



Space 101: Orbits

"Gravity. It's not just a good idea; it's the law!"

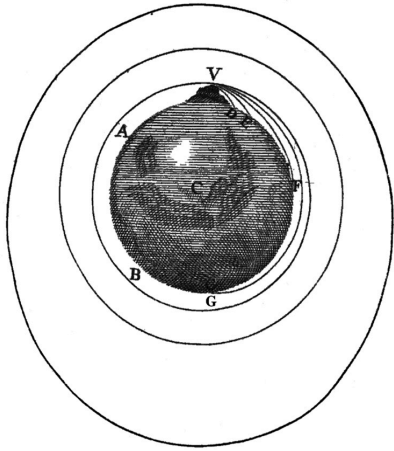
- Adam Savage

A Long, Long time ago ...

Sir Isaac Newton is best remembered for getting hit with an apple and thereby 'discovering' gravity. For this, he is admired. Possibly his second-most remembered achievement was discovering Calculus. For this, he is less-well liked (particularly by liberal arts majors compelled to take the subject in high school by their tiger-mother because it was supposed to advance a future career in Accounting. *Sigh*. Moms. They're kinda great.) But, unless you bucked your family legacy and went into rocket surgery, you probably never put Gravity and Calculus together. Those two concepts lead you to Orbital Mechanics. And that is beyond the scope of this 1(ish) page primer. What IS in scope is simply the *concept* of an orbit.

Newton's Cannon (Analogy)

from Newton's thought experiment on Orbits



Google "orbit cannon analogy," you'll find a plethora of images, and they're all a variation of Sir Isaac Newton's diagram originally published nearly 300 years ago.

I know of no better explanation than this. The language is a bit weird (a lot of "for suth" and such, kind of like Shakespeare would teach a science class, but less poetic). So let's break it down. You have a cannon, or you can throw a ball really hard, and you're standing on this hilltop (Point 'V' in the diagram). You fire horizontally and the ball / projectile / apple goes a certain distance and is pulled to the ground by gravity. Basically.

Figure 1: The Principia - The System of the World, 2nd ed p.6

You fire again. Harder this time. And you get to point 'E'. Harder still and you get to point 'F'. Frustrated as hell that you haven't left Earth's gravity well, you strap a rocket to that projectile apple. This time the apple is traveling so fast that it is traveling faster horizontally than gravity can pull it to the ground, AS THE GROUND CONTINUES TO SLOPE AWAY! Well, ALMOST. You make it to Point 'G'. But now you get the concept and you've almost tasted victory, so you strap a bigger rocket to your First Orbital Apple Projectile and send it again. The FOAP is traveling so fast that even as it falls towards the earth (from Gravity) its distance traveled "down" is less than the curvature of the earth, so it continues to "fall" and 'miss' the earth. And, because the atmosphere is so thin (minimal friction), your FOAP doesn't slow down. It keeps falling, missing, falling, missing in perpetuity. Congratulations, your FOAP is now in ORBIT!

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