

Amazing Earth: facts that fascinate – teacher's notes

The following facts and anecdotes are offered to teachers as suggestions for enhancing their lessons. All have been checked for accuracy and sources have been given where available.

Earthquakes

- The Earth rings like a bell after a large earthquake – the lowest ring tone is E flat in the 20th octave below middle C (Source: F Press and R Siever, *Earth*, New York: Freeman, 1986, p 467).
- Sound from the eruption of Krakatau (Krakatoa) in 1883 travelled nearly 5000 km (3000 miles). (Source: P Francis, *Volcanoes: a planetary perspective*, Oxford: OUP, 1993, p 80).
- The ash cloud from Krakatau (Krakatoa) travelled round the Earth several times and caused amazing sunsets. The Earth cooled down by 0.25 °C because the ash reduced the energy received from the Sun. (Source: P Francis, *Volcanoes: a planetary perspective*, Oxford: OUP, 1993, p 377).
- Earthquakes in Wales in 1984 and 1990 were due to Atlantic floor spreading, crushing Britain towards Asia. European plate movement is largely eastwards – so the crushing movement is towards Asia.
- To create a mountain system requires several million earthquakes over tens of millions of years.
- Northridge Mountains in the USA rose in height by 70 cm due to a magnitude 6.9 earthquake on the Richter scale releasing energy equivalent to 2 billion kg of high explosive - equivalent to 100 of the atomic bombs used at Hiroshima.
- Small (magnitude 2) earthquakes happen several times per day; the Earth moves, yet we can't feel them - they can only be detected by instruments.
- Scientists are still investigating whether dogs do howl before an earthquake strikes. There have been so many reports of this and of chickens roosting before an earthquake that it is no longer dismissed as a myth.
- Some people have tried to lubricate fault planes with water and mud to avert earthquakes. More recently people have suggested forcing the faults apart using high pressure steam.
- There is no chance of outrunning an earthquake - P waves travel at several kilometres per second.
- The deepest recorded earthquake started 730 km (450 miles) below ground. The ones that do the most damage tend to originate 0 – 65 km (0 - 40 miles) below ground.
- Chinese scientists claim that they can predict an earthquake by monitoring the water level in wells and boreholes. Others say that levels of radon gas in the ground may increase before an earthquake because of the increased pressure underground releasing the gas. Changes in electrical resistance of the ground may also hold clues.
- The Kobe earthquake in Japan in 1990 caused a loss of \$200 billion – the most expensive natural disaster of all time (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 20).
- Around 1400 earthquakes rock the planet every day. (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 30).

- In 1556, a single earthquake in China is estimated to have killed 800 000 people. (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 30).

Volcanoes

- In the 1960s, a Royal Navy patrol ship (ironically called HMS Protector) became stuck in floating pumice from a new volcanic eruption in the South Sandwich Islands in the Pacific Ocean.
- Nine of the world's most expert vulcanologists were killed when a volcano blew up in their faces, whilst they were on a field trip. It happened on Galeras Volcano, in Columbia, South America, in 1991. Some of them thought that they could tell when the volcano would erupt, by studying the gases which were being given off. Another was hoping to use variations in the Earth's gravity field to tell if molten magma was getting near to the surface. Thinking that it was safe for a few more days, they went down into the crater. The gravity meter seemed to be broken. However, it now seems more likely that, as the pressure built up in the volcano, the changes in gravity were so great, that the instrument had gone off scale. The volcano suddenly erupted, not with runny lava, but with solid blocks of rock as big as fridges. These flew up into the air and fell on the scientists, killing nine of them and badly injuring several more. (Source: *Horizon*, BBC TV, 17/1/02).
- In 1783, the Laki fissure volcano in Iceland erupted over a period of eight months. The eruption produced acid rain and ash, which fell across much of Northern Europe. It also reduced the average temperature of Northern Europe by about 1 °C. A widespread famine affected many people. Even the cows in the fields starved, because the grass was so coated with abrasive ash that their teeth were worn down and they couldn't eat.
- Mont Pelée is a volcano in the West Indies. In 1902 it began to show signs of eruption, and one man told everyone to get out of the nearby town of St Pierre. There was an election coming up and everybody thought he was saying it for political reasons, so they ignored him. However, he was right. On 8th May 1902, a cloud of white hot ash particles and gases shot out of the crater, and rushed down the slopes of the volcano, burning and suffocating everything in its path. Over 30 000 people were killed, the harbour water boiled and ships were overturned. There were only two survivors. One was the man who gave the warning, who acted on his own advice. The other was a condemned murderer in an underground cell. When he was finally discovered, he was reprieved, and went on to earn a living travelling the world on lecture tours.
- Mount St Helens is a volcano in the western USA. Before it erupted in 1980, scientists had been studying it and thought they knew what was going to happen. The authorities evacuated people from what were thought to be the dangerous spots. However when the volcano erupted, a cloud of hot ash rolled rapidly down one side of it. Two people in a car got away, driving along a forest road at 160 km per hour (100 mph). They overtook a car going at about 110 km per hour (70 mph), whose driver was later found dead, having been caught up by the moving ash cloud, and suffocated.
- Lava flowed at 60 km per hour (40 mph) during the eruption of Nyiragongo, Africa in January 2002 and engulfed the Congolese town of Goma, so quickly that people were trapped between lava flows. (Source: Geological Society website, www.geolsoc.org.uk, accessed February 2003).
- The amount of heat flowing from the Earth amounts to 40 million MW. The total electricity generating capacity of the USA is, by contrast, 400 000 MW - or only 1% of the Earth's heat flow. The Earth loses 2 million

MW through volcanic eruptions (2% of the global heat flux). The hot springs area of Yellowstone National Park (Wyoming, USA) produces 4200 MW. (1 MW is 1 million joules per second.)

Tectonic plates and the structure of the Earth

- Tectonic plate movement is around 3.5 cm (1.4 in) per year on average, about the same as the rate that fingernails grow.
- South America and Africa were once joined – the evidence is seen in the continuity of rock types and many types of land fossils.
- The deepest hole ever drilled has a depth of 12 km (8 miles), so far, 2003. Progress is slow because the drill tip quickly gets blunt and lifting 12 km of drill out to replace it takes ages. This is only 0.2% of the radius of the Earth (6361 km, 3953 miles) – so a 'Journey to the Centre of the Earth' is not feasible.
- The Earth's crust's average thickness is 35 km (22 miles) under continents and 6 km (4 miles) under oceans. A rough analogy to this is a postage stamp stuck on a football.
- The Earth's magnetic field has flipped over many times; every 500 000 years on average. Flipping over may take about 10 000 years. The last major period of reversal was over 500 000 years ago, so we are overdue for another flip. Recent measurements of the magnetic field in the South Atlantic indicate that a reversal may be starting now (2003).

Atmosphere and ocean

- 70% of the oxygen added to the atmosphere each year comes from plankton in the sea, only 30% from land plants (Source: W. Heathcote, *Whale Nation*, London: Jonathan Cape, 1988, p 131).
- One cubic kilometre of seawater contains 4 kg of dissolved gold (Source: B. Mason, *Principles of Geochemistry*, New York: Wiley, 1966, p 196).
- In 1970, nearly 4 cm (about 1.5 inches) of rain fell in 60 seconds on the island of Guadeloupe in the West Indies (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 16).
- Nearly 4 metres of rain in 24 hours was dropped on the island of Réunion in the Indian Ocean by a passing cyclone in 1952. (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 16).
- Tornadoes have windspeeds up to 500 km per hour (300 mph). (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 20).
- When, in 1998, Hurricane Mitch dropped over 30 cm (12 in) of rain on Central America, it triggered more than a million landslides in the country of Honduras alone. (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 20).
- If the Greenland Ice Sheet melts, all the world's coastal cities will be drowned, from New York to London to Sydney. (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 63).
- Sea levels have risen by over 120 m since the ice started to retreat around 18 000 years ago. (Source: B. McGuire. *A guide to the end of the world*, Oxford: OUP, 2002, p 91).