Teacher's notes Earthquake prediction

This activity lets pupils investigate how, why and where earthquakes happen with a fun hand's on experiment.

Level: NI: Key stage 2
ROI: 3, 4, and 5th class

Time required: 15/20mins activity, plus 5/10 mins set up

Curriculum links: This experiment links with the National Curriculums of Northern Ireland (The World Around Us) and Ireland (Geography, History and Science)

Northern Ireland	**Ireland**
Change Over Time: **Ways in which change occurs over both short and long periods of time in the physical and natural world (KS2):** How the world has changed over time; How change is a feature of the human and natural world and may have consequences for our lives and the world around us **How change is a feature of the human and natural world and may have consequences for our lives and the world around us (KS2):** comparing an aspect of the community over a long period of time; Some of the characteristics of past societies and distinctive features of life in the past.	**Geography - Natural Environments:** The local natural environment; Land, rivers, and seas of my county; Rocks and Soils; Weather, climate and atmosphere
Place: Features of, and variations in places, including physical, human, climatic, vegetation and animal life (KS2): Places then and now	**History - Local Studies:** Buildings, sites or ruins in my locality; My locality through the ages; Continuity and change in the local environment;

Interdependence: The effect of people on the natural and built environment over time (KS2): Ways in which the use of natural resources through time has affected the local and global environment; Local habitats; Ways in which the use of natural resources through time has affected the local environment	**Science – Living Things:** Human life; Plant and animal life

Learning Objectives:

Students will understand:

- the Earth is a dynamic planet
- earthquakes occur along plate boundaries
- earthquakes are difficult to predict
- earthquakes have severe consequences for the human population

Students will have developed their skills in:

- Using pictures, maps and globes
- Investigating and experimenting
- Observing
- Recording and communicating

They will use these resources:

- Globe displaying structure of the earth
- Tectonic plate map
- Earthquake distribution map
- Experiment card

Prior Knowledge:
Pupils should be familiar with the following terms and concepts:

- The Earth's structure, crust, mantle and core
- The devastation Earthquakes can cause

Stages of the lesson and methods used:

- A general discussion should take place on the structure of the Earth

- Students should be asked to study the map of plate boundaries, followed by a map of the distribution of earthquakes. Are there any similarities?
- Students should be asked to name any recent earthquakes and volcanoes. How did they know about these?
- The question should be asked why people still live in areas that are known to be in danger from earthquakes and volcanoes
- The difficulties in predicting when earthquakes will occur should be discussed. Seismologists know that they will occur but can't predict exactly when
- The earthquake prediction experiment should now be carried out
- This activity can be carried up with the creation of newspaper articles and / or recordings from various groups affected by the earthquakes. These may include local residents, farmers, scientists, local governments, and emergency services.

Background Information

What is an earthquake?
An earthquake is the sudden release of energy in the Earth's crust that creates seismic waves. They manifest themselves by shaking and sometimes displacement of ground. Where an earthquake occurs offshore, the seabed may be displaced enough to cause a tsunami (often incorrectly referred to as a tidal wave).

An earthquake is a general term and is used to describe any seismic event that generates seismic waves, whether this is natural or caused by humans. Natural earthquakes are discussed further below, but examples of man-made events that cause earthquakes are mine and quarry blasts, and nuclear tests.

Why do earthquakes happen?
Before talking about how earthquakes occur, it is first of all important to look at the interior structure of the Earth (see the structure of the Earth diagram). The Earth is layered in spherical shells, like an onion. Each of these layers has different characteristics. Starting from the outside, the Earth has a thin solid crust, then a highly viscous mantle, a liquid outer core, and finally a solid inner core. It sometimes helps to compare each of these layers to an apple, with the crust being the skin, the mantle being the main flesh, the outer core being the ring around the apple seeds and the inner core being the seeds themselves.

The thin crust of the Earth is cracked into numerous tectonic plates that 'float' on the viscous mantle below. Due to convection currents in the mantle the plates move very slowly in a number of different directions, either away from each other, into each other, or alongside one another. It is this movement along the tectonic plate boundaries that causes earthquakes.

Where do earthquakes occur?
Most earthquakes occur along plate boundaries (see the plate boundary map) but in some cases this movement is spread out over a much larger area than the plate boundary itself.

How do we measure earthquakes?
Earthquakes are recorded by seismometers, that measure and record seismic waves. Often seismometers record earthquakes that occur a great distance away as seismic waves travel through the whole of the Earth's interior.

Earthquakes are measured by the Richter scale that measures the magnitude of an earthquake on a scale of 1 to 10 with 10 being the greatest magnitude. Each step on the scale represents an earthquake ten times stronger than the previous one, so a 4.0 earthquake is 10 times larger than a 3.0 one.

There are currently five permanent seismic recording stations in Ireland, and there are many more around the world that record all magnitudes of earthquakes ranging from small local events to larger events from across the globe.

What are the effects of earthquakes?
Most people simply associate earthquakes with shaking and ground rupturing but there are many other effects of earthquakes that are quite often more devastating. Some of these are listed below:

1. **Landslides and avalanches:** Earthquakes can result in slope instability that can lead to landslides.
2. **Fires:** These can be caused after damage to electrical and gas lines. These can often be difficult to treat as damage can also be caused to water supplies.
3. **Tsunamis:** If earthquakes occur offshore they can result in displacement of the sea bed that can cause tsunamis.
4. **Floods:** Damage to dams can be caused by earthquakes leading to flooding.
5. **Human impact:** One of the most obvious effects of earthquake is road and bridge damage, and general property damage causing injury or loss of life.

Do we get earthquakes in Ireland?
Ireland is located far away from any major plate tectonic boundary so is lucky enough not to feel the effects of any major earthquakes. However, minor earthquakes do occur due to the release of stresses within tectonic plates and these have been felt in Ireland. Many of these are often described as being like a large lorry driving past and they are only felt very locally. The most recent one struck in June 2012, when a 4.0 Mag earthquake was recorded about 60km off the Mayo/Sligo coast.

The largest earthquake felt in Ireland was in 1984 when a magnitude 5.4 earthquake on the Lleyn Peninsula in NW Wales was felt on the east coast.

The Seismographs in Schools Network (RoI) and the School Seismology Project (NI) forms a network of seismographs throughout Ireland that can record small local earthquakes and major earthquakes from across the world. This network enables primary and secondary schools to record this information and use it for education purposes but also gives us a much greater appreciation of how many earthquakes occur across the island.

There are seismographs in the following locations:

1. Sligo Institute of Technology, Sligo, Co. Sligo
2. Our Lady of Mercy Primary School, Sligo, Co. Sligo
3. St. John's National School, Sligo, Co. Sligo
4. Breifne College, Cavan, Co. Cavan
5. Marble Arch Caves Visitor Centre, Co. Fermanagh
6. Enniskillen Collegiate Grammar School, Enniskillen, Co. Fermanagh

Experiment - Earthquake Prediction

Aim: To understand the difficulties involved in earthquake prediction

What you'll need:

A clamp stand

A mass hanger

Mass weights (each 100g)

These could be borrowed from your closest secondary school if not available

Goggles

Party poppers

Instructions

1. Secure a party popper upside down in the clamp stand.
2. Tie a loop in the string that comes from the bottom of the party popper.
3. Hang a mass hanger from the string.
4. Ask the children to guess the number of weights it will take for the party popper to explode.
5. Get the children to add weights to the mass stand one at a time (each one wearing goggles). Make sure they use a variety of drop and gentle movements.
6. The party popper will eventually pop. Take note of how many weights it takes for this to happen.
7. Repeat the experiment and see if the number of weights needed for the party popper to explode is different.

What's happening?

Each party popper is filled with a different amount of explosive material than the next. This means that the amount of strain needed for the popper to explode will be different every time. This is also the case for earthquakes. Although we know where earthquakes are likely to occur, it is impossible to predict exactly when they will occur. Scientists can guess roughly when earthquakes will occur, by looking at

factors such as tremors (small earthquakes) that occur before a major earthquake but the exact timing is just impossible to work out

Resources – Earthquake Prediction

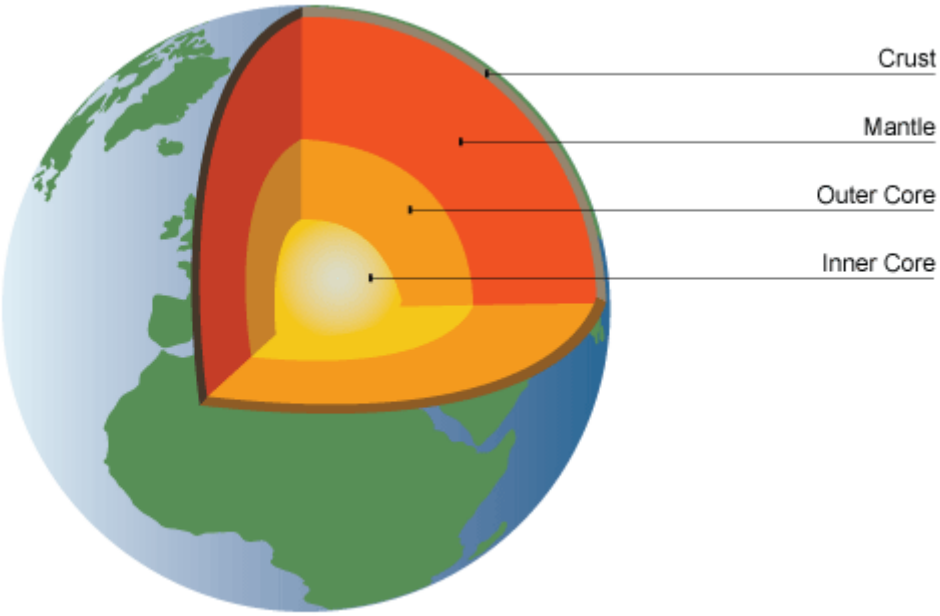
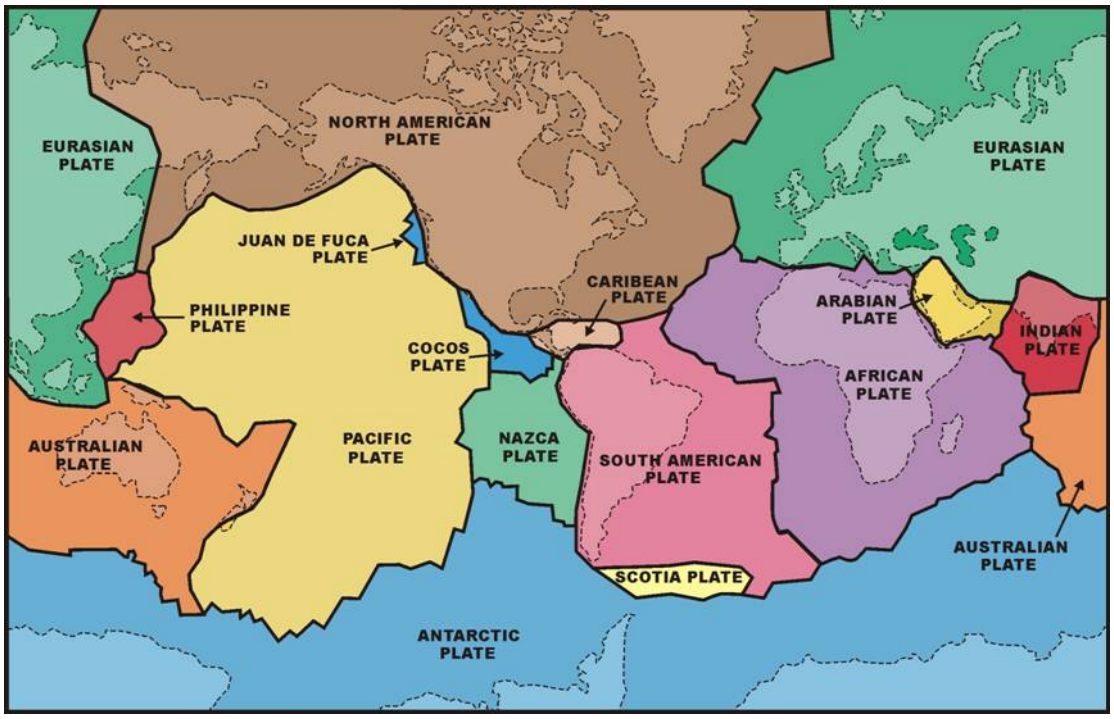
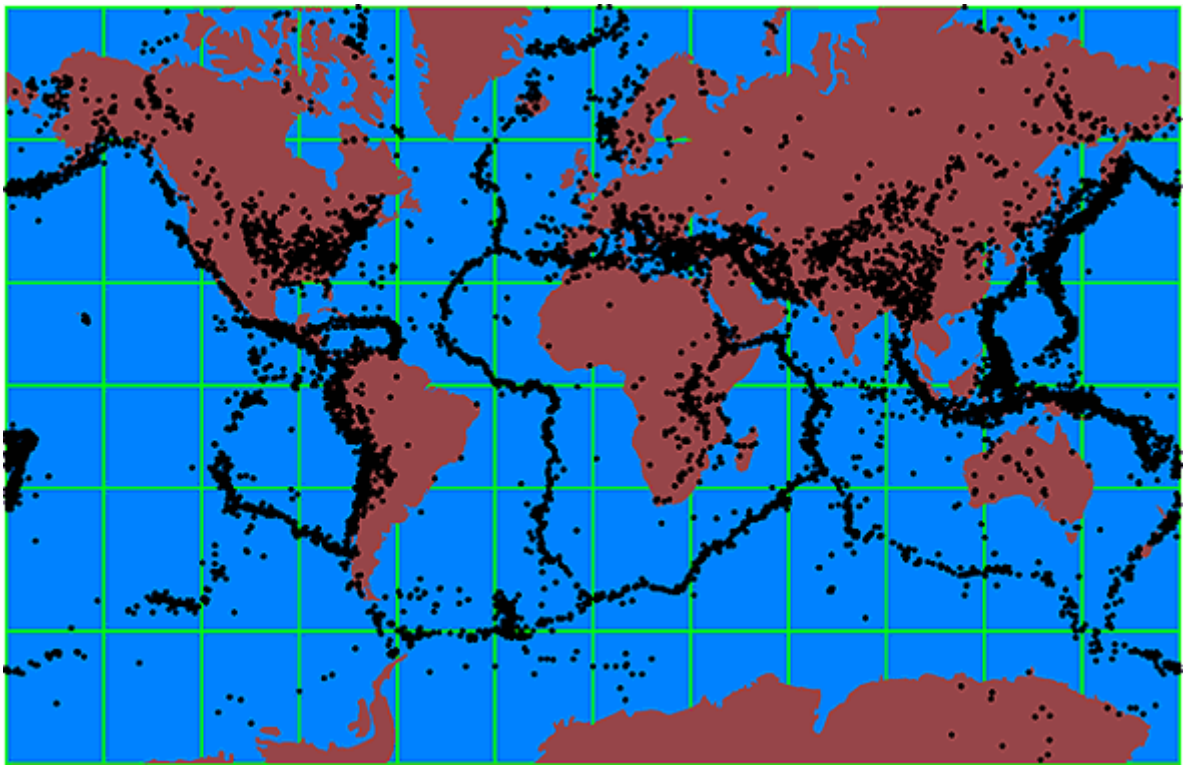


Diagram showing the structure of the Earth



Map of Tectonic Plates



Map showing the distribution of earthquakes across the world

Each black dot represents the occurrence of an earthquake