

# Cirque du Soleil's magic based in math

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ATLANTA, Georgia (CNN) -- If you've ever wondered why you learned science or math in school, visit the Canadian circus Cirque du Soleil. There, you'll think flying trapeze artists, acrobats, and contortionists are defying those scientific laws you once learned, when in fact they're making science and math come alive.

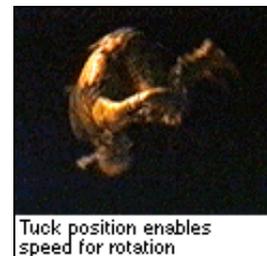


Ron Graham juggling

Scientist Ron Graham says juggling is a form of math. "Juggling, like mathematics, is based on patterns. There's a fundamental pattern here and you can modify the pattern," Graham says.

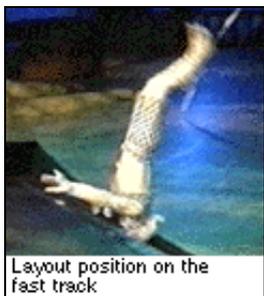
The same tactic is used by acrobats who perform basic patterns, then complicate them to create the element of surprise or danger.

What's tougher to do is a full body somersault. It's called the conservation of angular momentum. That's the long way of saying that the smaller and more compact the acrobats can make their bodies, the faster and easier they move through space.



Tuck position enables speed for rotation

"If you're in a layout position (or straight body), you have more inertia, and it takes more energy to get around," Graham says. "Whereas if you're twisting, that is rotating around the long axis in your body, then you want to be very straight because it's very hard to twist if you're in a ball."



Layout position on the fast track

One of the more difficult maneuvers is when you're somersaulting and twisting at the same time.

The acrobats use what's called a fast track, or a trampoline-like runway. It allows them to gain speed and momentum, which converts into height, and that's where the intricate moves occur.

The acrobat propels himself upward, and the higher he goes, the more time he has to perform those twists and turns. "When you're tumbling along the fast track you have to keep straight, you have to keep in line as well. You don't want to fall over sideways. And that's something you learn also through training," says acrobat Michael Rosenburger.

A somersault naturally propels an acrobat forward. Forcing the body to turn in one place requires flexibility and strength. "It's never been difficult for me. But lots of people say it's hard," says acrobat Danielle Rodenkirchen.

Flying through the air looks easy, but these acrobats are timing their rotations so when they let go, there's someone there to catch them -- or else.

Smaller circles rotate faster than larger circles. To slow down or speed up, the acrobats have to change the size of their bodies as they rotate.

What often goes unnoticed is the sheer strength needed to perform these acrobatic feats.

Two 11-year-old girls from Mongolia have performed with Cirque du Soleil for two years. They are contortionists. Nomin has been training since she was 8, Ulzee since she was 5. "She's more flexible because she started (at) five years old. I think she (was) born with (a) flexible body. Nomin needs practice more than Ulzee, because she started at eight," says the contortionist's coach, Shirnen Otgonjargal.



According to most sports experts, only certain people are born with this type of elasticity in the ligaments. The endless hours of training enhances that flexibility and builds strength. The most difficult move is when Nomin balances 57 pounds on one hand.

"You'll notice when she's doing handstands with her hands are on the floor the hands are bent, because you have more strength that way," Graham says.

But what happens to their internal organs during these pretzel-like moves? "The rib cage will protect their lungs and their heart; the abdominal cavity will get moved around quite a bit by what they do. But the contents of the abdominal cavity are soft and flexible and they would accommodate that without causing any problems," says orthopedic surgeon Dr. Carl Fackler.

Odds are the body becomes less elastic with age, so doing these moves when Ulzee and Nomin are 30 is a long shot. But for now, they, along with the other artists at Cirque du Soleil, rely on those laws of nature to amuse and entertain as long as they can.