

Conditions of Space

- Dangerous radiation
- Extremes of temperature
- Vacuum
- Microgravity
- Closed environments



NASA

Low Earth Orbit (LEO)

- > 100 km & < 2,000 km
- Crowded space
- Satellites
- Space stations
- Space junk



CARTOONSTOCK

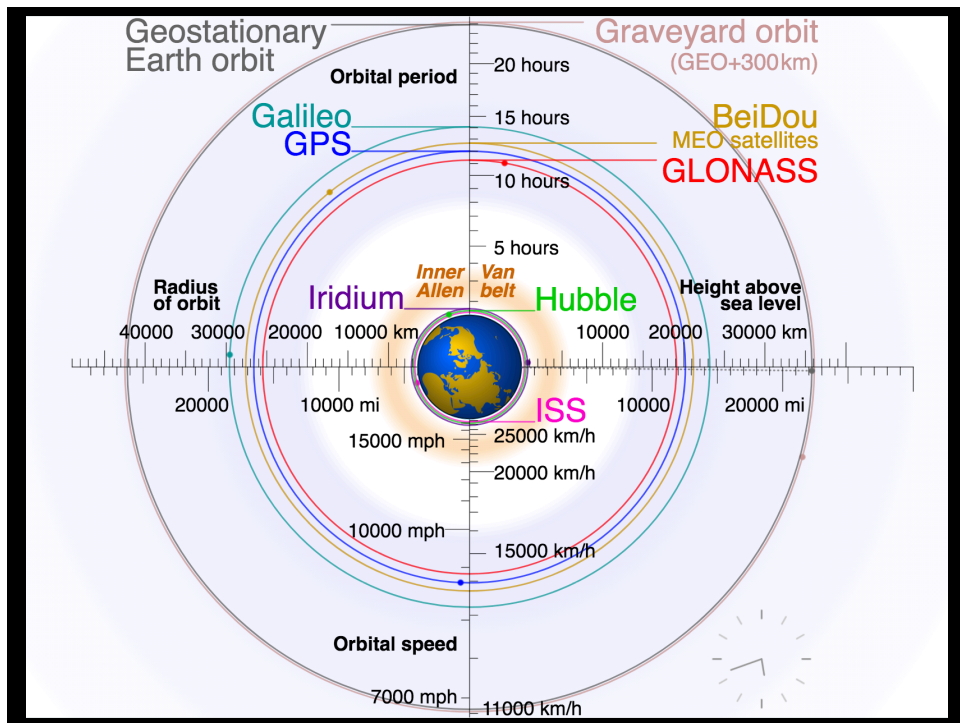
Search ID: jman242

Low Earth Orbit (LEO)

- Escape Velocity: 11.2 km/s
- Distance & velocity relationship
- Atmospheric drag
- 160 – 2,000 km
- Orbital location

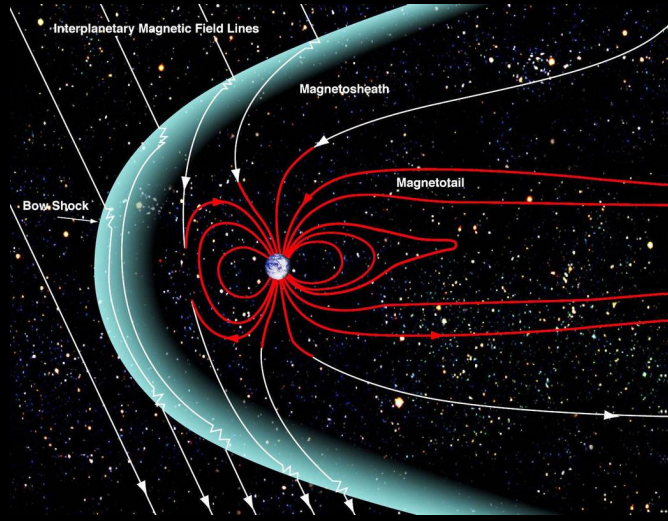
The diagram illustrates the Earth with three distinct orbital paths. A yellow path labeled 'polar' shows a satellite orbiting from the North Pole to the South Pole. A red path labeled 'low-earth orbit' shows a satellite orbiting just above the Earth's surface. A green path labeled 'geostationary' shows a satellite orbiting at a higher altitude, appearing stationary relative to the Earth's surface.

Sites.Google.com



Magnetosphere

- Molten iron core
- Rotation
- Magnetic field



NASA/Goddard/Aaron Kaase

Aurora

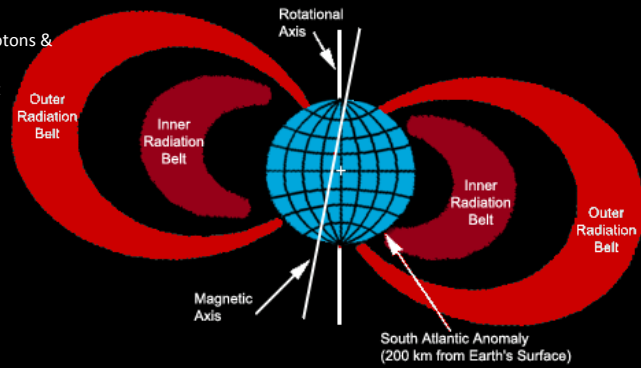
- Aurora Borealis
- Aurora Australis
- Charged particles
- Solar wind
- Auroral oval
- Kp Index



Rick Stankiewicz

Van Allen Belts

- James Van Allen
- 1958
- Inner belt: high-energy protons
- 1,000 – 12,000 km distant
- Outer belt: high-energy protons & electrons
- 13,000 – 58,000 km distant



Early History of Low Earth Orbit

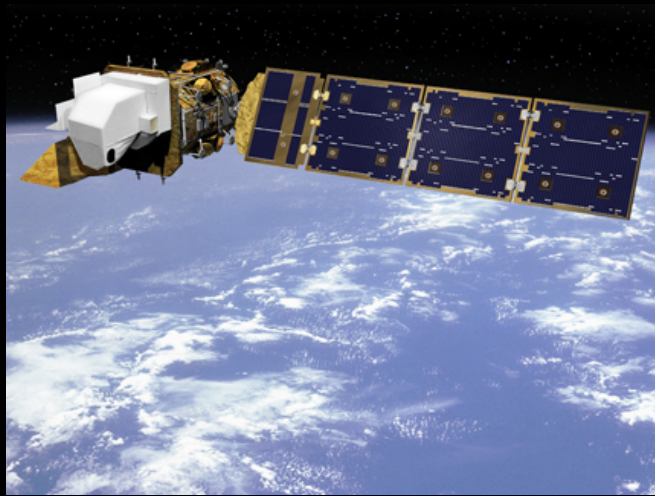
- Albert II
- June 14, 1949
- 134 km (83 mi)
- Sputnik 1
- October 4, 1957
- Sputnik 2
- November 3, 1957
- Explorer 1
- January 31, 1958
- Yuri Gagarin
- April 12, 1961
- Alan Shepard
- May 5, 1961
- Virgil "Gus" Grissom
- July 21, 1961
- Gherman Titov
- August 6, 1961
- John Glenn
- February 20, 1962



Roskosmos

Earth Observation & Remote Sensing

- Bird's eye view
- Environment
 - Land
 - Sea
- Meteorology
- Cartography
- Military



Landsat 8: Artist's concept

Communication Satellites

- Modern communication
- 500 km – 2,000 km
- Latency
- Connectivity
 - OneWeb
 - Kuiper
 - Starlink



Telesat Canada

Space Stations

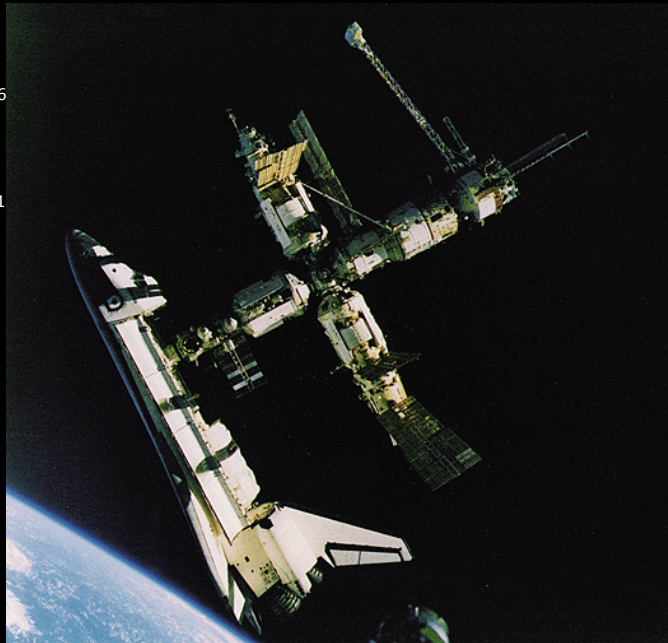
- Skylab
- Launch: May 14, 1973
- Length: 30 m (99')
- Orbit: 435 km (272 mi)
- Troubled history
- Reentry: July 11, 1979



NASA

Space Stations

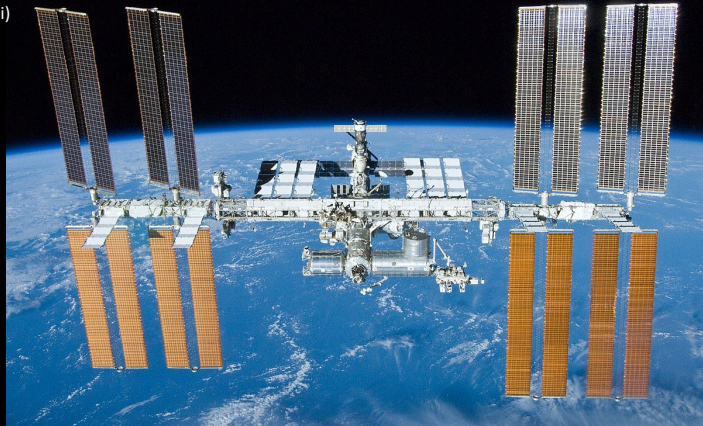
- Mir
- Launch: February 20, 1986
- Length: 37 m (122')
- Orbit: 358 km (224 mi)
- 8 modules
- Deorbited March 23, 2001



Atlantis & Mir: NASA

Space Stations

- International Space Station (ISS)
- Launch: November 20, 1998
- Orbit: 400 km (250 mi)
- Length: 109 m (357')
- 16 modules
- Status: operational



NASA

Space Stations

- Tiangong - 1
- Launch: September 29, 2011
- Orbit: 355 km (221 mi)
- Length: 10.4 m (34')
- 2 modules
- Reentry April 2, 2018
- Tiangong - 2
- Launch: September 16, 2016
- Orbit: 370 km (230 mi)
- Length: 10.4 m (34')
- 2 modules
- Deorbit July 19, 2019
- Tiangong Space Station
- Launch: April 29, 2021
- Orbit: 340 - 450 km (280 mi)
- Length: 55.6 m (182')
- 3 modules
- Status: operational



CMSA

Space Telescopes

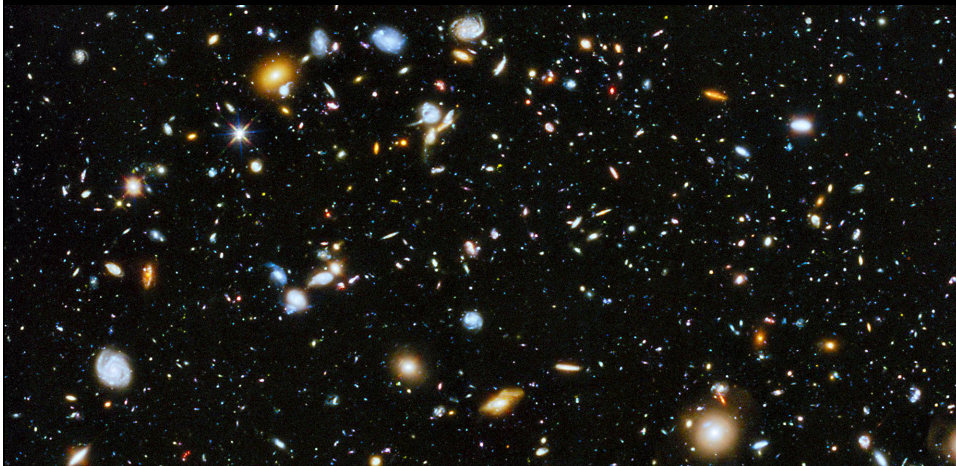
- Hubble Space Telescope (HST)
- Launched April 24, 1990
- 540 km (340 mi)
- 5 servicing missions
- Ultra-violet / visible light / near-infrared
- > 1.4 million observations
- > 18,000 peer-reviewed science papers
- Inspired millions & revolutionized our understanding of the Universe



NASA

Space Telescopes

- HST Ultra Deep Field
- > 5,500 galaxies
- 13.4 billion light years



Hubble Space Telescope: NASA

Technology Transfer

- Make life safer, more enjoyable and better
- NASA mandate since 1958
- 1,000s of consumer goods
- Safety equipment
- Medical advancements
- Agriculture
- Industrial applications
- New manufacturing techniques



Controlled Environment Agriculture: vertical farm

Space Debris

- Space junk yard
- Millions of pieces
- High velocity
- Risk to hardware & manned spaceflight
- > 9,200 tonnes
- Space Surveillance Network



Kessler Syndrome

- Donald Kessler
- Collisional cascade



iStockphoto

Space Debris Guidelines

- Enforceable regulations nonexistent
- NASA Orbital Debris Program
- United Nations Guidelines
- Responsible stewardship



United Nations

Clean Up Strategies

- e.DeOrbit Mission



Next Month's Novice Astronomy Class ...

Lesson # 22 Exoplanets
Postponed until May 3, 2024

