



A woman cleans up her family's home in Prague, Oklahoma, after an earthquake in 2011.

The EARTHQUAKE State

Why has the number of earthquakes in Oklahoma skyrocketed in recent years?

Just before 7:45 p.m. on November 6 last year, 11-year-old Caden Kennedy was about to practice the trumpet in his home in Cushing, Oklahoma. Suddenly, he was interrupted by a loud noise.

"It sounded like a big rumble," the fifth-grader says.

Words to Know

extracted (ek-STRAK-tihd) *verb, past tense.* removed or pulled out

dispose (dihs-POHZ) *verb.* to get rid of; throw away

The next thing Caden knew, the floor started to shake. The lights went out, and pictures fell off the walls. Caden knew what was happening: It was an earthquake! He and his family quickly fled from their home.

"When we got outside, everyone was panicking, like, 'What do we do?'" says Caden.

Fortunately, nobody was killed in that quake, and only a few people suffered minor injuries. But several buildings were

damaged, and schools were closed the next day so officials could check that they were safe. Caden and his family had to stay with a friend in another town for five days while they waited for their home to be inspected. Luckily, it had only minor damage, like cracks in the walls.

For Caden and many Oklahomans, earthquakes have become an all-too-common occurrence. Scientists measure the strength of an earthquake by

COVER ILLUSTRATION BY PETER/JESE ZAMANN; PAGE 4: JIM BECKEL/THE OKLAHOMAN (WRECKED HOME); ISTOCKPHOTO.COM/GETTY IMAGES (EARTHQUAKE CRACK)

its magnitude. A quake with a magnitude of 3 or higher is strong enough for most people to feel. In 2016, Oklahoma had more than 600 earthquakes with a magnitude of 3 or greater. The one that struck Cushing on November 6 was a magnitude 5. (The strongest quakes measure 9 or higher, but they are very rare.)

Oklahoma wasn't always quake country. For decades, the state averaged fewer than two earthquakes with a magnitude of 3 or greater each year. But in the past few years, that number has soared. What's causing all these earthquakes?

Human-Made Quakes

For as long as scientists have been recording earthquakes, Alaska has had the most of any state, followed by California. These states are located near the edges of tectonic plates (*see map*). These plates are massive, slow-moving slabs of Earth's crust that float on top of hot liquid rock. Most earthquakes occur when plates slide past each other, push together, or pull apart from each other.

But Oklahoma isn't near the edges of major plates. Scientists say the increase in earthquakes there likely has to do with drilling for oil and natural gas. In the past decade, Oklahoma's production of oil and natural gas has skyrocketed. Companies drill deep underground for oil and gas, which is often mixed with water and chemicals. Once the liquid is **extracted** from the ground, the water must be separated from the oil and gas. The problem is, this water isn't safe to use.

"It's very salty water and also has some bad chemicals in it, so

Plate Positions

This map shows the major tectonic plates near the western coasts of the United States.



Source: U.S. Geological Survey

you can't **dispose** of it very easily," says scientist Jeremy Boak. He's the director of the Oklahoma Geological Survey, the group that studies earthquakes in the state.

To get rid of that water, oil and gas companies dig deep wells to pump it back into the earth. Scientists say that's probably causing the earthquakes (*see "Triggering Earthquakes"*).

A Shaky Future?

None of Oklahoma's quakes have been deadly, but many people in the state are worried. The Oklahoma Corporation Commission oversees the state's oil and gas drilling. Last May, it responded to concerns about an increase in quakes by placing new limits on the amount of wastewater that companies can pump into the ground. So far, that change seems to be helping. Last year, the number of quakes dropped from a record high of 907 in 2015.

Meanwhile, many Oklahomans are getting used to living with earthquakes. Lisa Favalora, Caden's teacher at Cushing Middle School, remembers feeling her first one.

"I thought, 'Oh my goodness, is that an earthquake?,'" she says. "Now we're like, 'Oh well, there was another one.'"

—by Joe Bubar

TRIGGERING EARTHQUAKES

Here's how drilling for oil and natural gas can lead to earthquakes.

