VOLUME 1.1 APRIL 19, 2021

The Earth Science Teacher

Welcome

This is the first issue of The Earth Science Teacher - the member-only journal of GEOetc. In it you will find some background information, teaching ideas, links and even some story from a member about a topic - in this case Earthquakes. The plan is that The Earth Science Teacher will come out a few times a year - each time with a different topic theme (the next will be on volcanoes).

I would really love to get you feedback about this resource - if it is helpful and how could it be improved. Please drop me an email at gary@geoetc.com.

I hope that you all stay safe and look forward to hearing from you.

Gary

Gary Lewis
President, GEOetc LLC

WHAT IS INSIDE

Member Speaks
Kate Lefever tells us about her experience of living through the Christchurch, New Zealand earthquake.

Classroom activities
How can you have students experience an earthquake and take measurements…

© GEOetc LLC 2021

Earthquakes

Earthquakes have to be one the scariest phenomenon to experience. We all consider that the ground on which we stand to be stable and solid, and it is a real shock to find in those few seconds of a quake that the very foundation on which we stand is shaken and anything but 'stable'. What is even more frustrating is that earthquakes can't be predicted.

Geoscientists can tell us a lot about the risks of earthquakes including those areas of high risk of a quake occurring - such as on plate boundaries, known active faults etc. They can measure stress and strain in rocks in an area. They can use historical data to estimate the past timings of quakes. What they can't does predict when or how large any event will be.

In 2009 a group of Italian geoscientists was arrested for manslaughter because they did not predict an earthquake. They have since been acquitted, but it begs the question: How liable can a scientist be for not being able to predict an event?

Read about the case here: https://tinyurl.com/5xck4mru

Maybe, as technology rapidly developed, we will be able to provide a better way to know about upcoming natural disasters. Some events, like volcanic eruptions, do provide some forewarnings if we instruments in pace to monitor those events.

But in the end, we all need to realize that we live on a very dynamic planet and while in our lifetimes things may seem stable, over geological time we know they are not!

Member Speaks

I survived a 7.1!

Kate Lefever

Growing up in Christchurch, New Zealand earthquakes were a way of life. It was not unusual to have the windows rattle or light fixtures swing as a minor earthquake occurred. Often this was the only way we knew something had happened as the ground certainly didn't move beneath our feet.

Earthquake drills along with fire drills were part of growing up. I still vividly remember an earthquake drill when I was about nine

© GEOetc LLC 2021

years old. The alarm sounded and the teacher announced it was an earthquake drill. I, along with another classmate, promptly sprinted outside and ran to the back of the school field. Several minutes later, we sheepishly returned to the classroom to find the rest of the class taking refuge underneath their school desks. My classmate and I may have survived a fire but our earthquake drill skills needed much work.

The Cathedral of the Blessed Sacrament

On September the 4th, 2010 at 4.35 am I experienced an earthquake of a completely different magnitude. A 7.1 earthquake only 10km (6 miles) deep and 40 kilometres (25 miles) to the west of Christchurch hit. Luckily, like much of Christchurch, I was asleep when it hit. My single story bungalow started rocking back and forth waking me within the first 5 seconds. After lying in bed for what was probably another 10 seconds and realizing the shaking was not going to stop I rolled out of bed. There was absolutely no way I could stand, so I began crawling up my floor towards the door. The house tipped in the opposite direction causing me to make slightly quicker progress and I took refuge under the door way. Nearly twenty seconds later the shaking stopped.

The first thought that went through my head was wondering what has happened to Wellington, the capital city of New Zealand. Wellington lies directly on top of a fault line and I feared the fault had gone, and that we had simply felt the aftermath. This later turned out not to be the case.

My second thought was to get out of the house. Yes – I learnt absolutely nothing from my primary school experience as a nine year old. It was pitch black outside and I ran out of the house, down the stairs into the back yard not knowing whether or not my yard would be there. Luckily it was. However only a few houses down a huge void had opened up in one of our neighbours yard. My neighbours heard me outside and yelled to see if I was OK. They were OK, but their chimney had collapsed and the bricks had come through the fireplace and taken out the wall on the opposite side of their living room.

The next earthquake of international significance occurred on Tuesday 22 February (6.3). However, it is important to note that we had experienced something in the vicinity of 10 000 aftershocks (many of which exceeded a 5 on the Richter scale) in this time. We had had nearly a week of no activity at all which we were enjoying.

It was lunchtime, so luckily most students were outside at the time. Staff were in the staffroom which was located in the historical

© GEOetc LLC 2021

homestead located on the school grounds. I was in the toilet. The shaking started. It got so strong I remember thinking I needed to pull up my pants as I did not want to face the indignity of being pulled from rubble with no pants on. As I ran from the bathroom the wallpaper was rolling off the walls. Some staff had taken refuge under the chairs (that were certainly not big enough to provide any real protection).

We exited the premises and headed for the back field. Each aftershock caused the perfectly level earth to roll like hills before coming to rest like it had never been moving. At one point the trees along the school perimeter were swaying from side to side so violently that the roots became exposed. A huge dust cloud could be seen rising about the CBD.

Shortly after this I received a text message from my sister checking to see I was OK. I let her know I was and set about helping get students safely home. I was unaware that my sister was trapped along with 35 workmates on Level 9 of the building that housed the law firm for which she worked.

They were unable to exit as the stairs had dropped from the stairwell. The stairwells were running with water and loose electrical wires. Luckily, there were two stair wells at opposite ends of the building. After several hours firemen were able to get to my sister and her colleagues. They followed the stairs that were in place and when they found stairs missing they moved to the opposite end of the building in hopes those stairs were there. By doing this, moving back and forth across the building, they were able to successfully descend to the ground floor. There were a few jumps along the way where the stairs were gone but she came out unscathed about 5 hours after the initial earthquake. It was then that she let us know what had happened. No one had thought to check she was OK (we had assumed from her text she was).

The earthquakes changed the lives of everyone in Christchurch in some way of another. My childhood home was destroyed while others lost loved ones. In 2012 we left Christchurch for more stable ground in Australia. Since then we have experienced bushfires, droughts and a volcanic eruption in Bali. It seems wherever one goes you cannot escape the forces of mother nature.

Teaching Earthquakes

Teaching about Earthquakes can lead you down so many pathways - especially for those people who are following an inquiry based, student-led questioning approach (like the NGSS in the USA). I hope that here I can give you some ideas on what pathways you can take and that you can adjust your approach to fit your curriculum requirements.

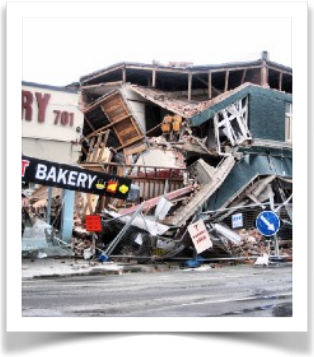
© GEOetc LLC 2021

RELEVANCE AND STIMULUS

Teaching about something relevant to your students experience can always make the lesson so much more powerful. For some locations, most students will have experiences an earthquake. But in many others students will have no idea what it is like for the 'always stable ground' to become anything but stable.

One interesting way to start off a unit is to have students watch videos of real earthquakes and have them make observations.

What do you observe happening to nature?



What do you observe people doing?

How long does it appear to last?

What would you do in this situation?

This YouTube video is a great start (https://youtu.be/NT_fVQ1LdQY) as it shows ten different events around the globe. It is around 8 minutes long.

CLASSROOM ACTIVITIES

For an in-classroom activity, you can follow this up with building your own simple earthquake simulator. This requires 15-20 balloons (please check your schools policy on using latex) and stable table that you can turn upside down. Folding plastic tables need to be avoided. Blow up the balloons to around 3/4 full or air and tie then off. Place them evenly under the upturned table and stabilize the table by holding the table legs. Students can then step onto the center of the table and you can shake the table gently to simulate a quake. (you can read a little more about the process here https://geoetc.com/how-to-experience-an-earthquake/).

An engineering-based extension to this is to use the same table to have students design a way to measure the 'magnitude' of the shaking of the

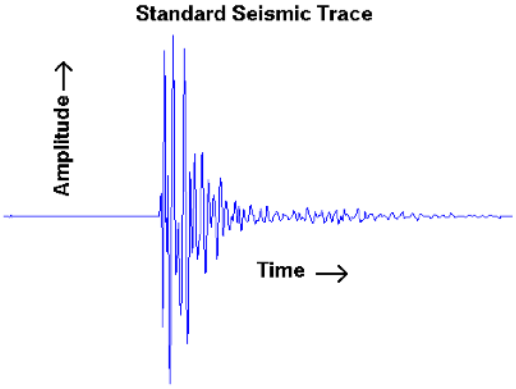


table. Providing them paper, felt-tipped pens, meter rulers (yard sticks), table, rubber bands etc. Some great solutions to this activity include paper being pulled at a constant rate below a pen connected to the table, so the pen traces a mark on the paper perpendicular to the way the paper is being pulled ie to simulate a seismic trace.

WORKING WITH DATA

Once students have a good feel for the process of measuring an earthquake, then you can link them to real earthquake data, like the data released by the USGS here https://earthquake.usgs.gov/earthquakes/map/ You can zoom out and find your location anywhere around the globe.

© GEOetc LLC 2021

SOME EARTHQUAKE TERMS

Fault - the surface along which rocks break and move causing an earthquake.

Focus - the point on the fault along which the rocks have moved to cause an earthquake. This can be a point or even a long zone.

Epicenter - the place on the Earth's surface directly above the focus.

Seismometer - a device that measures ground motion during an earthquake. A geophone is the term used for the same device when used to measure human-made events, such as when using seismic waves to look for oil.

Seismograph - a seismometer that is attached to a timing device (clock) that records ground motion over time.

Seismogram - the data that comes from a seismograph. It used to be on paper, now it is digital.

Magnitude - the size of the earthquake event based on the maximum released energy. This is calculated from the seismograms.

Richter scale - the scale used to measure magnitude in California (note that the richter scale is NOT used to measure earthquakes outside of California. Local Magnitude (just called magnitude) is used. Blame the media for the over use of 'richter scale'

Modified Mercali Scale - a scale used to measure the effects of an earthquake based on what was experienced and/or damage done.

Seismic waves - the waves generated by an earthquake. They are divided up into P waves, S waves and L waves.

GEOetc Resource Highlights

There are a number of Earthquake related resources in the Member resources section of GEOetc.com.

Find Detritus (https://geoetc.com/detritus/)

One of the most important concepts when teaching students about measuring earthquakes is to have them understand that we can calculate the distance from a point that an earthquake took place using a seismograph – but not a direction! And so one seismograph provides us with a circle-locus of points equally distanced from the station. However, if we have three stations we can plot the three distance circles on a map, and where they intersect is the location of the earthquake's epicenter.

This activity introduces that concept using the story of a lost dog and three observations from three places (stations). It will require a compass or similar device to draw accurate circles.

Reading Time and Distance Graphs (https://geoetc.com/earthquake-time-distance-graph/)

Have your students read a simple time-distance graph that shows the relationship between the arrival times of P and S earthquake waves and

© GEOetc LLC 2021

the distance the earthquake is away. This is a fundamental data skill and will help them understand other earthquake epicenter location activities. This is a 20 min activity. (NGSS linked)

Earthquake Magnitude Demonstration (https://geoetc.com/earthquake-magnitude/)

This teacher demonstration (with student participation) shows how the magnitude scale increases logarithmically (factor of 30 with each increase in magnitude number). It uses a couple of boxes of spaghetti.

Great other resources

IRIS (Incorporated Research Institutions of Seismology) has fabulous materials such as:

Teachable Moments

Teaching Resources

USGS (United States Geological Survey) has great resources on recent earthquakes and links to 'did you feel it' citizen science. Click here.

Geoscience Australia - for details on Australian events and great background materials. Click here.

Teacher Field Experiences

The COVID pandemic has really caused issues for anyone wanting to get out and explore or amazing planet - but we are starting to see the light at the end of the tunnel.

In 2020 GEOetc postponed for cancelled its trips for teachers. In 2021 it looks like only one trip will run. But we have confidence that our trips to Hawaii, United Kingdom and Iceland will all run in 2022.

These trips are designed for teachers - for them to experience phenomenon in the field so they can take those experiences back into their classrooms. They are affordable, friendly and fun experiences - and you earn professional development hours for attending (check your state/district requirements).

Find out more here (https://geoetc.com/field-adventures/)

© GEOetc LLC 2021

Contact us

EMail : gary@geoetc.com
www.geoetc.com

The Earth Science Teacher is a product of GEOetc LLC. Copyright GEOetc LLC 2021.

No part of this publication can be reproduced without the written permission of GEOetc LLC.