

## Seismic Superheros Introductions

Have students introduce themselves using the following biographical paragraphs in order to show how ideas about the earth and earthquakes have changed through time as recorded in various historical documents.

1. Hi, my name is **Thales of Milet** (624 to 546 BC). I am considered to be the founder of the Ionic philosophy of nature. Water and humidity are the most basic elements for me. I think that the movement of the earth's disk on top of the ocean is the cause of earthquakes.
2. Hi, my name is **Anaximenes of Milet** (584-525 BC). I succeeded Thales' successor Anaximander of Milet who thought that the Cosmos is a sphere and the earth is a huge cylinder that floats in the Cosmos with no support. I assert that the earth is a disk that is carried by air. Earthquakes occur when the earth collapses into subterranean cavities filled with air.
3. Hi, my name is **Anaxagoras** (499-428 BC). I believe that the sun is a glowing mass and that the earth emerged out of vapour and ether that were separated by rotation. I think the earth is a cylindrical disk that solidified out of vapour and rests at the center of the cosmos due to its enormous size. I think that earthquakes are caused when ether permeates the earth from below and violently blasts through obstructed pores.
4. Hi, my name is **Democritus** (460 –370 BC). I traveled around the eastern Mediterranean and followed Leukippos' idea of atomism. I think that earthquakes are generated as water sloshes back and forth in underground caverns.
5. Hi, my name is **Platon** (428-348 BC). I was a disciple of Socrates until his death. Then I traveled around the Mediterranean. I saw volcanoes in Sicily. My idea is that earthquakes are generated by fiery flows in the interior of the earth.
6. Hi, my name is **Aristotle** (383-322 BC). I attended Platon's academy and became the tutor for Alexander the Great. After Alexander's death I was accused of blasphemy but I escaped trial by moving to Chalkis. I think that earthquakes are linked to atmospheric and cosmic events (meteors), and should be studied as part of meteorology.
7. Hi, my name is **Straton of Lampsacus** (3??-269 BC). I became the leader of the Peripatetic school in 286 BC. I think the basic forces in the world are "warm" and "cold". I deny that there are any supernatural/theological forces at work in the processes of nature. I differ from both Democritus and Aristotle and think that the fight between the two basic forces of warm and cold underground causes earthquakes.
8. Hi, my name is **L. Annaeus Seneca** (A.D. 4-65). I came from Spain to Rome to become Nero's tutor, but later he had me put to death. After a devastating earthquake

in Pompeii in A.D. 63, I made a comprehensive summary of all knowledge of classic antiquity concerning the causes and mechanisms of earthquakes.

9. Hi, my name is **Pliny the Elder** (A.D. 23-79). I wrote a compendium of 23 books on natural history. I was a navy commander and tried to rescue people from the city of Stabiae near Mount Vesuvius as it erupted. Our boats could not leave the harbor and I died as ash and sulfurous vapors descended across the city and bay. In my books, I modified Aristotle's atmospheric theory and maintained that earthquakes are subterranean thunderstorms.
10. Hi, my name is **Claudius Ptolemaeus**, but I'm known as **Ptolemy** (writings from AD. 127-145). I furthered Aristotle's concepts of the cosmos, and devised a number of shells of "crystal spheres" surrounding the Earth at the center to explain astronomical observations. Similarly, the earth contains subsurface shells. Early Christians accept my model of the Cosmos and make it dogma for centuries.
11. Hi, my name is **Chang Heng** (writing about A.D. 132). I developed what is now called a seismoscope—a device for showing the motions that an earthquake generates. The seismoscope consists of levers inside an ornately decorated urn that release balls held by dragons' heads. When the earth shakes, the levers move in the direction of ground motion, the balls drop from the dragons' mouths oriented in the same direction, and fall into the mouths of ceramic frogs below.
12. Hi, my name is **Albertus Magnus** (A.D. 1193-1280). I taught Christian Aristolism in religious schools in Germany and France. I included Greek, Roman, Arabic and Jewish ideas concerning various subjects, but basically I taught Aristotle's earthquake theory.
13. Hi, my name is **Saint Thomas Aquinas** (A.D. 1225-1274). I am a disciple of Albertus Magnus. I systematized scholastic philosophy and reinterpreted Aristotle's earthquake ideas in a Christian manner.
14. Hi, my name is **Konrad Von Megenberg** (A.D. 1309-1378). I wrote the first German history of nature and translated books on astronomy into German. I followed the ideas of Aristotle as written by Albertus Magnus.
15. Hi, my name is **Leonardo Da Vinci** (1452-1519). I am an artistic and engineering genius that worked for several Italian and French aristocrats. I think that earthquakes are caused when caves subside and compressed air escapes.
16. Hi, my name is **Georg Bauer**, aka. **Agricola** (1494-1555). I taught school, became a medical doctor, and moved to Chemnitz (now Germany) where I became the first systematic mineralogist and geologist while continuing to practice medicine. From my experience in underground mines, I came up with the idea that earthquakes are caused by self-igniting subterranean fires that try to escape from their caves.

17. Hi, my name is **Giordano Bruno** (1548-1600). I fought against “the system” at numerous junctures in my life and was punished for it, first with banishment, later imprisonment, and finally was burned at the stake for heresy during the Inquisition. I thought that there were numerous solar systems in the cosmos. I attacked the Aristotelian theory of nature and was forced to leave Paris after I had already been forced out of Italy. I think that all cosmic bodies are both machines and organisms and that earthquakes are diseases of the earth.
18. Hi, my name is **Galileo Galilei** (1564-1642). I taught mathematics at several Italian universities. I published a discussion about the differences between the old Ptolemaic system of the cosmos and the new, much superior Copernican system, for which I was prosecuted by the Inquisition. I was banished to my country villa near Florence. I think the earth has a dense and heavy core and does not have hollow internal strata.
19. Hi, my name is **Johannes Kepler** (1571-1630). I taught mathematics in Germany during the Reformation and was forced with all the other Protestants to leave the town of Graz. I was an assistant to Tycho Brahe and served the aristocracy as a mathematician, land surveyor, and astronomer. I believe that planets have a soul, and earthquakes are analogous to utterances of a living being.
20. Hi, my name is **Rene’ Descartes** (1596-1650). I am famous for my work as a philosopher and mathematician. I developed a model of the crust of the earth. I think that earthquakes are caused by sulfuric vapors that ignite by sparks of fire such that explosions rock the walls of subterranean caves for several days.
21. Hi, my name is **Athanasius Kircher** (1601-1680). I taught mathematics in Germany and then taught mathematics and Hebrew at the Vatican. I invented the “magic lantern”. I developed and illustrated a theory in which the center of the earth has a central fire and many subsidiary subterranean fires.
22. Hi, my name is **John Ray** (1628-1704). I taught Greek and mathematics at Cambridge and described natural items, particularly plants, throughout Europe. I advocate that earthquakes played a major role in the development of the earth.
23. Hi, my name is **Robert Hooke** (1635-1702). I carried out early chemistry experiments, taught geometry, and helped with the reconstruction of London after the Great Fire. I argued about physics with Sir Isaac Newton and REALLY WAS THE FIRST to develop the theory of gravity. I thought that earthquakes could change the direction of the earth’s axis.
24. Hi, my name is **Niels Stenson**, or in Latin, **Nicolaus Steno** (1638-1686). I am a Dane, but worked on the geology of Italy, Austria, Germany, and the Netherlands. I studied “bodies” that are enclosed in other “bodies” and have been called the father of paleontology. I think the uplifting or subsidence of strata in the earth causes earthquakes.

25. Hi, my name is **Martin Liester** (or Lyster; 1638-1712). I joined the Royal Society in London after having been a physician in York. I became the personal physician of Queen Ann. Earthquakes are caused by “phosphorous as the inflammable spirit of pyrite”.
26. Hi, my name is **Gottfried Wilhelm Leibniz** (1646-1716). I went from Leipzig to Paris to accompany a baron. After the baron’s death, I worked as a librarian in the service of a duke in Paris for the next forty years. I invented differential and integral calculus (NOT Newton!). I tackled various philosophical and mathematical problems. I explored the possible origin of the earth out of a glowing body. I consider earthquakes to be the consequences of local fires in caves that emerged due to the cooling of the earth’s crust.
27. Hi, my name is **Edmond Halley** (1656-1742). I am an astronomer and surveyor and published “Principia”, written by my friend Sir Isaac Newton. I may be the first geophysicist, because I was sent to the southern ocean to measure magnetic declination and inclination. I was appointed to be Royal Astronomer. You may have heard of my comet! I defend the hollow-sphere theory of the interior of the earth.
28. Hi, my name is **John Bevis** (or Bevans, 1693-1771). I published a volume called *The History and Philosophy of Earthquakes* in 1757, following the great Lisbon earthquake in 1755. This book is a collection of essays and observations by ten of Europe’s greatest naturalists. It gives later workers a measure of the breadth of knowledge of the causes and phenomena of earthquakes in the 18<sup>th</sup> century.
29. Hi, my name is **Benjamin Franklin** (1706-1790). Others have used my experiments with lightning to speculate that underground lightning and thunder cause earthquakes. However, I think that the earth’s core is a highly compressed, dense gas. The earth’s crust is floating on this gas. Because the earth rotates, the compressed gas deforms, breaking the crust. In addition, the compressed gas generates undulations, which cause tremors over wide areas.
30. Hi, my name is **Georges Louis Leclerc, Comte de Buffon** (1707-1788). I thought earthquakes fell into two classes, those caused by subterranean fires and explosions of volcanoes, and those with no clear connections to volcanoes or subterranean fires.
31. Hi, my name is **Elie Bertrand** (1712-1790). After all the earthquakes in Europe and the New World in the 1850’s, I wrote a book on the earthquakes of Switzerland and also noted the seiches (sloshing waves) on Swiss lakes following the great Lisbon quake of 1755. I was the first to make a list of known earthquakes and their locations in Switzerland from A.D. 563 to 1756.
32. Hi, my name is **Friedrich Jacobi** (1712-1791). I wrote of experiences of the Lisbon and Hannover earthquakes. I developed a “steam-pressure” theory of generating earthquakes based on simple steam engines that had just been invented by Papin and Newcomen (before James Watt).

33. Hi, my name is **Giovanni Battista Beccaria** (1716-1781). I, along with William Stukeley in Britain and several others, were so impressed by Benjamin Franklin's experiments with electricity, that we think earthquakes are caused by underground lightning storms. I point out that the high propagation speed of earthquakes over land and water means that only lightning is a plausible explanation.
34. Hi, my name is **Tobias Mayer** (1723-1762). I worked as a map maker and published several works on natural sciences and mathematics. I published the first map of the moon based on detailed measurements. I postulate that sudden changes in the orientation of gravity are the real cause of building collapse during earthquakes.
35. Hi, my name is **John Mitchell** (1724-1793). I studied the great Lisbon earthquake of 1755 and concluded that earthquakes are caused by vapors from the interior of the Earth raising strata and causing them to ripple outward like air under a rug. I think that earthquake motions can be analyzed using Newtonian mechanics. I observe that earthquakes consist of "waves set up by shifting masses of rock miles below the surface". The waves are of two types: a "tremulous" vibration followed shortly by "wavelike undulation" of the Earth's surface. I have tried to measure the speed of earthquake waves and think that they move at 500 meters per second.
36. Hi, my name is **Emmanuel Kant** (1724-1804). Following the Lisbon earthquake in 1755 and other large earthquakes in Europe and the New World, I wrote three treatises on the causes of earthquakes and how their effects could be propagated to large distances. I believe earthquakes spread as the result of hot compressed air in subterranean passages under big mountain ranges and along rivers. A chemical respiratory process determines intervals between earthquakes—fire comes from the throats of volcanoes, but is snuffed out unless air gets to the passages. Then the fire is rekindled and earthquakes occur. Thus the earth has a gigantic respiration process like the human lungs. I suggest that some places are less affected by earthquakes than others, and that people should build earthquake-resistant buildings oriented away from earthquakes. I criticize those who blame mystical, astrological, or religious reasons for earthquakes, especially those who claim its "God's punishment". I say, "We stand with our feet on the cause".
37. Hi, my name is **Charles Robert Darwin** (1809-1882). I became a famous British naturalist. I experienced several earthquakes in my travels. I witnessed the aftermath of the great earthquake in Chile in 1835 and noted that uplift of land and eruption of volcanoes were simultaneous, and therefore are parts of the same great phenomenon.
38. Hi, my name is **Robert Mallet** (1810-1881). I am a brilliant engineer who witnessed the twisting of stone pillars in Italy due to earthquakes and established the discipline of observational seismology. I compiled a comprehensive library of writings about earthquakes and created reliable maps of zones of earthquake effects. I studied the speeds of earthquake waves in different rocks and alluvium by timing their motions

from artificial explosions. I infer that earthquakes start at a point, or focus, and move out in all directions. Italian earthquakes are due to the proximity of volcanoes.

39. Hi, my name is **Michele Stefano De Rossi** (1834-1898). I developed an earthquake-intensity scale that became widely used in Europe in the 19<sup>th</sup> century. The scale ranged from 1 (very slight shock, observed by one seismograph or one seismologist) to 10 (total disaster, fissures in the earth, rockfalls from mountains). One may illustrate the rather concentric decrease in earthquake intensity away from the epicenter by mapping the amounts of damage using my scale. The scale has continued to be modified, first by me, then it became the Rossi-Forel scale of intensity. My colleague Giuseppe Mercalli further modified the scale. In the United States the scale is called the Modified Mercalli scale. That scale now ranges from one to twelve and is delimited using roman numerals (I to XII).
40. Hi, my name is **Alexander McKay** (1841-1917). In 1886 I published perhaps the first observed cause-and-effect relationship between fresh fault scarps and historic earthquakes that I observed while working for the New Zealand Geological Survey. I noted that larger fault-zone features are similar to the historic fault scarps and therefore must have similar origins. When I was 60 years old, I experienced a tremor and reported, “a long swing, and if an earthquake can at all be a pleasing thing, this was not unpleasant; and to tell the truth I enjoyed the rocking motion.”
41. Hi my name is **Grove Karl Gilbert** (1843-1918). I joined a new organization at its inception in 1879, and became the Director of that “great engine of research”, the United States Geological Survey. My fieldwork and interests are broad and I published numerous articles and books without coauthors. I studied faults and fault scarps in California, Nevada, and Utah. I warned the citizens of Salt Lake City, Utah, that there had been large earthquakes there in the past and that more earthquakes are likely in the future.
42. Hi, my name is **John Milne** (1850-1913). I taught engineering at the Imperial College of Tokyo and later set up the Shide Seismological Observatory on the Isle of Wight. My colleagues James Ewing, Thomas Gray, and I developed seismographs capable of recording ground shaking in vertical and horizontal dimensions as function of time. These instruments were reliable and compact enough to transport and install around the world, which we did, to form the beginnings of a worldwide seismic recording network. This network led to rapid advances in understanding earthquakes and the structure of the Earth. I am considered to be the “founder of modern seismology”.
43. Hi, my name is **Bunjiro Koto** (1856 - 1935). I studied the Mino-Owari earthquake in Japan in 1891. A fault scarp formed at the same time as the earthquake. My observations are among the first and most thorough to link earthquakes with the formation of fault scarps. The fault scarp created with the earthquake is over 100 kilometers long, with vertical offsets up to 5 meters.

44. Hi, my name is **Andrija Mohorovicic** (1857-1936). I looked at arrival times of earthquake waves from an earthquake in my native Croatia and noted that some waves arrived earlier or later than expected. I developed a model of earthquake-wave refraction along a denser layer at depth. This denser layer was later discovered to be a worldwide fundamental feature of the earth's interior. The boundary between the layers above and below is between the crust and upper mantle and is known as the "Mohorovicic discontinuity" or the "Moho" for short.
45. Hi, my name is **Richard Dixon Oldham** (1858-1936). I looked at the arrival times of earthquake waves and deduced that the earth has a core. I am the son of the geologist who became director of the geological surveys of Ireland and India. I described the great Assam earthquake of 1897, in which there was complete devastation of 9,000 square miles and uplift of more than 35 feet along the Chedrang fault. I showed that peak accelerations of ground motion exceeded the vertical acceleration of gravity. By studying records of earthquake waves, I showed, as predicted by theory, that primary, secondary, and surface waves could be identified on seismograms and that the earth behaved as perfectly elastic.
46. Hi, my name is **Harry Fielding Reid** (1859 –1944). I am an engineer and seismologist who headed the commission to study the devastating San Francisco earthquake of 1906. I noted that opposite sides of the San Andreas Fault had moved 3.2 meters in the 50-year period before the fault moved, causing the earthquake. From that I surmised that strain along the fault had slowly built up and is released by sudden slip. The rocks snap back to their original shapes on either side of the fault. This is called "elastic rebound" and remains the best theory for most earthquakes. I also studied the great earthquake swarm in Socorro, New Mexico, in 1906.
47. Hi, my name is **Fusakichi Omori** (1868-1923). I became director of the Seismological Institute of Japan and studied the distribution of large earthquakes on the island of Honshu. I noted a progression of earthquakes and forecast that earthquake zones that were quiet in 1922 might become more active in the future, particularly near Tokyo. In 1923, an 8.2 earthquake in Sagami Bay south of Tokyo caused widespread building collapse, fire, and tsunami waves, resulting in over 143,000 deaths and over 1 million homeless.
48. Hi, my name is **Inge Lehmann** (1888-1993). I am a Danish mathematician and seismologist and one of the first females to be recognized as a worthy geophysicist. By studying earthquake waves and the paths they must have taken through the earth, I deduced that the earth has an inner core a little smaller in size than the moon. My results were published in an article with one of the shortest titles ever written, "P'" [p prime].
49. Hello, my name is **Beno Gutenberg** (1889-1960). I came to the United States from Germany in 1936. I taught seismology at the California Institute of Technology and studied the interior of the earth using seismic waves. I developed several seismometers and a way of estimating magnitude of earthquakes using S waves.

50. Hello, my name is Sir **Harold Jeffreys** (1891-1989). I pushed geophysics to a much higher level of practice. Among my many achievements, I discovered that the earth's outer core is liquid. I also was extremely critical of Wegner's concepts of how and why the earth's continents "drifted"—his interpretations are not geophysically supportable.
51. Hi, my name is **Victor Hugo Benioff** (1899-1968). I studied the depth of foci of earthquakes and discovered that some earthquake generating zones become deeper and deeper beneath island arcs and other volcanic arcs on continents. Other scientists named the Wadati-Benioff zone in my honor. I also invented sophisticated strain gages to look at deformation across active faults such as the San Andreas Fault. Besides my career studying earthquakes and developing seismologic instruments, I consulted for musical-instrument manufacturers to build better musical instruments.
52. Hi, my name is **Charles Richter** (1900-1985). I taught seismology at the California Institute of Technology for many years. In 1935 I proposed a scale for measuring sizes of local (California) earthquakes based on the amplitude of waves recorded on a particular design of seismograph. Because the size of earthquake waves range over several orders of magnitude, the scale is logarithmic, and each whole-number increase in log-scale represents a ten-fold increase in amplitude and roughly a 30-fold increase in energy release.
53. Hi, my name is **Kiyoo Wadati** (1902-1995). I developed an earthquake-wave amplitude-magnitude scale in Japan before the Richter scale was developed in California. I led the investigation of seismic-wave travel times leading to determination of mantle structure. I settled an argument between H.H. Turner (Oxford) and H. Jeffreys (Cambridge) about whether there are deep-focus earthquakes. I compiled incontrovertible evidence from earthquakes in Japan that quakes range from tens to hundreds of kilometers in depth and are oriented in a planar zone beneath the islands. Jeffreys argued that heat and pressure at depth would make it impossible for rocks to rupture. Because quakes originate at great depths, there must be some alternative mechanism to cause them.
54. Hi, my name is **Robert Earl Wallace** (1916-present). I worked for the U.S. Geological Survey in the western United States and Alaska and taught geology at several universities. I studied fault movements on the San Andreas Fault and helped develop methods to study prehistoric earthquakes and earthquake cycles by analyzing geomorphic features and sedimentary deposits involved with faults. These methods are called "paleoseismology".
55. Hi, my name is **Bruce A. Bolt** (1930-present). I taught many generations of students at Berkeley, California. We studied the earth's core using seismic waves from earthquake and nuclear explosions and determined that the transition from the liquid outer core to the solid inner core is very abrupt (within 5 km). I worked to verify



nuclear test bans and served as chairman of the California Seismic Safety Commission.

56. Hi, my name is **Sylvester Theodore Algermissen** (1932-present). Before I retired I was Chief of the Geologic Hazard and Risk Assessment Office of International Geology at the U.S. Geological Survey. My maps of probabilistic earthquake hazard and risk are widely used in the United States and are the basis for depicting earthquake zones in manuals of the Uniform Building Code (used throughout New Mexico as the state standard code).
57. Hi, my name is **T. Leslie Youd** (1938-present). I am a world-renowned and respected expert on earthquake-induced liquefaction and ground failure. Over the past 30 years I've conducted research on basic causes and processes of ground failure and resulting damage to engineered structures. I developed criteria for mapping liquefaction hazards and predicting ground displacements associated with liquefaction. I've traveled the world assessing damage to buildings, bridges, and other structures immediately after disaster has struck.
58. Hi, my name is **Tanya Maria Atwater** (1941-present). I use magnetic patterns preserved in oceanic crust to reconstruct motions of the earth's tectonic plates. I worked through the detailed implications of plate motions to reconstruct the development of geologic structure and evolution of the western United States. For my work and my teaching I received the Newcomb Cleveland Prize and the Encourage Award from the Association of Women Geoscientists.
59. Hi, my name is **Michael N. Machette** (1949-present). I work for the U.S. Geological Survey and have studied fault scarps throughout the western United States. I did the first quantitative fault-scarp work in New Mexico in the 1970's and have continued to produce regional maps of active faults in New Mexico and other states since then. With help from colleagues, I compiled a comprehensive catalog of all known fault scarps in New Mexico that have moved in the past 2 million years. The entries describe what is known about 145 faults or fault zones in the state.
60. Hi, my name is **James P. McCalpin** (1950-present). I study fault scarps and stratigraphy of sediments shed from uplifted scarps. I have reconstructed the earthquake prehistory of many faults throughout the western United States. I edited the book "Paleoseismology" for which I won the prestigious E.B. Burwell, Jr. Award from the Engineering Geology Division of the Geological Society of America.

If readers have comments or suggestions for including others Seismic Superheros, please contact [Dave@gis.nmt.edu](mailto:Dave@gis.nmt.edu)

*New Mexico Teachers*—there is a version that includes Seismic Superheros of New Mexico