An Hour With Acceleration

In the early days of the Mercury missions, men climbed atop the Redstone rocket, and blasted into space at horrific force. But what really is force?

When we push against a wall, and it doesn't fall down, we are exerting the same force as it exerts back. According to Sir Issac Newton's First Law of Motion, "Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it."

In everyday experience , we all know that a basketball resting on a table, sitting perfectly still, will not begin to roll until we give a gentle push. And then it will roll according to how much force we have applied. If we punch it, we risk abrading our knuckles, but more importantly, we impart a greater force with greater acceleration from our hand, and thence to the ball.

To understand where the ball will go, we must examine Newton's Second law of Motion. It says, "The relationship between an object's mass, **m**, its acceleration, ***a*,** and the force applied, ***F*,** is ***F=ma*.** Newton tells us that the ball will shriek off faster with more applied force, but he also gives us hints about where it's heading.

As the ball tips off the edge of our table, the ever-present force of gravity, now unrestrained by the table, begins to pull our ball towards the center of the earth. If our table were perched on the edge of a cliff, our basketball would begin some serious acceleration as it hurled downward. But how fast would it be going after one second, or three. And far would it have traveled?

To determine this, we turn to the formula $h = 1/2at^2$. This means height, or distance traveled downward, is equal to one half of the acceleration due to gravity squared. And that squared part is where all the action is!

In the first second, if we ignore the small countering force of air resistance, our ball will have fallen 16 feet. But in the next second, it falls a total of 64 feet. At the end of the third, it has fallen 144 feet! During the next three seconds, it has tumbled 256, 400, and 576 feet.

To determine how fast our basketball is actually traveling, we use the simple formula $V = d/t$, or velocity equals distance traveled per unit of time (in this example a second). After 6 seconds, the ball is moving at 96 feet per second, or about 66 miles per hour, which is above the speed limit in most places.

Now back to the Mercury missions of the early 1960s. Those fearless men blasted off from Cape Canaveral at 6 Gs, or about 192 ft/s^2. If you weigh 150 pounds on Earth at normal gravity, you would feel like you weighed 900 pounds under that acceleration. Your arm alone would seem to weight something like 120 pounds!

The next time you push a basketball up to the hoop, thank Sir Issac Newton.