Orbits

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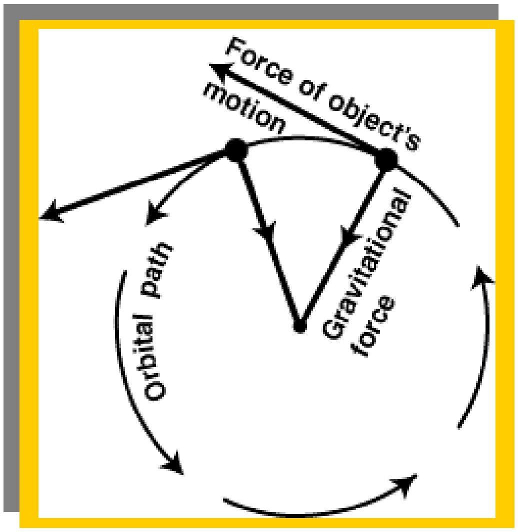
Hold a bucket of sand at arm's length, and you will feel a downward force on it from gravity. All masses have gravitational force. Large masses, like the Earth, have enough gravity to pull other masses toward them.



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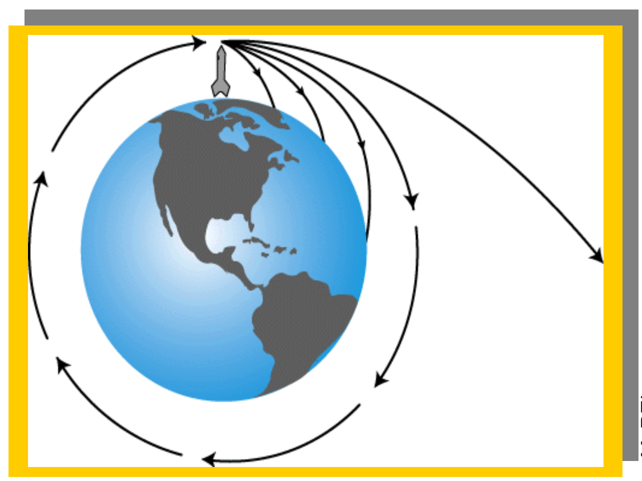
Now tie a rope to the handle of the bucket that you are still holding and swing it around in a big circle. The bucket is pulling out on the rope, and you must pull in to counteract it. If you suddenly let go, the bucket wouldn't travel in a circle any more, but would fly in a straight line in the direction it was going at the moment you released it. Also, the faster you swing the bucket around, the harder it pulls on your rope (and the harder you must pull back). Masses moving in a circle need an inward force directed toward the center to balance the force of their own motion. This pulling inward is called a centripetal force. The faster the motion, the stronger the balancing force needed.

What would happen if you shot that bucket past the Earth? The Earth's gravity takes the place of the rope to pull in on the bucket, making it curve around. If the bucket were traveling too slowly, then the Earth's gravity would win. The path of the bucket would curve in toward the surface until it hit (it would fall to Earth). If the bucket were traveling too fast, then the force of its own movement would win, as if the rope weren't strong enough. The bucket's path would only be curved a little, and it would continue flying in a somewhat different direction.

If the speed were just right, the bucket would be pulled around just enough so that it could never get away, yet never hit the ground. The two forces would be balanced and the curve of the bucket's path would go all the way around the Earth. This is an orbit, a balance between the bucket's movement in a straight line due to its speed and the pull of the Earth's gravity. In fact, the bucket is constantly falling; it just never hits the ground.



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Results of Different Launch Velocities

A common misconception is that astronauts orbiting the Earth, floating in their spaceship, experience no gravity above the atmosphere. This may be true for a spaceship far from the Earth, like one on its way to Mars. But even then, as the strength of the Earth's gravity may be small that far away, gravitational force technically has infinite range. For astronauts on a space shuttle or a space station, gravity is nearly the same as on Earth. The difference is that they are in free fall: they are in orbit inside an orbiting spaceship.