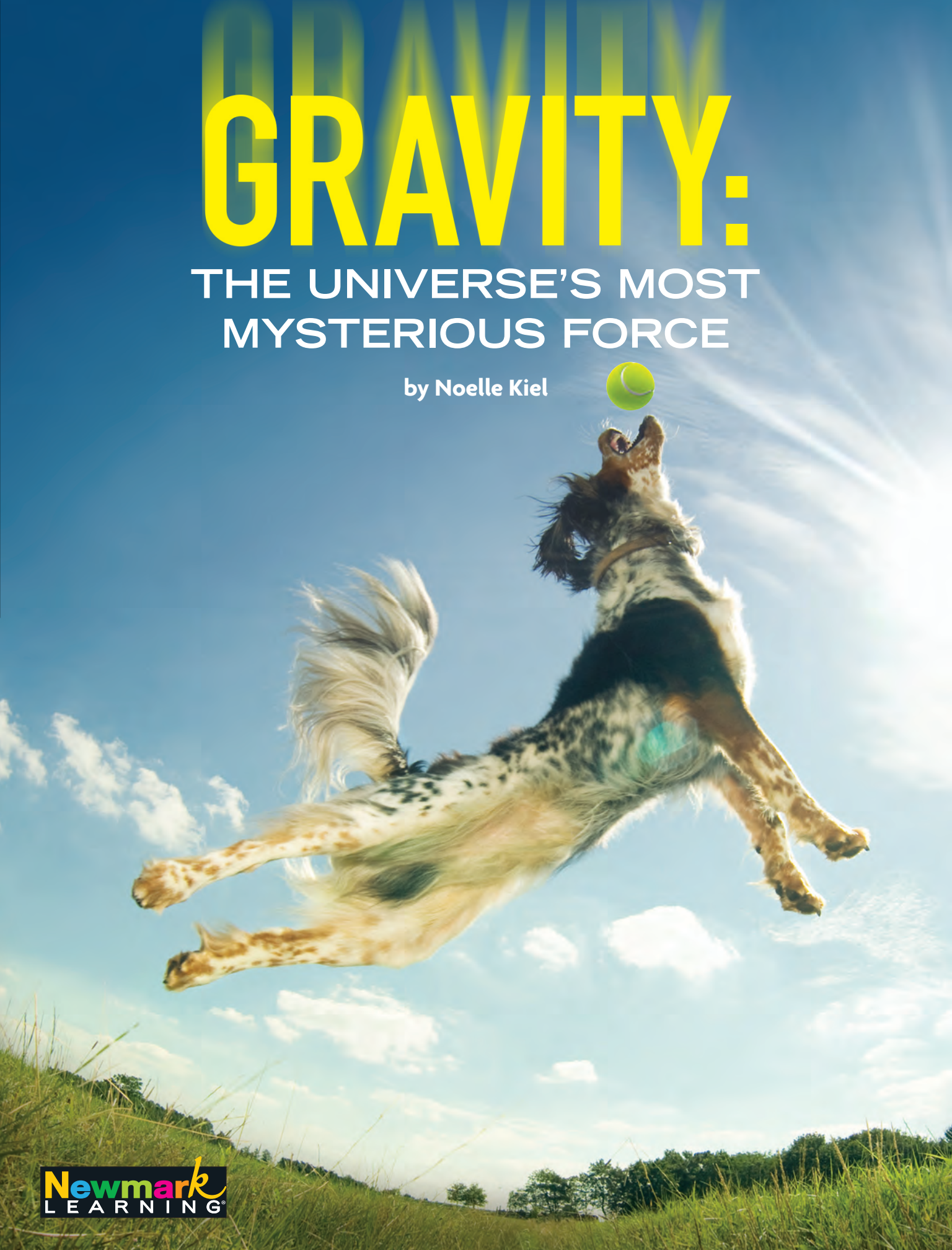
GRAVITY:

THE UNIVERSE'S MOST MYSTERIOUS FORCE

by Noelle Kiel



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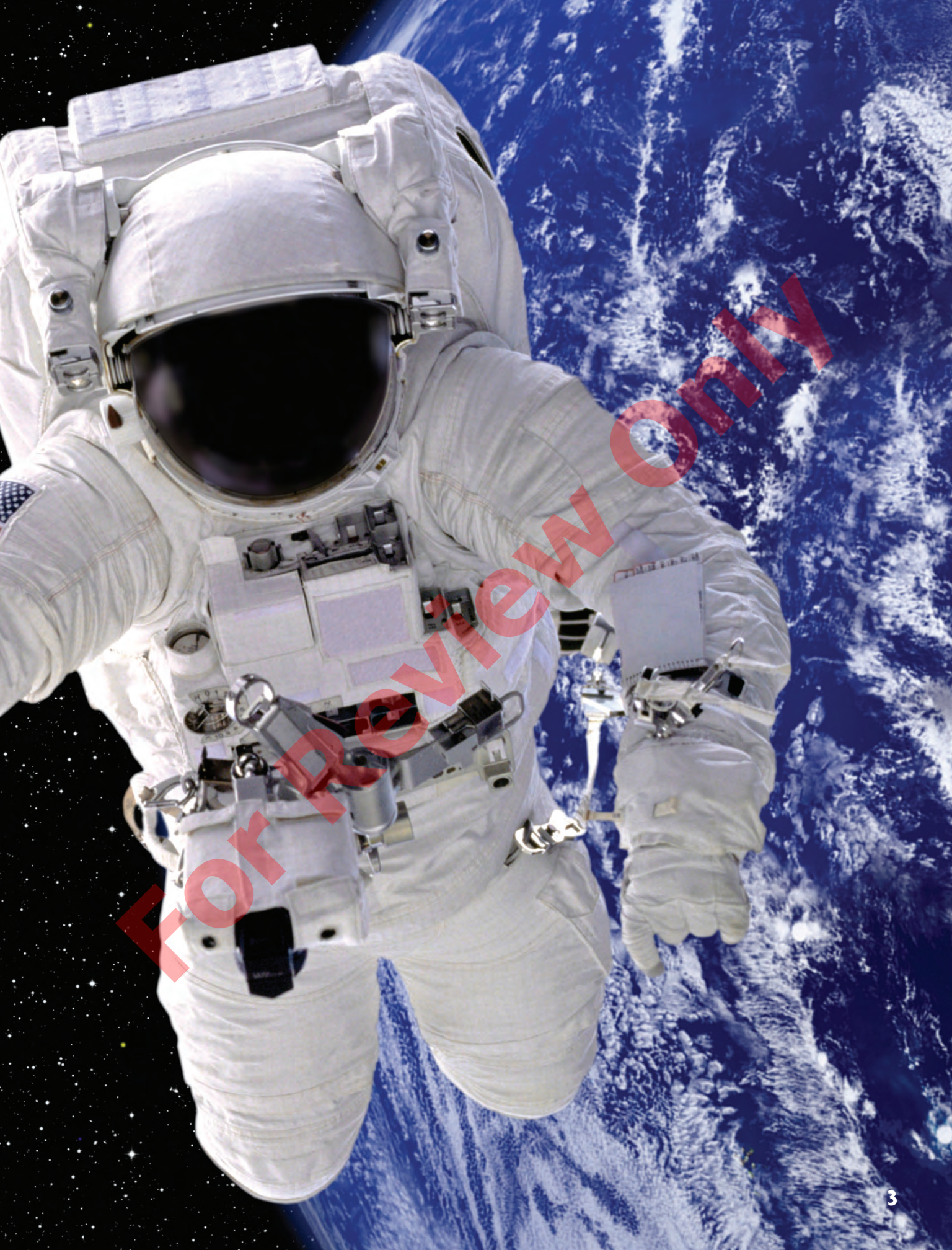

WHAT GOES UP MUST COME DOWN

What goes up must come down. People use this expression all the time without stopping to think about how true it is. What goes up into the air does, in fact, come back down again—because of gravity.

Gravity is the mysterious force that makes everything fall down toward Earth. Scientists at the California Institute of Technology define gravity as "a force which tries to pull two objects toward each other." It's the force of attraction between any two objects.

Earth's gravity, for example, pulls everything and everyone on the planet toward the surface. On Earth, gravity is the reason tennis balls drop back onto the court after being hit, and raindrops fall down from the sky instead of up.

ALMOST EVERYTHING HAS GRAVITY

Anything that has mass, or weight, also has gravitational pull. People have gravitational pull. So do tennis balls. However, the more mass an object has, the stronger its gravitational pull. Because Earth has so much more mass than people—or tennis balls—its gravitational pull is incredibly strong. So on Earth, almost everything that goes up must come back down, pulled toward the planet.

Besides mass, gravitational pull is also affected by distance. The closer two objects are, the stronger the gravitational attraction. That's why objects on or near Earth are subject to Earth's gravitational pull and not the gravitational pull of the planet Jupiter, for example. Jupiter might be bigger than Earth, but it's also farther away from objects on or near Earth.

GRAVITATIONAL FORCE

"Down" is the word used to describe the direction of gravitational pull.

THE MYSTERY OF GRAVITY

Gravity has been described and measured for hundreds of years. It's a fundamental force that helps shape the universe. However, gravity is also something of a mystery.

The mysterious nature of gravity is not obvious, because people have a natural understanding of how gravity works. Its effects are easily seen and felt. No one expects to jump off a ledge and fall up, or to hit a baseball that never comes down. Humans instinctively understand how gravity works because they see its power every day.

For scientists, too, how gravity works is observable and measurable. But despite this, gravity remains an enigma, or puzzle. Scientists don't truly understand what causes it. And they are still trying to figure out why it works.

Here's what physicist Neil deGrasse Tyson said in an answer to the question: *What is gravity?*

"We can describe gravity, we can say what it does to other things. We can measure it, we can predict with it… but when you start asking what it is? I don't know."

Physicists like Neil deGrasse Tyson study gravity and its effects on the universe.

GRAVITY, WEIGHT, AND HEIGHT

Gravity is what causes objects to have weight. When people step on a scale to weigh themselves, what they are really measuring is the force of gravity between themselves and Earth.

And thanks to gravity, people are also slightly shorter when they go to bed at night than they are when they wake up in the morning. According to the National Aeronautics and Space Administration (NASA), people can be up to 2 centimeters (0.8 inches) taller in the morning. As the day passes, the downward tug of Earth's gravity compresses people's spines, shrinking them.

GRAVITY AND FALLING OBJECTS

Gravity has the same effect on objects no matter where they are in the universe. Gravity makes all objects, even those of different weights, fall at the same speed. Galileo Galilei, an Italian scientist from the 1500s, was the first to observe and describe this fact.

According to the book *Cosmic Discoveries: The Wonders of Astronomy,* Galileo likely made his discovery while watching a hailstorm. He noticed that larger, heavier pieces of hail didn't fall to the ground any faster than smaller, lighter pieces. They fell at the same rate of speed. From this observation, Galileo concluded the existence of a force that pulled objects to the ground at the same rate regardless of their size or weight.

Before Galileo, people believed that larger, heavier objects fell at a faster rate. According to this belief, if someone were to drop a bowling ball and a basketball at the same time, without any outside forces acting on them, the heavier, larger bowling ball would fall faster and hit the ground sooner.

Galileo disproved this belief through his experiments. Any two objects, no matter how big or heavy, will fall at the same rate, unless something else affects their fall. When gravity is the only force affecting a falling object, the object is said to be free-falling. All objects free-fall at the exact same rate—9.8 meters (32 feet) per second.

>> FROM THE SOURCE

One of the most famous tests of Galileo's discovery was conducted on the moon in 1971. While being filmed for live TV, David Scott, the commander of the Apollo 15 moon mission, dropped a hammer and a feather at the same time. Because the moon has no air to affect how things fall, the hammer and the feather free-fell. They reached the ground at the same time. Here's what Scott said as he conducted the experiment:

"...In my left hand, a feather. In my right hand, a hammer. And I guess one of the reasons we got here today is because of a gentleman named Galileo a long time ago, who made a rather significant discovery about falling objects and gravity fields. And we thought, where would be a better place to confirm his findings than on the moon? And so we thought we'd try it here for you. How 'bout that? Mr. Galileo was correct in his findings."

— *Commander David Scott*

▲ Galileo Galilei