S3 New Curriculum Physics

Theme: Earth and space physics

Chapter 8 – Satellites and communication

A **satellite** is an object which moves around a planet or a star

Types of satellites

Natural satellites: These are celestial objects that naturally orbit planets, such as the moon orbiting Earth

Artificial satellites: These are man-made spacecraft launched into space for various purposes, including communication, weather monitoring and scientific research.

Types of satellites

Satellites come in many types, depending on their **purpose** and **orbit**.

Classification of satellites by Function (What They Do):

1. **Communication Satellites**: Relay TV, radio, internet, and phone signals across the globe.
2. **Navigation Satellites**: Provide GPS and positioning services for everything from smartphones to ships.
3. **Earth Observation Satellites**: Monitor weather, climate, agriculture, and natural disasters.
4. **Astronomical Satellites**: Observe stars, galaxies, and cosmic phenomena (like the Hubble Space Telescope).
5. **Reconnaissance (Spy) Satellites**: Used by militaries for surveillance and intelligence gathering.
6. **Scientific Satellites**: Study space, Earth's atmosphere, or conduct experiments in microgravity.

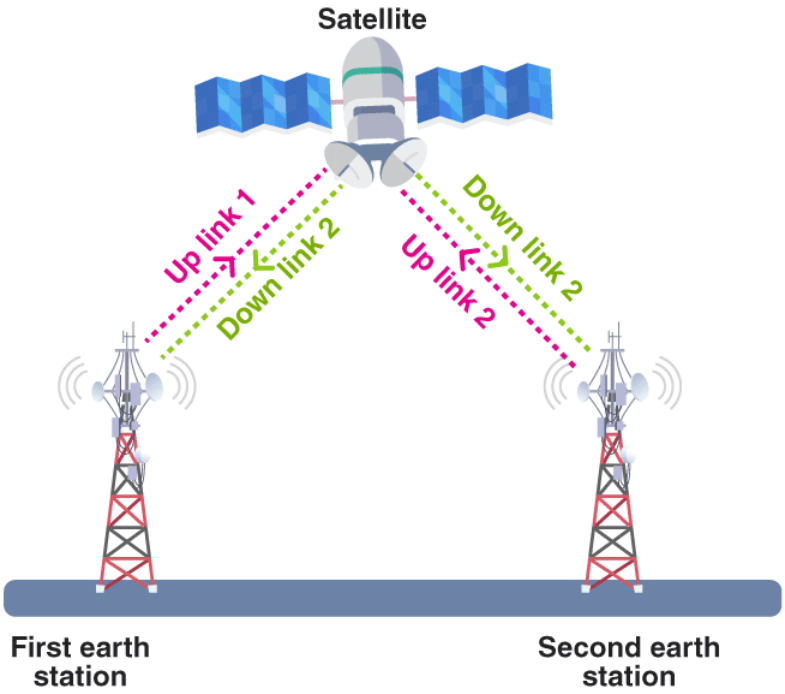
Classification of satellites by Orbit (Where They Are):

1. **Low Earth Orbit (LEO)**: 160–1,500 km above Earth. Used for imaging, communication (like Starlink), and the ISS.
2. **Medium Earth Orbit (MEO)**: Around 20,000 km up. Home to GPS satellites.
3. **Geostationary Orbit (GEO)**: 35,786 km above the equator. These satellites stay fixed over one spot—ideal for weather and communication.
4. **Sun-Synchronous Orbit (SSO)**: Passes over the same part of Earth at the same local time—great for consistent lighting in imaging.
5. **Polar Orbit**: Passes over Earth's poles, allowing full global coverage over time.

Satellite communication

Satellite communication is the use of artificial satellites to transmit signals—like voice, video, or data—between different points on Earth. It's how we get live TV broadcasts, global internet coverage, GPS navigation, and even weather updates from space.

How It Works:



1. A signal is sent from a **ground station** up to a satellite—this is called the **uplink**.
2. The satellite receives, amplifies, and often changes the frequency of the signal.
3. It then sends the signal back down to another ground station or receiver—this is the **downlink**.

The satellite acts like a **space-based relay station**, allowing communication over long distances—even across oceans or remote areas where cables can't reach.

Types of Satellite Communication:

- **One-way**: Like satellite TV, where signals go from the satellite to your dish.
- **Two-way**: Like satellite phones or internet, where signals go both ways between users and the satellite.

Importance of satellite communication

- **Global coverage**: Especially useful in remote or disaster-stricken areas.
- **Reliable**: Less affected by terrain or infrastructure damage.
- **Essential for modern life**: From banking to broadcasting to emergency response.

The Hubble space telescope

The **Hubble Space Telescope** is one of the most iconic and transformative scientific instruments ever launched into space. It was deployed by NASA on **April 24, 1990**, aboard the Space Shuttle *Discovery*, and it orbits Earth at about **540 kilometers (336 miles)** above the surface.

What Makes Hubble Special:

- It observes in **ultraviolet, visible, and near-infrared light**, giving us crystal-clear images of the universe without atmospheric distortion.
- Its **2.4-meter mirror** and suite of precision instruments have allowed it to capture breathtaking views of galaxies, nebulae, and distant stars.
- Hubble has helped determine the **rate of expansion of the universe**, provided evidence for **dark energy**, and even studied the **atmospheres of exoplanets**.

Key Contributions:

- **Deep Field Images**: Revealed thousands of galaxies in what looked like empty space.
- **Supernova Studies**: Helped refine our understanding of cosmic distances.
- **Black Hole Discoveries**: Offered visual evidence of supermassive black holes at galactic centers.

Even after more than **three decades in orbit**, Hubble continues to deliver groundbreaking science and stunning imagery. It's a true window into the cosmos.

Thanks

Dr. Bbosa Science