fact sheet

Satellites

image: NOAA - http://www.noaanews.noaa.gov/stories2008/20080122_npoess.html

Natural satellites

Natural satellites are celestial bodies that orbit a planet or other body. They include planets orbiting a star, small galaxies orbiting a major galaxy, and moons orbiting a planet (Io, pictured right, orbits Jupiter).

The Solar System has about 240 moons, including 166 that orbit the eight planets, four that orbit dwarf planets, and many more that orbit small bodies.

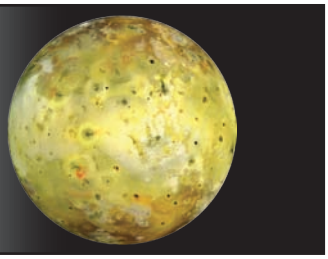


image: NASA - http://photojournal.jpl.nasa.gov/catalog/PIA02308

Artificial satellites

The world's first artificial satellite, Sputnik 1, was launched by the USSR in 1957. It signalled the start of the 'space race' between the USSR and USA.

By 2007, almost 2500 artificial satellites were in Earth orbit. Of these, about 540 are still fully functional. The rest are no longer operational for reasons that include:

- running out of fuel needed to keep them in their orbit and to maintain correct orientation to the Sun and Earth,
- computer or mechanical malfunction, and
- damage by radiation and or space dust.

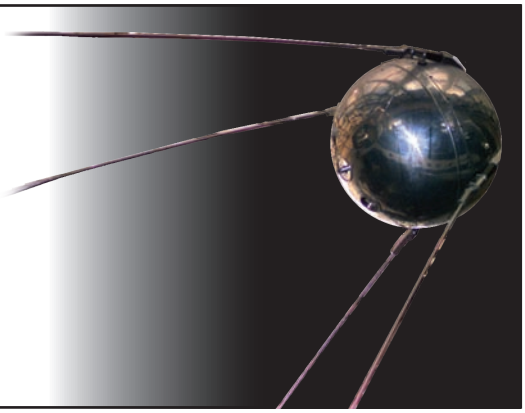
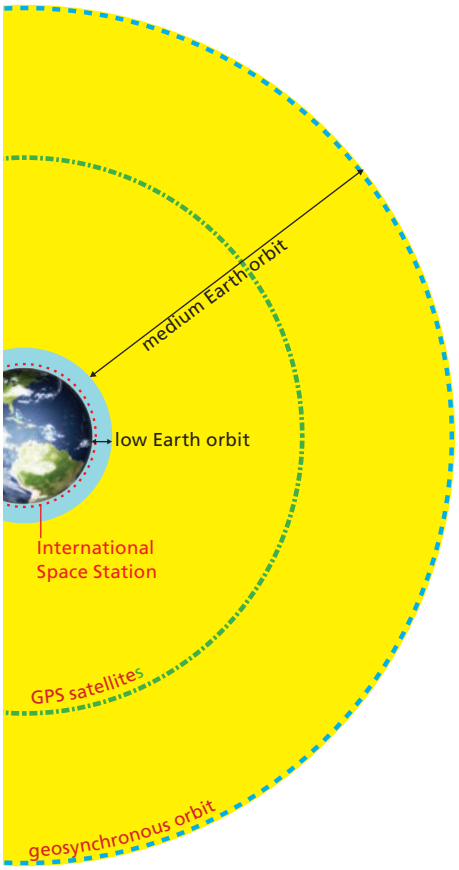


image: NASA - http://en.wikipedia.org/wiki/File:Sputnik_asm.jpg



Classifying satellite orbits

Satellite orbits are classified by their altitudes:

altitude classification	description
low Earth orbit (LEO)	altitudes of less than 2000 km
medium Earth orbit (MEO)	altitudes between 2000 km and 36 000 km, typically around 10 000 km
geosynchronous orbit (GEO)	altitude of 35 786 km in which the orbital period matches Earth's rotational period (a sidereal day = 23 h, 56 m, 4.09 s)
geostationary orbit (GSO)	a special geosynchronous orbit where the satellite is always positioned directly above the same point on the equator
high Earth orbit (HEO)	usually elliptical orbits at altitudes greater than 36 000 km

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All satellites orbit around centres of mass:

- Galactocentric satellites orbit about the centre of a galaxy, eg the Solar System.
- Heliocentric satellites orbit around the Sun, eg the planets.
- Geocentric satellites orbit around Earth, eg the Moon and artificial satellites. Geocentric orbits are further defined by:
  - shape — usually circular or elliptical,
  - altitude — constant for circular orbits but constantly changing in elliptical orbits, and
  - inclination — the angle between the orbital plane and Earth's equatorial plane.

Inclined orbits

orbit	inclination	description
polar	equal or close to 90°	These orbits pass above, or close to, the north and south poles on each revolution. Polar orbits typically have an altitude of 700-800 km and an orbital period of 90-100 minutes.
polar sun-synchronous	close to 90°	These almost-polar orbits pass over the equator at the same local time on each revolution.
inclined	between 0° and 90°	These orbits are inclined to the equatorial plane – for example, GPS satellites orbits are inclined at 55° to the equatorial plane

Most Earth-orbiting satellites are in geostationary or polar orbits.

Special orbits

orbit	description
prograde	These are orbits in which the satellite travels in the same direction as a planet's rotation. Satellites are usually launched in prograde orbits to save energy.
retrograde	These are orbits in which the satellite travels in the opposite direction to a planet's rotation. Retrograde orbits require large amounts of additional fuel to overcome the effects of the planet's rotation on the rocket's launch.
graveyard	Graveyard orbits are a few hundred kilometres above the geosynchronous orbit (35 786 km). Satellites can be moved to these orbits at the end of their useful life.

Powering satellites

Most Earth-orbiting satellites generate their operating power from photovoltaic cells.

Interplanetary satellites that travel great distances from the Sun, such as the *Voyagers*, are powered by nuclear reactors.

Thruster motors maintain satellites in stable orbits around Earth and keep their solar panels oriented towards the sun by firing jets of compressed gas or spent fuel. Satellites cease to function properly when these run out.

The decay of satellite orbits

Satellites in low Earth orbit are constantly slowed by drag on their surfaces from the outer atmosphere. When their thrusters can no longer counter this deceleration, the satellites spiral towards Earth and 'burn up' (vaporise) in the atmosphere.