors that can hardly be felt, while others are much stronger.

Earthquakes

Earthquakes happen because the earth's tectonic plates are always moving and floating on molten rock. As these plates slowly move alongside, under, and over each other the stress builds up. When the stress exceeds the strength of the rock an earthquake occurs (sudden, fast relative movement of plates). The accumulated energy is released in the form of seismic waves. Depending on the size of the earthquake, they may cause a loud noise (similar to a truck passing by) and the ground and buildings may shake. They can last from a few seconds to nearly a minute. Hours or even days later, you may still feel the earth move. These movements are called aftershocks, which are usually less severe than the initial earthquake (main shock).

Measuring earthquakes

Earthquakes are detected by instruments called seismometers. Seismometers measure the intensity and duration of ground shaking generated by an earthquake. The arrival times of these seismic waves, and the speed at which they travel are used to determine the location of the earthquake. The size of an earthquake (or its magnitude) is the measure of the energy released when the fault ruptures.

Magnitudes are often represented as, for example, M3.0, M6.5 etc. Largest earthquakes to date have not exceeded 9.5 on the moment magnitude scale (1960 Chile). An increase in one unit of magnitude signifies an increase in released energy by a factor of approximately 32. So for example, a magnitude 7.0 earthquake releases about 32 times as much energy as a magnitude 6.0 earthquake, which in turn releases 32 times as much energy as a magnitude 5.0 earthquake and so on.

The effects of earthquakes on people, environment and man-made structures are described by the Modified Mercalli Intensity (MMI) Scale. The intensity of the earthquake is represented using Roman numerals. On this scale 'I' represents a tremor that's not felt except by a few individuals under favourable conditions, and 'X' represents catastrophic damage. In general, the intensity of shaking (and the effects on people and their surroundings) will decrease with distance from the epicentre. Special circumstances related to the effects of the underlying soil can however contribute to shaking at greater distances.

Did you know?

- Geoscience Australia in Canberra estimates that, on average, the Australian region experiences an earthquake of at least magnitude 5.5 every 13-15 months. Further, the Australian region experiences, on average, an earthquake of M5 or greater at least once a year.
- Ninety per cent of all earthquakes in the world take place at tectonic plate boundaries and are the result of the constant movement of the plates against each other.
- The oldest parts of Australia, the western and central areas, are the most seismically active.
- The 1989 Newcastle Earthquake was Australia's most damaging earthquake with 13 fatalities and insured damages of $1124 million.

Earthquake vibrations travel very fast, up to 14 kilometres per second. The fastest seismic waves take less than 20 minutes to reach the other side of the earth, a distance of almost 13 000 kilometres!

Earthquakes:

Be prepared

You can survive an earthquake and minimise damage by being aware of, and prepared for, potential hazards.

An earthquake will be over before you can do much about it.

Most people are killed or injured when they attempt to move during the earthquake and are struck by falling or flying objects.

Your chances of avoiding serious injury are high if you remain calm and take cover as recommended below. By following this advice and being well-prepared, you could be a potential resource for your community.

Are you at risk?

- Check with your state or territory emergency service (SES) to find out whether tremors or earthquakes have occurred in your area and what damage resulted.
- Ask your SES if they have a pamphlet or poster showing Australia's earthquake hazard zones.
- Even if you're in a slight risk zone, ask your council how to make your house safer.
- Check that your insurance covers earthquake damage.

Planning for the disaster:

There are several steps you need to take when planning for the possibility of an earthquake.

Create a family emergency plan that includes:

- a list of safe places in the house during an earthquake and aftershocks
- where to meet if you are separated
- A list of all the emergency phone numbers you will need, making sure everyone knows where this is displayed (e.g. on the fridge). You should also have a copy of emergency phone numbers in your Emergency Survival Kit.

Research your local emergency services websites to locate an appropriate Emergency Survival Kit.

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

- DROP COVER HOLD
- 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 outside

- 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

- 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 from emergency services.
- Watch for hazards and check for injuries or damage.
- Turn off electricity, gas and water.
- Avoid driving unless there is an 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.

STUDENT ASSIGNMENT

Investigating earthquakes

Student name: . . . . . Date / /

At 10.27 am on 28 December 1989, Newcastle (Australia's sixth largest city at the time) was devastated by a magnitude 5.6 earthquake.

It was the deadliest earthquake in Australia since European settlement, with 13 deaths and more than 160 hospitalised. 35,000 homes and more than 3000 other buildings in Newcastle were damaged. To find out more about earthquakes and the Newcastle example, use the following sites, and others of your choice, to answer the questions (you may need to type 'earthquake' into the sites' search facilities to find the information).

- Geoscience Australia - www.ga.gov.au
- University of Queensland (UQ) – www.uq.edu.au
- USGS (United States Geological Survey) website – www.earthquake.usgs.gov
- City of Newcastle website – www.newcastle.nsw.gov.au

All about earthquakes

What is an epicentre?

What are the main causes of earthquakes?

What tool is used to measure earthquakes?

How does the measurement scale work?

Newcastle earthquake

Where was the epicentre of the Newcastle earthquake?

How far away from the epicentre was the Newcastle earthquake felt?

What was the cause of the Newcastle earthquake?

How did the emergency services react to the earthquake?

How different would it have been if it wasn't school holidays when the earthquake struck?

What can people do to protect themselves and stay safe during an earthquake?

STUDENT ASSIGNMENT

My earthquake project

Use these questions and ideas to find out more about earthquakes.

1

Investigate how earthquakes occur.

Use text and diagrams to explain the phenomenon.

2

Research the way earthquakes are measured.

Define terms such as seismographs, magnitude and aftershock.

3

Research the San Andreas Fault.

Find its location and size and answer the following questions:

- Why is it an important fault?
- Was the 1906 San Francisco earthquake related to the San Andreas Fault?
- What were some features of this Californian quake that made it so historically significant?

4 Refer to a geological map to discover...

which rock and soil types your house/school/workplace is built on.

How might this affect the building's chance of withstanding an earthquake?

5 Create a presentation for your class about earthquakes.

You could focus on one or more of the following:

- the location/s of major earthquakes and the intensity or damage caused
- earthquake survival stories – consider the humanitarian impacts of earthquakes
- interesting earthquake facts
- earthquake management strategies.

Real life earthquake stories

Australia's first recorded earthquake since European settlement occurred at Port Jackson, New South Wales, in June 1788 and lasted for about three seconds.

Other earthquakes recorded in early Australian history were in:

- Hobart in 1827
- South Australia in 1837
- Melbourne in 1841
- Perth in 1849

The first recorded deaths in Australia caused by earthquakes occurred in 1902, at Warooka, South Australia. Two people died after a magnitude 6.0 earthquake.

In 1917, one miner died and five were injured in an underground rock fall triggered by an earthquake in Kalgoorlie, Western Australia.

In the last 80 years, there have been 17 earthquakes in Australia registering M6.0 or more. This is a rate of about one earthquake every five years, compared to the world average of about 140 per year.

Some larger Australian earthquakes have caused significant damage, but more damaging earthquakes have occurred in other parts of the world. Until the December 1989 earthquake in Newcastle, NSW, damage caused by earthquakes in Australia was comparatively low.

Quakes that shook the nation

Here is some information about major Australian earthquakes:

Ellalong, New South Wales

DATE :
August 1994

This damaging earthquake affected the Ellalong-Cessnock area of the Hunter region in New South Wales. Measuring magnitude 5.4, it became our third most damaging earthquake. Several homes, hotels and other buildings were severely damaged and up to 1000 homes were partly damaged. Infrastructure, commercial and industrial losses also occurred. Insurance payouts were $38 million and total damage costs exceeded $150 million (1997 values).

Newcastle, New South Wales

DATE :
December 1989

At 10.27 am, Newcastle (Australia's sixth largest city at the time) was struck by a moderate earthquake measuring magnitude 5.6. This earthquake claimed 13 lives, the first earthquake-related deaths in Australia recorded since European settlement.

The devastation to buildings and other structures was extensive, which was unusual for a relatively small magnitude earthquake. This was due mainly to an underlying, thin layer of alluvium, which appeared to magnify the quaking. The epicentre of the earthquake (the point on the Earth's surface directly above the focus of an earthquake) was 15 km west south-west of the city centre, near Boolaroo.

Tennant Creek, Northern Territory

DATE :
January 1988

Significant earthquakes of magnitudes 6.3, 6.4 and 6.6 occurred near Tennant Creek in the Northern Territory. These resulted in large, long ground ruptures and a 35 km fault (up to 2 m displacement) which warped underground gas pipelines and caused minor damage to the hospital and some houses in the town.

Meckering, Western Australia

DATE :
October 1968

One of the more serious Australian earthquakes occurred at the small town of Meckering, WA. Residents reported seeing ground waves and experienced difficulty driving when the 6.5 magnitude earthquake struck. The earthquake collapsed old buildings, buckled railway lines, fractured pipelines, and caused a 37 km fault scarp (up to 2.5 m high). Sixteen injuries were reported and the total cost of damage estimated $50 million.

Adelaide, South Australia

DATE :
March 1954

On 1 March 1954, an earthquake struck Adelaide, followed by shaking severe enough to crack walls and loosen plaster and chimneys from many houses. Although minor compared to many international quakes, the Adelaide earthquake was, at magnitude 5.4, severe enough to cause damage estimated at $350 million (1997 values). No serious injuries were reported.

The end of a myth

Despite Australia's seemingly low-risk situation in the middle of one of Earth's larger tectonic plates, we have had many earthquakes larger than the one in Newcastle. This map shows that Australia is in the middle of the Australian-Indian Plate.

The Geoscience Australia in Canberra estimates that on average, the Australian region experiences an earthquake of at least magnitude 5.5 occur every two years.

Most of these earthquakes have been in sparsely populated areas, so for many years people thought Australia could not be affected by this natural hazard.

The Newcastle experience dispelled this myth.

Australian geology

Due to Australia's geological position, we are prone to what seismologists call 'intra-plate' earthquakes. These are different to the more familiar plate-margin earthquakes, common in areas such as California, USA, and Japan.

Related links

Recent earthquakes measured by Geoscience Australia

http://www.ga.gov.au/earthquakes/index.jsp

Latest earthquakes in the world (measured by USGS)

https://earthquake.usgs.gov/earthquakes/index.php

How seismographs work

http://www.iris.edu/hq/inclass/search#

What is an earthquake?

http://www.ga.gov.au/scientific-topics/hazards/earthquake

How plate tectonics work

http://www.extremescience.com/how-plate-tectonics-works.htm

/ End.

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