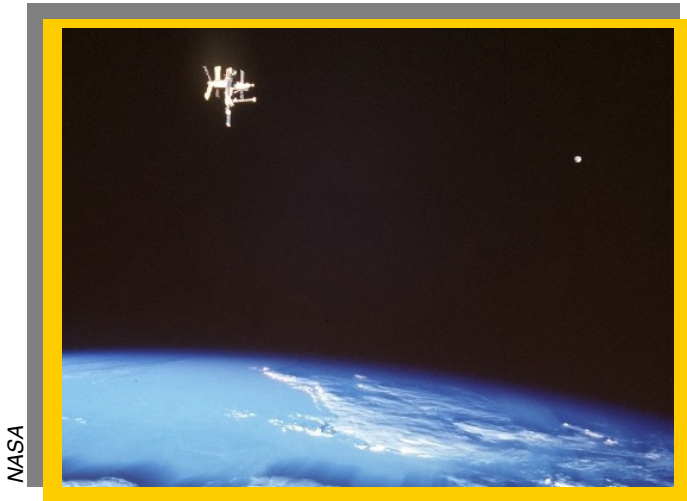


Satellites in Orbit

By Christopher Boozer

Astrophysical and Planetary Sciences Department, University of Colorado, Boulder

An object in orbital motion is moving on a roughly circular path around an object or an imaginary point. Some spacecraft and the moon are considered satellites because they orbit the Earth. An object moving near the Earth is not necessarily in orbit. It could be moving straight down (falling) toward the Earth's surface. Only if it is moving in the correct direction and with just the right speed will it be considered to be orbiting.



Mir and Moon, Earth's two largest satellites

To achieve orbit, a spacecraft must overcome the force of Earth's gravity, which tends to pull it back to the surface. There must be a balance between the force of movement of the spacecraft and the force of gravity. The spacecraft must be going fast enough to create this balance: a speed called orbital velocity.

The force of the Earth's gravity gets weaker as the spacecraft moves farther away from the surface. What does that mean to the orbital balance of forces? As an object moves away from the Earth, it must move more slowly to be in a stable orbit. For example, the moon is in orbit around the Earth. It is also fairly far away (on average 384,390 kilometers, or 238,606 miles), so it slowly circles around us. It takes

one month to go all the way around. In fact, that's what a month means — simply restated, a "moonth." Man-made satellites, on the other hand, often stay pretty close to Earth (just a few hundred kilometers up). On a clear night, you may see them crossing the sky. Look for a bright dot, like a medium-bright star. Many satellites orbit straight east-to-west, or straight north-to-south. They zip across your field of view in just a few minutes. Many satellites make a full orbit in less than two or three hours. Why do they move so fast? Their orbit is closer than the moon's.

If the speed of the orbit depends on the size of the orbit (the distance from the Earth) and the orbital period (how long it takes to go all the way around), then could you find an orbit that had any particular period you wanted? Within reason, yes. Could an orbit have a period of exactly one day? It takes exactly one day for a spot on the ground (like you, for instance) to turn once around the Earth's axis as the Earth spins. A satellite in a one-day orbit could go around in synch with a spot on the ground. That's called a geo-synchronous orbit. A satellite in geo-synchronous orbit is one at just that precise altitude that creates a 24-hour period, so it appears to stay in the same part of the sky all the time. It turns out that it takes a pretty high orbit (around 36,000 kilometers, or 22,000 miles), but sometimes it is still a useful spot to put a satellite.