

Quantitative Measures

Lesson

In this lesson, students read several versions of the same article. ARTICLE A contains few quantitative measures (numbers), ARTICLE B offers a range of choices for reasonable quantitative measures, and ARTICLE C is the original article as published.

Quantitative measures are given in correct and comparable units.

SciJour Standards for Scientific Literacy

Objective: Students will recognize the importance of quantitative measures (numbers) in articles to enhance credibility and understanding.

Materials: ARTICLE A *Earth Knocked for a Loop*

ARTICLE B *Earth Knocked for a Loop*

ARTICLE C *Earth Knocked for a Loop*

Time: approximately 40 minutes

Getting Started

NOTE: Do not initially reveal to the students the objectives of this lesson. Ask how many students recall the earthquakes in Haiti and Chile of 2010? What do they recall about those events? Ask if anyone understands the causes of earthquakes. Tell the students that today they will be reading several articles about the earthquakes.

Addressing the Topic

Distribute ARTICLE A. (In this edited version of the article the numbers have been replaced with vague references to amounts. Ideally, as the students read the article they will notice the lack of detail and may become frustrated with the limited quantitative measures.)

Read ARTICLE A either together as a class, or have students read to one another in pairs. Encourage students to comment on the article as it is being read. If none of the students notice the lack of numbers, the teacher may pose some “wondering” questions such as (following paragraph 1) “I wonder how large the earthquake was?” or (following paragraph 3) “I wonder how fast those plates really are colliding?” Continue with “wondering” questions that are about quantitative measures that are lacking in the article.

The article can be read in its entirety, or (once the lack of number amounts has been noted) move on to ARTICLE B.

Distribute ARTICLE B. (In this edited version of the article the numbers have been replaced with groups of choices. One of each group is correct and was taken from the original version). Read the article aloud with the class and stop at the first set of choices (#1). Have students select the answer choice that seems most reasonable. Then, have students read the rest of the article in pairs and decide together which answer choice to select.

Distribute ARTICLE C. (This version of the article is the original with the complete numbers in place.) Have students read the article individually. (They will be eager to do so to see which choices had been correct.)

Follow-up

Close with a *quick-write* in which the students think and write about the inclusion of numbers and the importance of numbers when writing articles of their own.

Article A

Earth knocked for a loop

Chilean quake sped up Earth's rotation, tipped planet's axis

By [Sid Perkins](#)

Science News Web edition : Wednesday, March 3rd, 2010

NOTE: This article has been edited for educational purposes.

The large quake that slammed central Chile in February knocked the entire planet for a loop — literally. The sudden, large-scale movement of tectonic plates that triggered the quake shifted immense masses of rock a few meters closer to Earth's core, tilting the planet's axis and shortening the day, analyses indicate.

Disaster struck in the early morning, when seismic stresses that had been building for a long time let loose. Rocks along the interface between two tectonic plates slipped past each other a distance of several meters, says Jian Lin, a geophysicist at the Woods Hole Oceanographic Institution in Massachusetts.

Those pieces of Earth's crust — the South American plate and the Nazca plate, a big slab of seafloor that lies just west of South America — are colliding at an average speed of several centimeters per year. "This is one of the fastest plate convergence rates on Earth," Lin notes. Rather than moving steadily, the plates can remain locked in place for long intervals and then slide past each other in quick bursts.

The early-morning temblor, which involved slippage along a large stretch of the tectonic interface, is among the strongest ever recorded: Only a few quakes since 1900 — including the largest on record, a huge shock that shook southern Chile in May 1960 — have been larger, Lin says.

"The new quake picked up where the 1960 rupture ended," he notes.

The death toll from the February quake stands at a large number, Chile's National Emergency Office reported March 3. That tally is still climbing but won't rise to anywhere near the huge death toll of the magnitude 7.0 quake that struck Haiti on January 12. This dramatic difference probably stems from several factors, Lin speculates.

First, even though the Chilean temblor released about a lot more energy than the Haitian quake, it originated deeper within the Earth and farther from densely inhabited regions. And Chile's long experience with large quakes and the strong, well-enforced building codes that have been developed as a result also saved lives, Lin says. "The contrasts between the aftermaths of these quakes remind us, once again, that 'earthquakes do not kill people, buildings do,'" he notes.

In a few days, the Chile quake has spawned more than lots of aftershocks, including some above magnitude 6.0. One large aftershock, centered about 125 kilometers off the Chilean coast, was almost as large as the Haiti quake of January 12.

The movement of tectonic plates in Chile February 27 has triggered glitches in Earth's rotation, a new analysis suggests. Sudden subduction of the Nazca plate carried large amounts of mass closer to the center of the Earth — which, conceptually but on a vastly different scale, works like spinning skaters bringing their arms closer to their bodies, says Richard Gross, a geophysicist at NASA's Jet Propulsion Laboratory in Pasadena, Calif. As a result, Earth's day is now shorter than it was before the massive quake, Gross estimates.

And because the quake's shift in mass occurred deep in the Southern Hemisphere, Earth was slightly tipped off balance — a result similar to a spinning skater bringing in one arm but not the other. The planet's "figure axis," the line about which the Earth is balanced, shifted about 8 centimeters, Gross notes.

Earth's axis is constantly wobbling at various frequencies, with some oscillations measuring several meters and taking months to unfold (*SN: 8/12/00, p. 111*). Forces driving those cycles, including those resulting from winds and ocean currents, act continually across Earth's surface and often are about a thousand times larger than those generated during the Chilean quake.

Article B

Earth knocked for a loop

Chilean quake sped up Earth's rotation, tipped planet's axis

By Sid Perkins

Science News Web edition : Wednesday, March 3rd, 2010

NOTE: This article has been edited for educational purposes

The magnitude **1. (A. 5.3, B. 9.9, C. 6.1, D. 8.8)** quake that slammed central Chile February 27 knocked the entire planet for a loop — literally. The sudden, large-scale movement of tectonic plates that triggered the quake shifted immense masses of rock a few meters closer to Earth's core, tilting the planet's axis a few centimeters and imperceptibly shortening the day, analyses indicate.

Disaster struck just after 3:34 a.m. local time, when seismic stresses that had been building for decades, if not centuries, let loose. Rocks along the interface between two tectonic plates slipped past each other a distance of

2. (A. 1-2 cm, B. 7-11 meters, C. 87-90 meters, 1-2 kilometers), says Jian Lin, a geophysicist at the Woods Hole Oceanographic Institution in Massachusetts.

Those pieces of Earth's crust — the South American plate and the Nazca plate, a continent-sized slab of seafloor that lies just west of South America — are colliding at an average speed of about **3. (A. 8 cm per year, B. 34 cm per year, C. 3 meters per year, D. 2 kilometers per year)**. "This is one of the fastest plate convergence rates on Earth," Lin notes. Rather than moving steadily, the plates can remain locked in place for long intervals and then slide past each other in quick bursts.

The early-morning temblor, which involved slippage along a 400-kilometer stretch of the tectonic interface, is among the strongest ever recorded: Only four quakes since 1900 — including the largest on record, a magnitude **4. (A. 4.7, B. 6.5, C. 8.6, D. 9.5)** that shook southern Chile in May 1960 — have been larger, Lin says.

"The new quake picked up where the 1960 rupture ended," he notes.

The death toll from the February 27 quake stands at **5. (A. 36, B. 623, C. 799, D. 234)**, Chile's National Emergency Office reported March 3. That tally is still climbing but won't rise to anywhere near the **6. (A. 200,000, B. 7,652, C. 417, D. 27,000)** death toll of the magnitude 7.0 quake that struck Haiti on January 12. This dramatic difference probably stems from several factors, Lin speculates.

First, even though the Chilean temblor released about 500 times more energy than the Haitian quake, it originated deeper within the Earth and farther from densely inhabited regions. And Chile's long experience with large quakes and the strong, well-enforced building codes that have been developed as a result also saved lives, Lin says. "The contrasts between the aftermaths of these quakes remind us, once again, that 'earthquakes do not kill people, buildings do,'" he notes.

In a mere six days, the Chile quake has spawned more than 180 aftershocks, including seven above magnitude 6.0. One aftershock, a magnitude 6.9 quake centered about 125 kilometers off the Chilean coast, was almost as large as the Haiti quake of January 12.

The movement of tectonic plates in Chile February 27 has triggered glitches in Earth's rotation, a new analysis suggests. Sudden subduction of the Nazca plate carried large amounts of mass closer to the center of the Earth — which, conceptually but on a vastly different scale, works like spinning skaters bringing their arms closer to their bodies, says Richard Gross, a geophysicist at NASA's Jet Propulsion Laboratory in Pasadena, Calif. As a result, Earth's day is now about

7. (A. 7.3 seconds, B. 876.56 microseconds, C. 2.67 seconds, D. 1.26 microseconds) shorter than it was before the massive quake, Gross estimates.

And because the quake's shift in mass occurred deep in the Southern Hemisphere, Earth was slightly tipped off balance — a result similar to a spinning skater bringing in one arm but not the other. The planet's "figure axis," the line about which the Earth is balanced, shifted about 8 centimeters, Gross notes.

Earth's axis is constantly wobbling at various frequencies, with some oscillations measuring several meters and taking months to unfold (*SN: 8/12/00, p. 111*). Forces driving those cycles, including those resulting from winds and ocean currents, act continually across Earth's surface and often are about a thousand times larger than those generated during the Chilean quake.

Article C

Earth knocked for a loop Chilean quake sped up Earth's rotation, tipped planet's axis

By [Sid Perkins](#)

Science News Web edition : Wednesday, March 3rd, 2010

The magnitude 8.8 quake that slammed central Chile February 27 knocked the entire planet for a loop — literally. The sudden, large-scale movement of tectonic plates that triggered the quake shifted immense masses of rock a few meters closer to Earth's core, tilting the planet's axis a few centimeters and imperceptibly shortening the day, analyses indicate.

Disaster struck just after 3:34 a.m. local time, when seismic stresses that had been building for decades, if not centuries, let loose. Rocks along the interface between two tectonic plates slipped past each other a distance of seven to 11 meters, says Jian Lin, a geophysicist at the Woods Hole Oceanographic Institution in Massachusetts.

Those pieces of Earth's crust — the South American plate and the Nazca plate, a continent-sized slab of seafloor that lies just west of South America — are colliding at an average speed of about 8 centimeters per year. "This is one of the fastest plate convergence rates on Earth," Lin notes. Rather than moving steadily, the plates can remain locked in place for long intervals and then slide past each other in quick bursts.

The early-morning temblor, which involved slippage along a 400-kilometer stretch of the tectonic interface, is among the strongest ever recorded: Only four quakes since 1900 — including the largest on record, a magnitude 9.5 shock that shook southern Chile in May 1960 — have been larger, Lin says.

"The new quake picked up where the 1960 rupture ended," he notes.

The death toll from the February 27 quake stands at 799, Chile's National Emergency Office reported March 3. That tally is still climbing but won't rise to anywhere near the 200,000-plus death toll of the magnitude 7.0 quake that struck Haiti on January 12. This dramatic difference probably stems from several factors, Lin speculates.

First, even though the Chilean temblor released about 500 times more energy than the Haitian quake, it originated deeper within the Earth and farther from densely inhabited regions. And Chile's long experience with large quakes and the strong, well-enforced building codes that have been developed as a result also saved lives, Lin says. "The contrasts between the aftermaths of these quakes remind us, once again, that 'earthquakes do not kill people, buildings do,'" he notes.

In a mere six days, the Chile quake has spawned more than 180 aftershocks, including seven above magnitude 6.0. One aftershock, a magnitude 6.9 quake centered about 125 kilometers off the Chilean coast, was almost as large as the Haiti quake of January 12.

The movement of tectonic plates in Chile February 27 has triggered glitches in Earth's rotation, a new analysis suggests. Sudden subduction of the Nazca plate carried large amounts of mass closer to the center of the Earth — which, conceptually but on a vastly different scale, works like spinning skaters bringing their arms closer to their bodies, says Richard Gross, a geophysicist at NASA's Jet Propulsion Laboratory in Pasadena, Calif. As a result, Earth's day is now about 1.26 microseconds shorter than it was before the massive quake, Gross estimates.

And because the quake's shift in mass occurred deep in the Southern Hemisphere, Earth was slightly tipped off balance — a result similar to a spinning skater bringing in one arm but not the other. The planet's "figure axis," the line about which the Earth is balanced, shifted about 8 centimeters, Gross notes.

Earth's axis is constantly wobbling at various frequencies, with some oscillations measuring several meters and taking months to unfold (*SN: 8/12/00, p. 111*). Forces driving those cycles, including those resulting from winds and ocean currents, act continually across Earth's surface and often are about a thousand times larger than those generated during the Chilean quake.