

A red banner advertisement for Toyota. On the left, a white box contains the text "#1 FOR A REASON". In the center is a white Toyota pickup truck. To the right of the truck is a red button with the text "See local offers" and a right-pointing arrow. Below the truck, it says "Options shown.". On the far right is the Toyota logo with the text "TOYOTA moving forward" and "See details". A "Replay" icon is in the top right corner.[Back to Article](#)[Click to Print](#)

Friday, Mar. 18, 2011

Japan's Earthquake Warning System Explained

By Lucy Birmingham / Tokyo

Just after 2:46 p.m. on Friday, March 11, an earthquake warning buzzed on the cell phone belonging to Professor Kensuke Watanabe. He knew it was time for everyone in his class to bolt under their desks. The university building in Sendai, the biggest city hit by the quake and subsequent tsunami, began to shake violently. But Watanabe and his students, with that small warning, were able to use the sturdy desks as protection against falling objects. Shortly after, they fled the building for open ground. None in the group was hurt by Japan's worst earthquake on record. "It was terrifying," says Watanabe, "but the mobile warning really helped."

Japan has the most advanced earthquake early-warning system in the world. A nationwide online system launched in 2007, it detects tremors, calculates an earthquake's epicenter and sends out brief warnings from its 1,000-plus seismographs scattered throughout the country, one of the most earthquake-prone nations on the planet. ([See TIME's exclusive pictures of the devastation in Japan.](#))

How does it work? "First you need to know about P-waves and S-waves," says Satoko Oki of the University of Tokyo's Earthquake Research Institute. The plucky 30-something seismologist cuts a rare figure among her male colleagues. Since the March 11 magnitude-9.0 earthquake and tsunami devastation in Japan's northeast, Oki has been responding to public concern and media interest as an in-demand specialist and spokesperson on earthquakes.

"Here, let me show you this pamphlet that we use to teach elementary schoolchildren," she says. I read wide-eyed as the cartoon characters — a little green *P* and a big pink *S* — show me the powerful science behind quakes. P-waves are the first evidence of a quake (*P* is for *primary*), and have fast, short wavelengths and do little damage. These are followed usually several seconds later by the destructive S-waves (*S* is for *secondary*) with longer wavelengths. These snakelike seismic waves, feared as earth dragons in ancient China and Japan, are the gut-wrenching movements that crush buildings and create landslides. "The good news is that P-waves always come before S-waves so you can prepare yourself," says Oki. "All Japanese are taught to sense the difference

when they experience a quake." It's clear this is not just nationally endorsed education, but a means for survival. ([See pictures of Japan's devastation.](#))

While the system is run by the National Research Institute for Earth Science and Disaster Prevention, the Japan Meteorological Agency sends out the earthquake warnings. There are also private early-warning systems at offices and factories. Japan Railways, a nationwide railway network, launched its own large-scale system about 20 years ago when the superfast Nozomi bullet train was introduced.

Last Friday's historic earthquake struck off Japan's northeast coast at 2:46:45 local time. It took just seconds for a seismometer located on land, closest to the epicenter, to detect enough signals to determine an alert was necessary. The alert was automatically issued at 2:46:48 via locations such as factories, schools, TV networks, radio stations and mobile phones. Professor Watanabe's cell phone buzzed seconds later thanks to a technology called the Area Mail Disaster Information Service. ([See how Japan became a leader in disaster preparation.](#))

Damaging S-waves travel at about 2½ miles (4 km) per second. So they would have seriously rattled his university building in Sendai in about 32 seconds at 2:47:17. The city of 1 million is located 80 miles (130 km) to the west of the epicenter. The S-waves would have reached Tokyo, 230 miles (370 km) to the south, in about 90 seconds.

Although the systems can only give warnings from seconds to one or two minutes before the powerful S-waves hit and shaking gets serious, it can mean the difference between life and death. It can be just enough time to take cover, drive a car to the side of the road, step back from getting on an elevator or stop medical surgery. ([Read "How Prepared Are Countries for a Tsunami?"](#))

Tsunami warnings take longer because more calculations are involved. A regional tsunami warning was made nine minutes after the March 11 quake struck. In the areas hardest hit by the tsunami, residents probably had only about 15 minutes of warning.

Japan has learned much from its great earthquakes. Many lives were saved last Friday because of the combination of stricter building codes and early-warning systems. The deadliest earthquake in Japan so far is the Sept. 1, 1923, Great Kanto Earthquake that killed 100,000 to 140,000 people. In commemoration, every Sept. 1 is Disaster Prevention Day as a reminder of the importance of earthquake preparation. On that day, schools, fire stations and public and private facilities practice earthquake and fire drills, with great earnestness. ([Comment on this story.](#))

When my children were small, I would pick them up every Sept. 1 at their elementary school as part of the drills. It was always an impressive sight — all the children lined up neatly in tight rows, wearing the padded protective headwear called *bosai zukkin*, normally used as their desk

seat cushions. I have always prayed that if a great earthquake would strike, my children would be safe. Fortunately, last Friday they were all unhurt. One spent the night safely at her high school with about 1,000 other students and teachers. But my heart goes out to those in the northeast. Surely the nationwide earthquake early-warning system has helped to lessen this unimaginable tragedy.

[See TIME's complete coverage of the Japan earthquake.](#)

[See the graphic "What Causes a Tsunami?"](#)

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