

Earthquake activity 8: **Earthquake Quiz**

Description: This is an independent study activity for senior secondary school students. Students will read about earthquakes in Canada and then complete a quiz of true or false, or multiple choice questions.

Teacher instructions and notes:

1. Refer your students to the information on earthquakes in Canada on the following websites:
Atlas of Canada: Earthquakes [PDF] - included as part of these resources
Geological Survey of Canada <http://earthquakescanada.nrcan.gc.ca/info-gen/faq-eng.php>
2. Have students read the information on earthquakes and then complete the quiz on the following pages. If a student chooses 'false' on a true/false question, they must add a brief statement explaining why the statement is false.
3. The correct answers are given below. Some talking points have been added for the teachers' use.

Quiz answers and talking points for the teacher:

1. a) 3500 (8 to 10 every day) *The number of earthquakes located in Canada has increased over the years. This is due to more sensitive recording instruments and increased numbers of instruments installed across the country. The actual number of earthquakes is not increasing.*
2. b) 50 to 55 (1 every week) *The majority of these felt earthquakes are too small to cause any damage. In the entire twentieth century, about 20 earthquakes have caused significant damage in Canada.*
3. a) True. *Some of the world's largest earthquakes have occurred in Canadian territory, including the magnitude 9 Cascadia earthquake of 1700 and the magnitude 8.1 Queen Charlotte Island earthquake of 1949.*
4. a) British Columbia. *More than half (around 1800 per year) of Canada's earthquakes occur in this province and the neighbouring Pacific Ocean. Quebec comes in second with roughly 500 per year, while the Yukon is third with 150. In contrast, Manitoba, Saskatchewan and Prince Edward Island are Canada's quietest provinces, seismically speaking. On average, only 1 or 2 earthquakes are recorded each year in these three provinces.*
5. a) True, *but the exact number of people is unknown and depends on how one determines if the fatalities are directly or indirectly related to the earthquake.*
6. e) All of the above. *These varied lines of evidence helped to show that a giant (estimated magnitude 9) earthquake occurred along the Cascadia Subduction Zone at about 9 p.m. Pacific Standard Time on January 26, 1700.*
7. c) 1150 kilometres. *The earthquake occurred along the Cascadia Subduction Zone, which extends from offshore of central Vancouver Island to northern California.*
8. e) 2600 MT, the equivalent of 2.6 billion tonnes of TNT explosive.
9. d) 10 to 12. *Of these, five earthquakes have been assigned a magnitude 6 or greater: 1663, 1791, 1860, 1870 and 1925 (most magnitudes are based on historical intensity and damage reports). The 1988 earthquake did not have its epicentre in Charlevoix but in the Saguenay region. Every year, more than 200 (mostly small) earthquakes are recorded in this region. Of these, only 4 or 5 are felt.*

10. d) 2 000 000 km². *Although the damage from this earthquake was limited to the immediate vicinity of the epicentre and scattered pockets in the cities of Québec and Trois-Rivières, it was widely felt in eastern Canada and the United States, from Nova Scotia to western Ontario and from James Bay to Kentucky.*
11. f) *None of the above. Most earthquakes in Canada occur at some depth (between 5 to 50 kilometres) on faults that never reach the surface and are unaffected by surface temperature, time of day or the tides. Large, damaging earthquakes release millions of times the energy of small earthquakes and their strength is unaffected by these relatively tiny events. Faults do not separate to create chasms and, in Canada, the vast majority of faults visible on the surface were formed thousands or even millions of years ago and have not been proven to be seismically active.*
12. True. *Intensity values are based on how the earthquake was felt in each location and will vary from city to city depending on distance from the epicentre and local geological conditions,*
13. a) *It has no limits. Magnitude scales are not physical measuring instruments. They are numbers determined from a mathematical formula based on the amplitude of seismic waves recorded at different distances. Each unit on the Richter scale represents a 10-fold increase in the amplitude of the measured seismic waves. Seismographs can record very small 'microseisms' (magnitude -1 to -2). Generally, earthquakes must have a magnitude of 2 or 3 before they are widely felt. The largest instrumentally measured earthquake in the world had a magnitude of 9.5 and occurred off the coast of Chile in 1960.*
14. d) between 1 and 12.
15. d) 5 to 7 kilometres per second. *A large earthquake occurring on Canada's west coast will be recorded across the country, the fastest seismic waves arriving on Canada's east coast, 5000 kilometres away, in a matter of minutes. The magnitude 8.1 earthquake off British Columbia's Queen Charlotte Islands on August 22, 1949 (the largest earthquake in Canada in the twentieth century) was recorded by instruments across the country and around the world.*
16. a) Pressure wave.
17. e) \$15 billion. *The \$15 billion does not include loss of revenue due to the shut down of businesses in order to recover from the earthquake.*
18. d) All of the above. *Consult Public Safety Canada or your provincial emergency preparedness organization for information on how to prepare for natural disasters in Canada.*
19. c) Head for high ground immediately! *Never go to the coast to watch a tsunami. A tsunami moves faster than a person can run. Residents of coastal areas should be prepared to evacuate to high ground immediately. Depending on an earthquake's origin, a tsunami could reach the coast in as little as 15 minutes or more than 15 hours later. Only after you have reached high ground (a minimum of 10 to 15 metres above sea level) should you listen to local media for further instructions. A tsunami is composed of several waves, and often the first wave is not the largest. Do not return to the coast until you have been told it is safe to do so.*
20. False. *Vibrations from explosions, rock blasts and even landslides are strong enough to register on local seismographs.*

Quiz : EARTHQUAKES

Name: _____

Select the correct answer. If you answer false on a true or false question, you must explain why the statement is false.

1. On average, how many earthquakes are recorded and located in or near Canada each year?
 - a) 3500 (8 to 10 every day)
 - b) 1000 (2 to 3 every day)
 - c) 350 (1 every day)
 - d) 100 (2 every week)
 - e) 10 (1 every month)
2. The majority of earthquakes are either too small or too remote to be felt. How many earthquakes are reportedly felt each year in Canada?
 - a) 350 to 400 (1 every day)
 - b) 50 to 55 (1 every week)
 - c) 10 to 15 (1 every month)
 - d) 1 to 2 (1 every year)
3. There have been several very large earthquakes in Canada. True or False?
4. Which province or territory has the most earthquake activity?
 - a) British Columbia
 - b) Manitoba
 - c) Nunavut
 - d) Quebec
 - e) Yukon
5. Someone has been killed by an earthquake in Canada. True or False?
6. The Cascadia earthquake in 1700 occurred a century before the start of the written historical record of the Pacific northwest. How did scientists determine the date, location and size of this event?
 - a) Carbon dating of drowned cedar trees preserved in tidal marshes.
 - b) Examination of deep sea cores of mud layers off the coast of Washington and Oregon.
 - c) Oral traditions of native tribes of the Pacific northwest.
 - d) Japanese written records of a tsunami that struck the coast of Honshu with no associated earthquake noted.
 - e) All of the above.
7. The estimated length of the fault that ruptured during the Cascadia megaquake in 1700 was:
 - a) 100 kilometres (equivalent to the distance from Vancouver to Victoria)
 - b) 600 kilometres (equivalent to the distance from Vancouver to Banff)
 - c) 1150 kilometres (equivalent to the distance from Vancouver to Saskatoon)
 - d) 1850 kilometres (equivalent to the distance from Vancouver to Winnipeg)
 - e) 3200 kilometres (equivalent to the distance from Vancouver to Toronto)

8. The energy released by the Cascadia earthquake in 1700 was equivalent, as measured in megatons (MT) of TNT explosive, to:
- a) 0.003 MT (the 1917 explosion of the Mont-Blanc in Halifax harbour)
 - b) 0.015 MT (the 1945 explosion of the Hiroshima atomic bomb)
 - c) 24 MT (the 1980 explosion of the Mount St. Helens volcano)
 - d) 50 MT (the 1961 Tsar Bomba Soviet nuclear test, the world's largest)
 - e) 2600 MT (the total estimated annual energy consumption for all of Canada)
9. The Charlevoix-Kamouraska region, northeast of the city of Québec, is one of Canada's most active seismic zones. How many damaging earthquakes have been recorded there in the past 350 years?
- a) 1 or 2
 - b) 3 or 4
 - c) 7 or 8
 - d) 10 to 12
10. The magnitude 6.2 earthquake of February 28, 1925 in the Charlevoix-Kamouraska region was felt over an area of approximately:
- a) 73 500 km² (the size of New Brunswick)
 - b) 480 000 km² (the size of the Yukon)
 - c) 650 000 km² (the size of Manitoba)
 - d) 2 000 000 km² (the size of British Columbia and Ontario combined)
 - e) 9 900 000 km² (the size of Canada)
11. Which of the following statements are true?
- a) There are more earthquakes in the winter than summer.
 - b) The earth opens up when there is a big earthquake.
 - c) Many small earthquakes 'let off steam' so there won't be a big one.
 - d) The earth's tides can trigger earthquakes.
 - e) There is a fault in my region, so there must be earthquakes.
 - f) None of the above.
12. An earthquake has only one magnitude but will have many intensity values.
True or False?
13. How large is the earthquake magnitude scale?
- a) it has no limits
 - b) about 30 centimetres
 - c) between -5 and +5
 - d) between 1 and 10
 - e) between 1 and 100
14. How large is the Modified Mercalli Intensity scale?
- a) it has no limits
 - b) between 1 and 9
 - c) between 0 and 21
 - d) between 1 and 12
15. How fast do seismic waves travel through the crust of the earth?
- a) 0.012 km/sec. (top speed of an Olympic sprinter, 43 km/hr)
 - b) 0.1 km/sec. (top speed of a Formula One race car, 360 km/hr)
 - c) 0.34 km/sec. (speed of sound in air, 1225 km/hr)
 - d) 5 to 7 km/sec. (almost the speed of the space shuttle as it orbits the earth, 28000 km/hr)

16. Which seismic wave travels fastest and appears first on a seismogram?
- a) pressure wave
 - b) shear wave
 - c) Raleigh wave
17. According to a study by the insurance industry, a magnitude 6.5 earthquake occurring beneath the Strait of Georgia would cause the following amount of damage to greater Vancouver's buildings and their contents:
- a) \$40 million (Celine Dion's annual salary)
 - b) \$350 million (construction cost of the CN Tower)
 - c) \$1 billion (construction cost of the 13 kilometre Prince Edward Island–New Brunswick Confederation Bridge)
 - d) \$2 billion (value of annual diamond production in Canada)
 - e) \$15 billion (total volume of sales processed through Canadian travel agencies)
18. During an earthquake:
- a) If you are inside, take cover under a heavy table, desk or any solid furniture and hold on. If you can't get under something strong, flatten yourself or crouch against an interior wall
 - b) If you are outside, stay outside, away from buildings, power lines, gas and water mains, and telephone poles.
 - c) If you are in a car, try to pull over to a safe place where you are not blocking the road. Stop the car and stay inside. Avoid bridges, overpasses, underpasses, buildings or anything that could collapse on you and your car.
 - d) All of the above.
19. If you are on the coast and feel strong earthquake shaking, you should:
- a) Go down to the shore to watch the unusual waves.
 - b) Tune in to your local media and await further instructions.
 - c) Head for high ground immediately.
20. Explosions are too weak to be recorded on a seismograph. True or False?