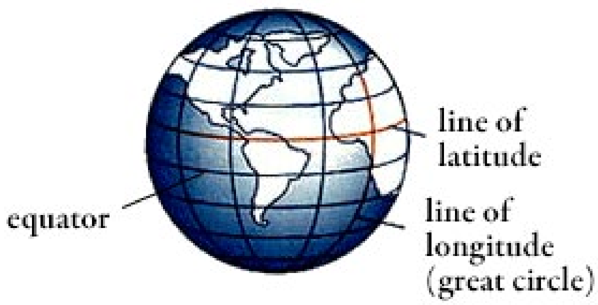
Satellite Ground Tracks

The Six Classical Orbital Elements allow us to describe what an orbit looks like in space. What we need to know next is what part of Earth the satellite is passing over at any given time. A **ground track** shows the location on the Earth that the spacecraft flies directly over during its orbit of Earth. To understand ground tracks, we need to know:

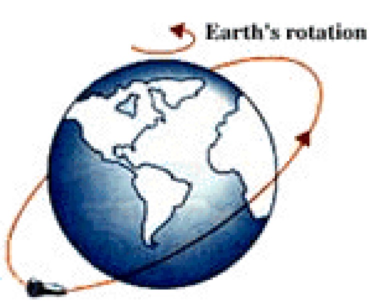
The ground track follows what is called a great circle route around Earth. A great circle is any circle that cuts through the center of the Earth. All ground-track drawings use the latitude/longitude system.



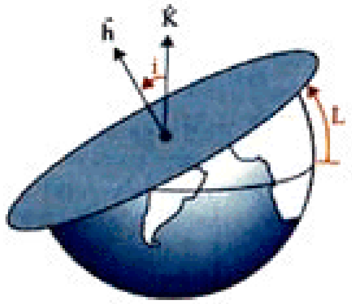
Latitude: Latitude measures how far north or south of the equator a point lies. The equator is at zero degrees latitude, the North Pole is at 90 degrees north latitude, and the South Pole is at 90 degrees south latitude.

Longitude: Longitude measures how far east or west a point lies from an imaginary line that runs from the North Pole to the South Pole through Greenwich, England. This line is called the prime meridian. The longitude varies from 0 degrees at the prime meridian to 180 degrees west and 180 east.

- Ground-track drawings appear on a Mercator projection of the Earth's surface. This type of map allows the entire surface of the round world to be represented on a flat map.
- The projection of a spacecraft orbit on a flat map (Mercator projection) looks like a sine wave. This is the spacecraft's ground track.
- If the Earth did not rotate, the ground track of an orbit would continuously repeat, and a satellite would pass over the same part of Earth over and over. But the Earth spins eastward on its axis at nearly 1,000 miles per hour at the equator while the spacecraft orbits around it.



How does this affect the ground tracks? Even though the spacecraft's orbit stays fixed in space, Earth rotates to the east. That means a spacecraft like the ISS goes over a different part of the Earth during each orbit. To a point fixed on the Earth, the spacecraft appears to shift to the west during successive orbits.



The highest latitude reached by a satellite orbit is equal to its inclination.

To illustrate this concept, these ground tracks represent orbits with the same period, but A has an inclination of 10 degrees, B has an inclination of 30 degrees, C has an inclination of 50 degrees, and D has an inclination of 85 degrees.