The Power of a Curved Line Known as Gravity

Since ancient times, many people have theorized why things fell toward the Earth. The ancient Greeks, Newton and Einstein have all dramatically expanded our understanding. Even today, it is still a subject of debate as new experiments may shed light on a topic that is as old as the universe itself. Gravity is usually described as an attractive force. But, that force is actually a by-product of the power in a curved line.

Ancient geometers were aware of curved line effects but, the significance of this concept wasn't attached to gravity until the time of Einstein. The writings of Aristotle stated that all things fell to Earth because everything was made of earthly substances and they were attracted to their natural home. Galileo substantiated this claim by stating that the center point of a pendulum's swing always pointed toward the Earth, which provided its source of attraction.

Newton also subscribed to this view of attraction, but he expanded it in significant ways. He is credited with giving the affects of gravity a mathematical foundation and directly associating gravity with the mass of an object. For example, an apple has mass. So does the Earth. Since the planet is bigger than the apple, it has more mass and thus, more attraction or gravity. So, an apple falls toward the ground because the Earth's attractive force is the larger. He applied this idea on a cosmological scale to account for why the planets in our solar system orbited the sun and why moons orbited planets. Because of Newton's combined knowledge in ancient geometry, alchemy and the use of Calculus to determine acceleration along a curved line, it is amazing that he did not relate this concept to gravity. But, eventually, someone did.

Einstein's first paper was found to be a special case over a limited range of circumstances, hence its common name of Special Relativity. It did not take into account the affects of gravity. He then developed a more general theory which did. It took him a decade to complete and it revolutionized the model we use to understand what gravity is and how it works.

Einstein stated that mass was not necessarily attractive, it simply bent or curved the space around it and that curve provided the means to move one body toward another. In Special Relativity he showed that spacetime is actually a fabric. In General Relativity he showed how it is bent or deformed by mass.

An easy way to imagine this process is to picture a bowling ball, which represents a planet, at the center of a trampoline, which represents the fabric of spacetime. Since the ball has mass, or weight, it curves the surface of the trampoline a great deal near the center and only a little at the edge. If we set a golf ball near the edge, it has very little mass, so it doesn't bend the surface very much. If we give the golf ball a little push around the edge, it will circle in a spiral that draws ever closer to the bowling ball.

Here's the key point Einstein made. The golf ball is merely following a path determined by the curve of the trampoline. The bowling ball is not actively exerting an attractive force. As the golf ball nears the center, the curve is greater hence, the force is greater and it "falls" even faster toward the bowling ball. Einstein showed that the acceleration that one massive object "feels" when it approaches another is what constitutes gravity. In other words, acceleration and gravity are the same phenomenon. Gravity then, is an effect or by-product of the bending of space.

It is unfortunate that most dictionaries and text books still describe gravity as an attractive force, which is often misunderstood to be akin to other types of attractive forces such as magnetism. This concept is misleading in that it attributes the force to the massive body, not to the curve.

There are several reasons to update this notion of attraction. You are not kept on the face of the Earth because it is pulling you down. You stay in place because space is pushing down on you. The moon has less mass than the Earth therefore it curves the space around it less. So, you weigh less on the moon simply because space is pushing on you less there. Einstein's model also shows how everything in the universe is connected to, and affected by, everything else in the universe.

There is no way to over-emphasize the importance of understanding the nature of gravity to our future knowledge of how the universe came to be, what it is, and how everything in it works. Gravity is, by far, the weakest of the four known forces. This disparity is the monkey wrench that keeps physicists from being able to generate a Grand Unified Theory. It is hoped that experiments at the new Large Hadron Collider will help identify why the forces aren't equal and whether gravity could be leaking out of our universe into others, as suggested by Lisa Randall, Professor of theoretical physics at Harvard University.

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