



*Looking towards Christ Church Cathedral from the Civil Defence headquarters at the Christchurch Art Gallery following the September earthquake*

# **The Canterbury, New Zealand Earthquakes**

## **September 2010, February 2011**

### **A teaching and learning resource for schools**

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#### **Introduction**

The earthquakes were major geological events which impacted significantly on people and property in the city of Christchurch and surrounding areas in Canterbury, New Zealand. This resource is intended to provide teachers with ideas and approaches they can use to support students and develop their understanding of these earthquakes. It is primarily designed to be used within the framework of The New Zealand Curriculum (NZC), however the approaches outlined can also be followed by schools outside of New Zealand, and the material supplemented by reference to other recent earthquakes (such as those in Haiti and Japan).

The province of Canterbury is located in the South Island. The main settlement is Christchurch, the second largest city in New Zealand. Information provided in this resource relates to both the Darfield

Earthquake of 4 September, 2010 and also the Lyttelton Earthquake of 22 February, 2011. (These were centered 40km west and 10km south east of Christchurch respectively.)

While the earthquakes were events of national and international significance, they were particularly significant for students in Canterbury, and those from Christchurch that have subsequently moved to live in other areas. Teachers should be conscious of the needs of these students and care should be taken so that any relevant learning is supportive and does not create additional anxiety.

*The School Curriculum: Design and Review* section of the NZC (pages 37 to 39) provides guidance for teachers related to the process of designing curriculum to incorporate learning about events such as the earthquakes. For example, it is suggested that:

- Curriculum change should aim to maximize the use of local resources and opportunities
- Schools have the scope, flexibility and authority to design and shape their curriculum so that it is meaningful and beneficial to their particular students
- The design of each school's curriculum should allow teachers the scope to respond to the particular needs and interests of students in their classes
- Links are made to values, key competencies and learning areas in the NZC.

## **Ideas for teachers**

The following ideas are provided to assist teachers to support students and develop their understanding of the earthquakes. For these purposes it is suggested that learning focuses on the following.

- Factual information about the processes that caused the earthquakes.
- Positive and constructive responses and actions following the earthquakes.
- Actions that can be carried out in the future to make people safe and redevelop Christchurch.

## **Helpful approaches**

Important advice relating to supporting students has been provided by the New Zealand Ministry of Education: *Well being – supporting children and students*. This is available on the Ministry's web site at: <http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/SchoolOperations/CanterburyEarthquake/WellbeingSupportingChildrenAndStudents.aspx>

Many students who have experienced the earthquakes will be resilient and coping well, however some may be unsettled and anxious. The advice notes that students will have questions, want to talk about the earthquakes, and hear from others, and that they will be looking to adults to provide a sense of safety and security. A helpful approach is to emphasise how people have coped and what is being done well to assist – at international, government, council and community levels, and by schools, family and neighbours.

The advice provided suggests that there may be issues related to fear of recurrence of the earthquakes and reactions to reminders (such as aftershocks). Factual information and reassurance will help address such fears. Teachers should also be aware that re-telling of the event (through sharing stories, showing pictures and replaying news media reports) may be an issue for some students who have experienced the earthquakes. It is helpful to encourage coping strategies and positive problem-solving (e.g. how some people were rescued, how support was provided after the earthquake, how buildings can be made

safer, and how people can prepare for such events). It is suggested that the earthquakes and their impacts not be over-emphasised for students in the local area and that they will be assisted by returning to the routines of normal curriculum delivery.

## Curriculum links

A useful approach for New Zealand schools may be to take particular aspects of the earthquakes and relate them to the curriculum. Some examples are listed below.

- Values – such as community and participation for the common good.
- Key Competencies – including managing self (people coping during the earthquakes), relating to others (members of the community working effectively together to provide support, such as family and neighbours) and participating and contributing (active involvement in community clean up and rehabilitation, such as the Student Volunteer Army).
- Social Sciences – the *Place and Environment* strand (how people interact with environments).
- Geography – extreme natural events.
- Science – the *Planet Earth and Beyond* strand.

The questions and answers included in this resource are provided as a starting point only. It is suggested that students have an opportunity to ask their own questions and investigate answers as well. This could be done within a social inquiry framework (NZC p. 30). The list of questions and answers can then be modified and expanded depending on what is relevant and appropriate for a particular group of students. Students may initially focus on the questions in list A, however, it will be helpful to ensure that the focus is shifted to coping strategies and the future too (list B questions).

## Learning activities

Teachers will need to design learning activities that are suited to the needs and interests of their students. The material in this resource can be supplemented, for example using the web sites listed and others, including media sites. Further information can be researched and discussed.

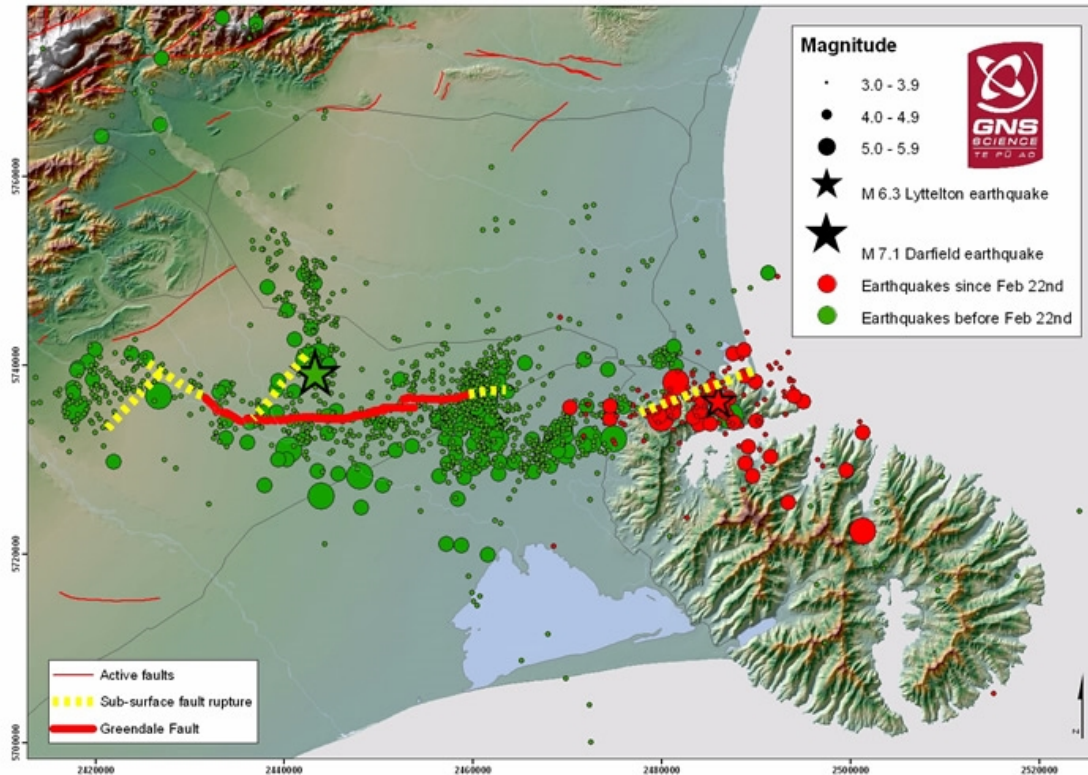
A key aim should be to develop the understanding of students – not simply knowledge of a multitude of facts related to the earthquakes. Where possible, learning activities should assist students to develop conceptual understandings, for example, of the relationships that exist between people and the environment (NZC p. 30.)

Students from the Canterbury area will all have personal experience of the events. Their experience should be acknowledged if they wish to share them (but in a structured and positive way). They can be encouraged to suggest what they would like to know about.

There are some general earthquake lesson plans available online e.g. on the GNS Science website: <http://www.gns.cri.nz/Home/Learning>

## Student material

The map below from Geonet shows the main earthquakes and aftershocks (above magnitude 3), and fault ruptures in Canterbury.



Graphic by Rob Langridge and William Ries, GNS Science.

## Questions and Answers

### List A – the earthquakes and their impact

What caused the earthquakes?

*The 4 September earthquake was caused by movement along the Greendale fault (a break in the rocks below the earth's surface) near to Christchurch. It happened when the forces within the earth became greater than the friction holding rocks together. As the rocks moved the vibrations caused the ground to shake. The fault had been hidden below the gravels of the Canterbury Plains. The earthquake was at 4:35 am on Saturday 4 September and had a magnitude of 7.1. The epicenter was 40km west of Christchurch and it was 10km deep.*

*The 22 February earthquake was centered near Lyttelton (10km south east of Christchurch and 5km deep) and it had a magnitude of 6.3. It took place at 12:51 pm. Movement occurred along an underground fault line, below the southern edge of the Avon-Heathcote Estuary. The energy released was focused towards Christchurch, and the shaking intensity was greater than for the September earthquake.*

Why do earthquakes keep happening?

*Following the main earthquakes there have been many smaller earthquakes (aftershocks). These are to be expected following such large events. They are caused by further tearing of rocks along the faults as stresses continue to be released.*

When will the aftershocks stop?

*It is to be expected that these will continue over a period of months but that they will be less severe than the main earthquakes, and will happen less often over time. However, significant aftershocks can occur and could cause further damage. Therefore people need to be able to respond to them in order to keep safe.*

*Note that while an expected pattern of aftershocks can be predicted, it is not possible to scientifically predict exactly when or where particular earthquakes will occur, or their magnitude. (Scientists did suggest that on average an aftershock of up to a magnitude 1.2 less than the September earthquake could follow. The February earthquake did fit approximately with this trend, although it was slightly larger than expected.)*

What impact did the earthquake have on people and property?

*Many deaths and injuries occurred in the February earthquake. These resulted mainly from the collapse of buildings (including the CTV and PGC buildings). Falling debris such as bricks and glass outside buildings and objects in houses also caused deaths and injuries. Rocks fell and cliffs collapsed on some roads, tracks and suburbs on the Port Hills. Some people were also injured in the September earthquake.*

*A large number of people have been affected following the earthquakes in different ways. They may be anxious, upset and worried, especially as the aftershocks continue. Some may have trouble sleeping. The normal functioning of communities was also disrupted. Familiar landmarks have changed or been destroyed and routines disrupted (such as going to work and school). A lot of people spent weeks without power, water and sewerage services. However, many people have coped well and provided support for family, friends and neighbours.*

*Damage has happened to buildings (homes, shops, offices, schools) and infrastructure (roads, railways, power and water supply and waste water pipes). Many services were disrupted. The damage was different in different places. Some areas were more likely to have significant damage e.g. swampy land or land subject to liquefaction. Some buildings in an area were more likely to be damaged e.g. old shops made from brick.*

What damage was caused to the land?

*Some land above the faults was offset by nearly 4 metres in the September earthquake. In places the land was also raised. A number of surface cracks appeared. Silt and sand was forced up by the process of liquefaction, for example in the eastern suburbs of Christchurch. Localised flooding took place in low lying areas. A large rockslide south of Kaikoura may have been triggered by an aftershock from the earthquake.*

*In the February earthquake land moved horizontally (land to the south of the fault moved west by tens of centimetres and land to the north of the fault moved east tens of centimetres). Parts of the Avon-*

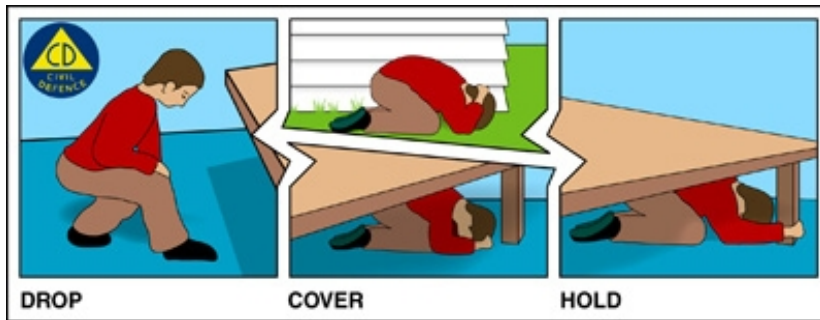


Heathcote Estuary sank by 10cm. Sections of the Port Hills were raised by up to half a metre. Large areas of land were also covered by silt and sand as a result of liquefaction, and flooding occurred again.

### List B – coping and the future

How did people protect themselves during the earthquakes?

If they were in bed during the September earthquake they were able to cover themselves for protection. In the February earthquake some used the “drop, cover and hold” approach.



Source: <http://www.getthru.govt.nz/web/GetThru.nsf/web/BOWN-7GY5TP?OpenDocument>

Why were there relatively few injuries in the September earthquake?

As the earthquake took place early in the morning, most people were at home in bed. This was lucky as falling walls, windows and verandahs by shops and offices would have injured many people during the day. Also building regulations in New Zealand mean that many newer buildings are relatively strong and can withstand earthquakes well.

Why did the February earthquake cause deaths and greater damage?

While the magnitude of this earthquake (6.3) was less than the September one (7.1), it was closer to Christchurch (only 10km south east) and shallower (5km deep). There was considerable shaking of the ground (up and down, and sideways), up to 2.2 times the force of gravity. Some buildings may have been weakened by the previous earthquake. The time of the earthquake (the middle of the day) meant that many people were in the central city where damage was considerable.

How did communities respond following the earthquakes?

Help was provided at many levels. Workers and shoppers in the central city assisted people trapped and injured. Families supported each other and checked on neighbours. Local councils put emergency response plans into action. Services such as the police, St John's Ambulance, Fire Service, armed forces, Red Cross and Civil Defence assisted. The government also provided much support. The Earthquake Commission and insurance companies provided advice and handled claims for damage. Public appeals raised money to help with relief. The news media reported on events and communicated information.

Considerable national and international help followed the February earthquake. This included urban search and rescue teams from many countries, additional police from Australia, soldiers from Singapore, and a victim identification team from the UK. A number of global fundraising schemes have been organised.

*There were three phases to the responses.*

- 1. Rescue. Immediately after the earthquakes there was a focus on rescuing those people who were trapped and injured and moving others to safety.*
- 2. Recovery. In the following days and weeks teams worked to search for people who had been killed. Services such as water and power were restored or provided. Portable toilets were distributed. Recovery centres were established to provide information and advice.*
- 3. Rehabilitation. In the longer term it is likely that parts of the city of Christchurch will be rebuilt and many buildings strengthened to better withstand possible future earthquakes. Some shops, offices and housing may be relocated. Businesses and services will be restored. People will have ongoing assistance.*

Will there be another big earthquake soon?

*While another earthquake as big is not likely to occur in the same area again soon, it is very difficult to predict what may happen further in the future.*

How can we prepare for future earthquakes?

*We need to know what to do when there is an aftershock – at school, around the town, or at home. Each household should have a plan, and an emergency kit. People can insure their home and contents. All communities and the government also develop plans.*

## **Further resources**

**Canterbury Earthquake Government website.** The site provides information and links to central and local government agencies and others supporting the response to the Canterbury earthquake.  
<http://www.canterburyearthquake.govt.nz>

**Canterbury Earthquake.** Earthquake site established by the Christchurch City Council and Environment Canterbury to provide information to residents. <http://canterburyearthquake.org.nz/>

**Canterbury Quake Live.** This site provides graphs, maps and other information based on data from the GeoNet site. <http://quake.crowe.co.nz/>

**Earthquake Commission.** Background information on earthquakes, including an interactive activity *Create your own earthquake*.  
<http://www.eq-iq.org.nz/eq-intro.aspx>

**GeoNet.** Tracks and provides information on earthquakes as they occur. (Refer to the earthquake drum for McQueen's Valley).  
<http://www.geonet.org.nz/earthquake/>

**GET READY GET THRU.** The Civil Defence site. (Includes templates for emergency plans and checklists for households.)  
<http://www.getthru.govt.nz/web/GetThru.nsf/web/BOWN-7GY2MF?opendocument>

**GNS Science.** Background information and lesson plans.  
<http://www.gns.cri.nz/Home/Learning/Science-Topics/Earthquakes>

**Ministry of Civil Defence and Emergency Management.** The government site for Civil Defence.  
<http://www.civildefence.govt.nz/>

**Ministry of Education.** Canterbury Earthquake information and advice for schools.  
<http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/SchoolOperations/CanterburyEarthquake.aspx>

**New Zealand Curriculum.** The recently implemented national curriculum statement.  
<http://nzcurriculum.tki.org.nz/Curriculum-documents/The-New-Zealand-Curriculum>

**New Zealand Fire Service.** Material from the Fire Service and Urban Search and Rescue.  
<http://www.fire.org.nz/Pages/Home.aspx>

**New Zealand Society for Earthquake Engineering Inc.** Background and technical information.  
<http://db.nzsee.org.nz:8080/en/web/lfe-darfield-2010/home>

**Royal Society of New Zealand.** An information paper on earthquake prediction and future earthquake risks for Christchurch and New Zealand.  
<http://www.royalsociety.org.nz/2011/03/16/earthquake-information-paper/>

**Te Ara Encyclopedia.** Historical and descriptive information.  
<http://www.teara.govt.nz/en/earthquakes>

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