An Egg Survives Better When Dropped on Its Side

Egg-drop challenges are popular science-engagement activities, but they often foster a misconception about the most impact-resistant part of an egg.

By **Michael Schirber**

Can you drop an egg on your kitchen counter without breaking it? If you accept the challenge, you might be tempted to orient the egg with its sharp-end down, as that dome-shaped top may seem to be the most structurally resilient part of the egg. Alas, dropping the egg in this vertical orientation would be a mistake. In a series of messy experiments, researchers have shown that releasing an egg sideways gives it the best chance of surviving a great fall [**1**].

The egg is admired for its surprisingly strong structure, which can withstand loads that are 100 times its own weight. And yet eggs can crack under a sharp tap. Teachers and other educators often use eggs in classroom demonstrations. A currently popular activity is the egg-drop challenge, in which students are tasked to protect a falling egg by covering it with bubble wrap, straws, balloons, or other materials. Tal Cohen, a professor of engineering, has hosted several such events at MIT. "It was kind of mission impossible," she says. "All the eggs would usually break."

If dropped on its side, an egg is less likely to break than if dropped on either end.
Credit: Towfiqu Barbhuiya

However, she noticed a trend in the student discussions, as well as in social media videos from other egg demonstrations. "The universal convention is that the egg should be in the vertical orientation when it hits the ground," she says. But from her experience, there wasn't clear evidence that this orientation gave an advantage.

Cohen and her students decided to put common wisdom to the test. They brought 180 eggs into their lab and dropped them in a controlled setting. Eggs were released from different heights (between 8 and 10 mm) in one of three orientations: sharp-end down, blunt-end down, and on their side. The results showed that sharp-end and blunt-end impacts resulted in cracks roughly at the same rate. However, eggs dropped on their side survived better. At an 8-mm drop height, horizontally oriented eggs cracked only 5% of the time, whereas vertically oriented eggs broke 55% of the time.

To understand why, the team performed static compression tests, in which they slowly squeezed an egg either along its long vertical axis or through its short horizontal axis at the equator. These tests showed that eggs can withstand the same force in both directions, only breaking when the force exceeds about 45 newtons. This per-egg load bearing can explain how a 170-pound (700 newton) person can stand on a crate of two-dozen eggs and not destroy them.

However, there was a difference in how the eggs deformed under compression: The vertically squeezed eggs deformed less than the horizontally squeezed ones. This observation confirmed the common perception that eggs are more rigid along their long axis—helping them distribute a heavy load over the surface. But being rigid is not advantageous during a fall: The more compliant horizontal orientation allows the egg to bend but not break at impact.

So, why do so many people have the wrong intuition? The researchers think that it comes down to terminology: stiffness vs toughness. "Stiffness is the amount of force you need to apply to deform an object, whereas toughness is the energy you can absorb before failure," says MIT's Joseph Bonavia, who worked on the study. He explains the difference by comparing a glass sphere with a rubber ball. The glass sphere is rigid and can support a heavy load but will shatter if it falls on the ground. The rubber ball is squishy but tough and can absorb the energy of an impact. In the case of an egg, the team's data show that the horizontal "tough" direction can absorb 10% to 30% more of the impact energy than the vertical "rigid" direction.

Cohen and her colleagues hope that this study will influence future egg challenges and the explanations that go along with them. "My daughter had an egg-drop challenge this year, and I'm going to share this study with her teacher," Cohen says. She thinks these challenges offer an opportunity for educators to explain the terminology and the physics behind energy absorption, which has important relevance in earthquake mitigation strategies and reusable rocket design.

But after breaking so many eggs, did the team celebrate with a giant omelet or a cake party? Unfortunately, no, Bonavia says. "Once an egg enters a chemically hazardous lab, the university's regulations stipulate that it's no longer food."

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REFERENCES

1. A. Sutanto *et al.*, "Challenging common notions on how eggs break and the role of strength versus toughness," **Commun. Phys. 8, 182 (2025).**