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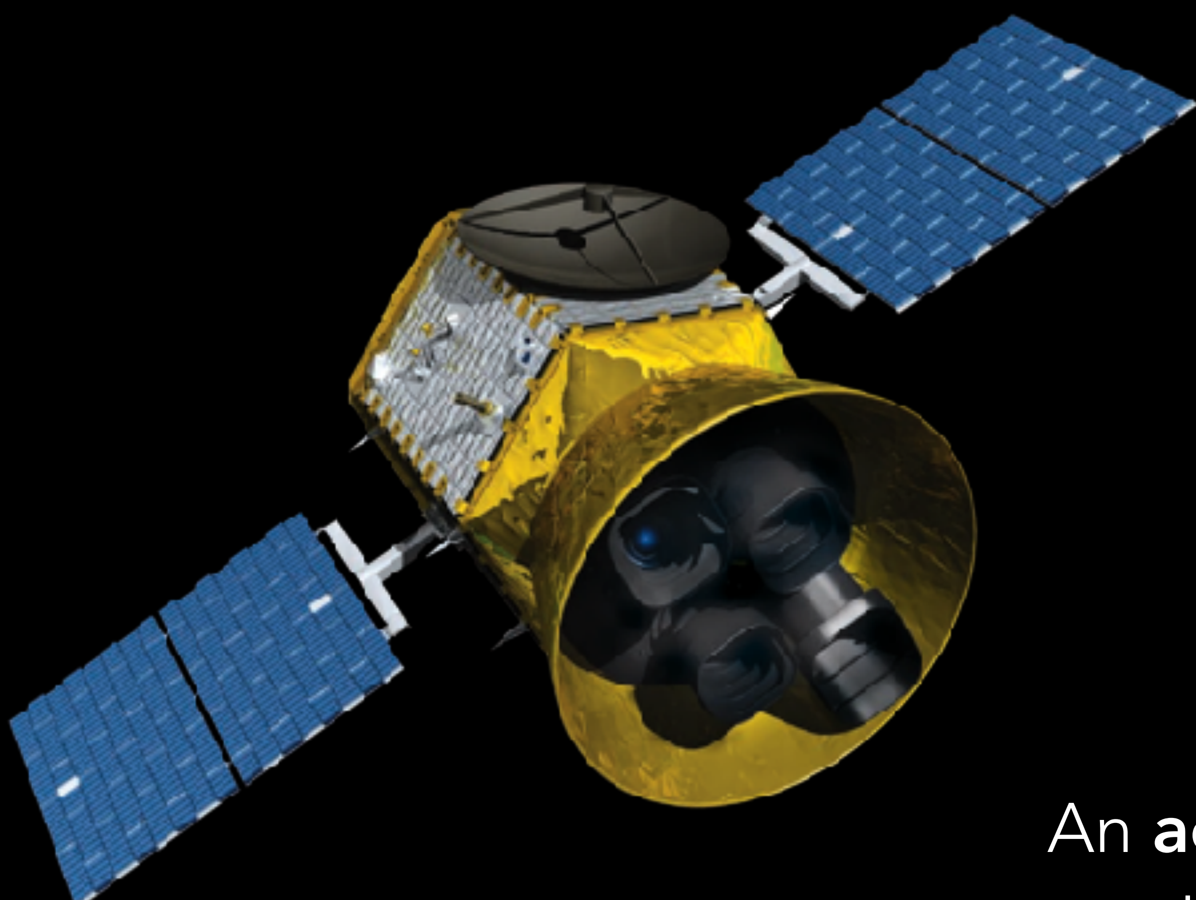
CLASSROOM ROCKET SCIENTIST

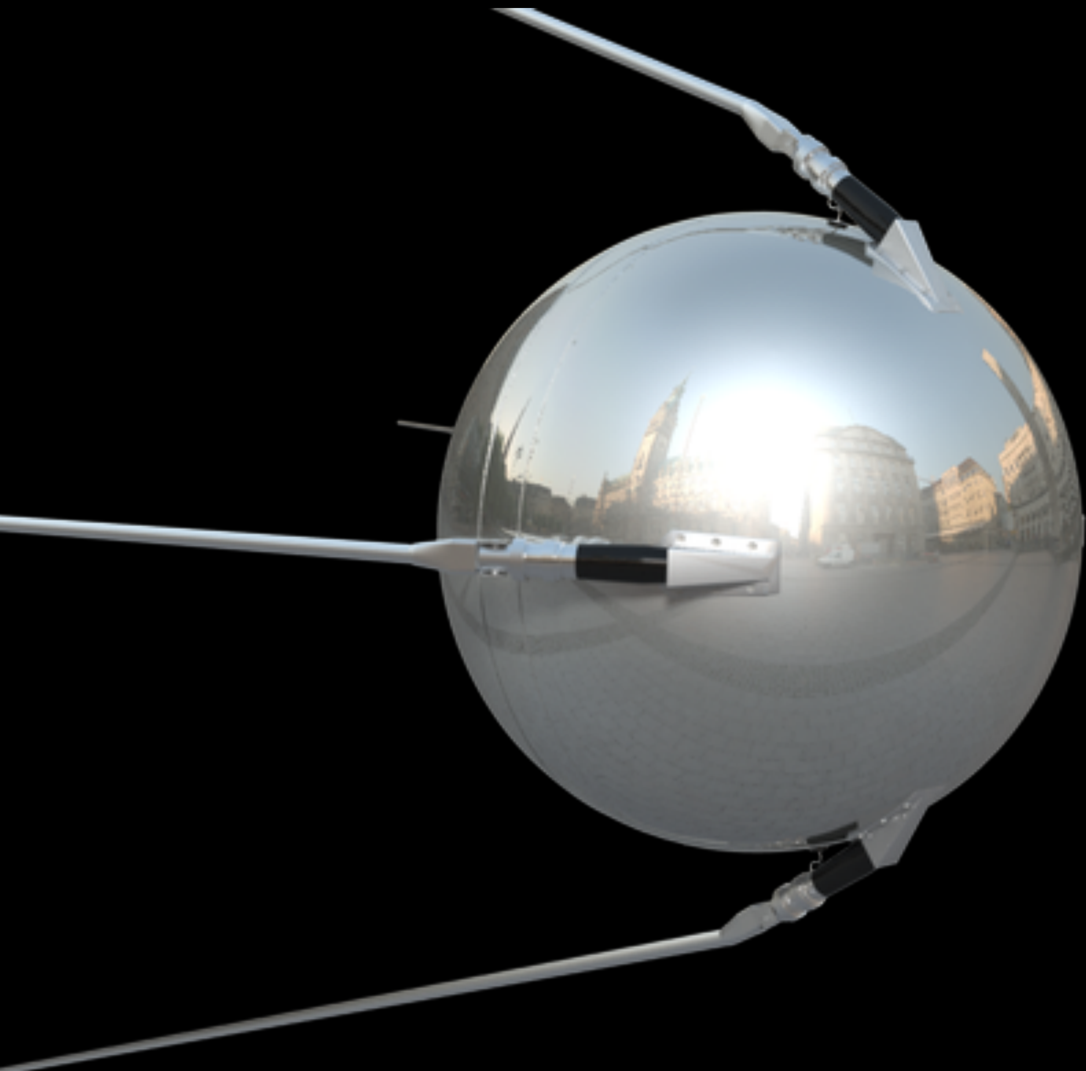
WHAT IS A SATELLITE?

A satellite is anything that orbits around something else.



An **active, artificial satellite** has a specialised wireless receiver and transmitter and is launched by a rocket into orbit.

HISTORY OF SATELLITES



The first satellite was Sputnik 1, launched into space in 1957 by the Soviet Union.

The satellite provided information about the highest layers of our atmosphere.

TYPES OF SATELLITE

Today there are thousands of satellites orbiting our planet

TYPES OF SATELLITE

Satellites come in all shapes and sizes and play a variety of roles.

COMMUNICATIONS

Communications satellites allow us to watch TV, make long distance phone calls, listen to the radio and browse the Internet.

EARTH OBSERVATION

Earth observation helps us map, monitor and protect the environment, manage resources, respond to global disasters and enable sustainable development.

NAVIGATION

Navigation satellites can determine a location anywhere on the Earth's surface to within a metres or better, whatever the weather .

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COMMUNICATIONS

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Telephone

Internet

Radio broadcast

Television

Military

TYPES OF SATELLITE

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EARTH OBSERVATION

Earth observation helps us map, monitor and protect the environment, manage resources, respond to global disasters and enable sustainable development.

Weather

Search & Rescue

Vegetation mapping

Climate monitoring

Agriculture

TYPES OF SATELLITE

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NAVIGATION

Navigation satellites can determine a location anywhere on the Earth's surface to within a metres or better, whatever the weather .

Personal use

Travel by air

Travel by road

Travel by water

Military

HOW SATELLITES WORK

A satellite consists of following major components:

- **Structure**: The body of the satellite.
- **Instrumentation**: The onboard instruments that steer the satellite, collect data, and more.
- **Power source**: To provide electricity to the satellite. Solar panels and batteries are two options.
- **Communication device**: A way to communicate with ground control and send data back to Earth.
- **Propulsion system**: The engine that keeps the satellite in orbit.

HOW SATELLITES WORK

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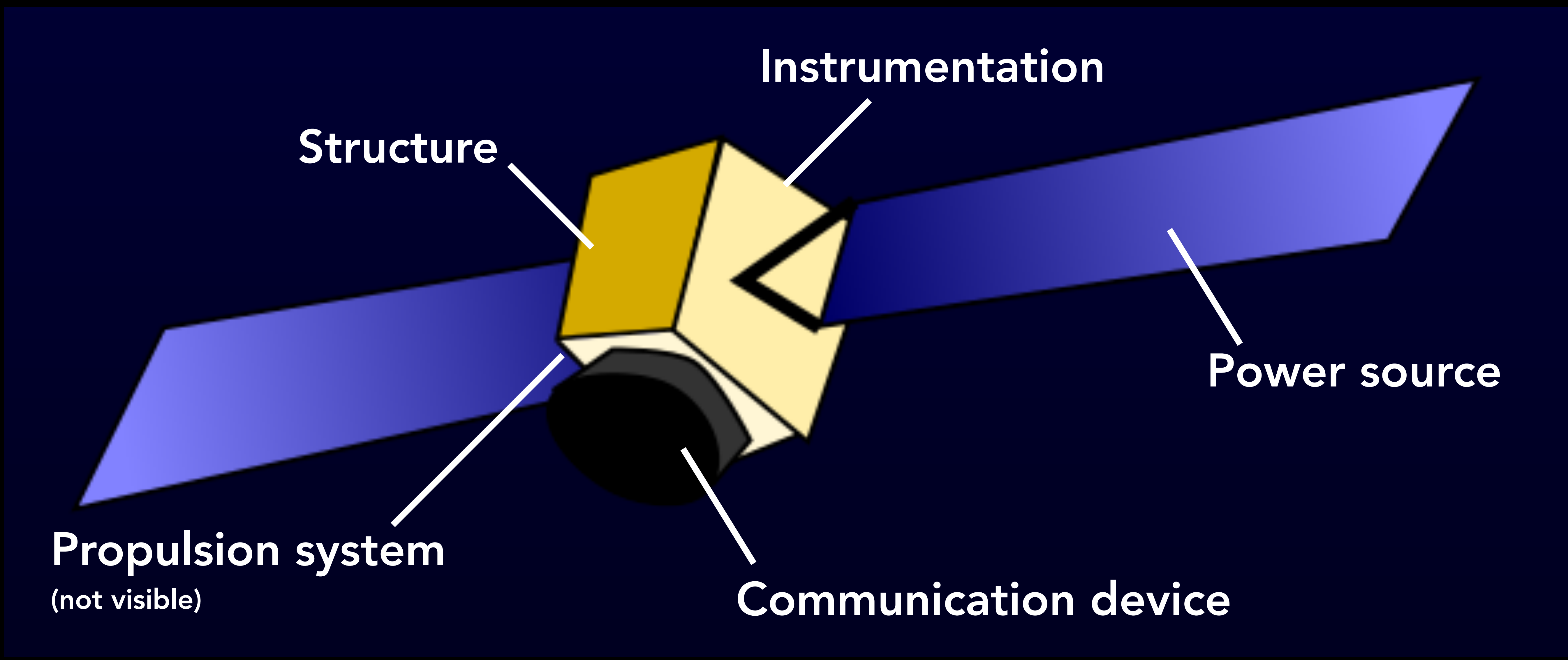
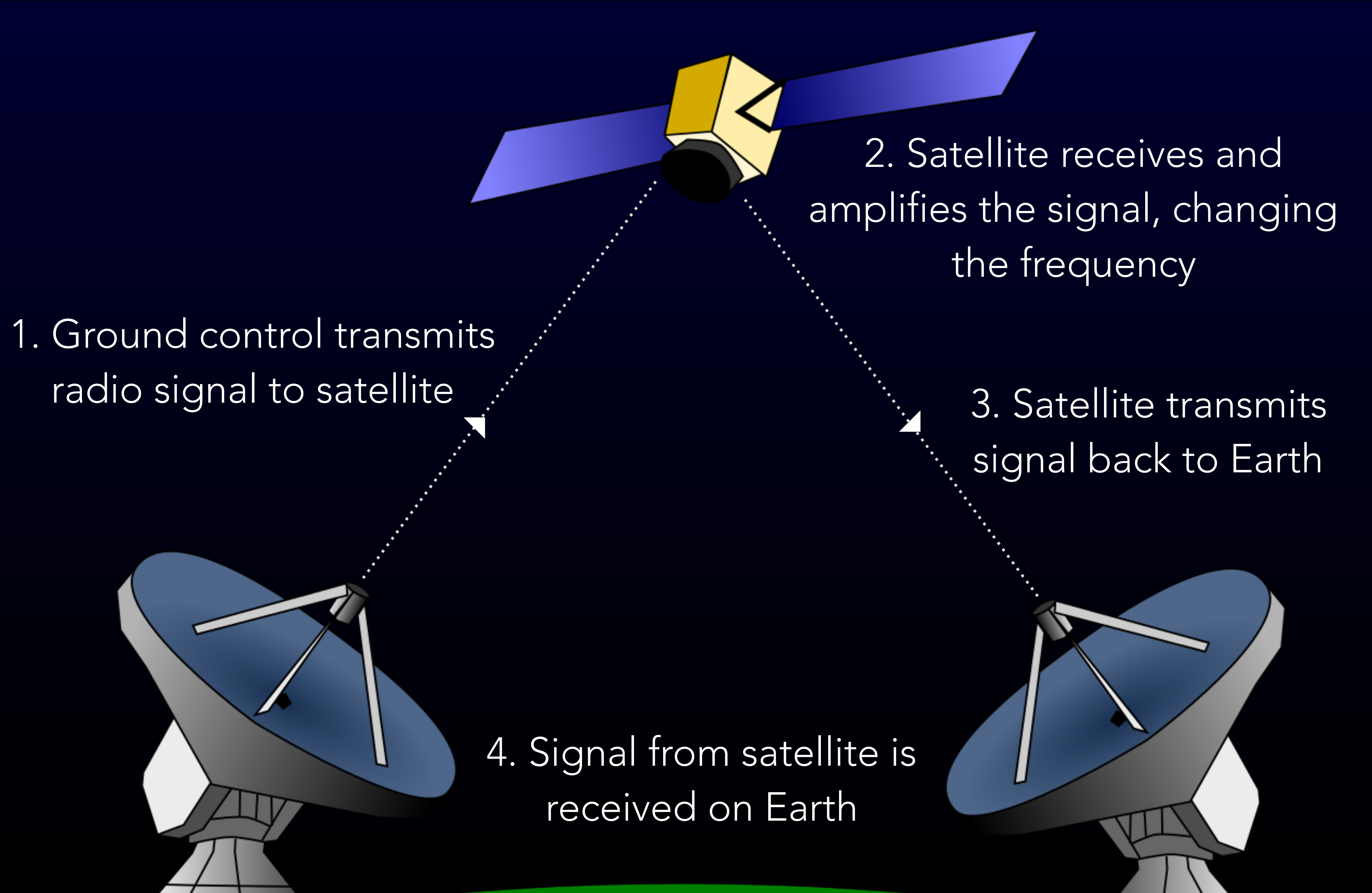


HOW SATELLITES WORK (Basics)



INSTRUMENTATION

All satellites need scientific instruments to carry out their purpose. Here is are some examples of instruments:

Atomic Clock: A very accurate clock, required by navigation satellites to measure the time very precisely.

Optical Camera: Provides images of the ground or clouds, for mapping or for monitoring natural disasters, e.g.

Infrared Camera: Provides images of the clouds and weather systems in the Earth's atmosphere, for weather forecasting e.g.

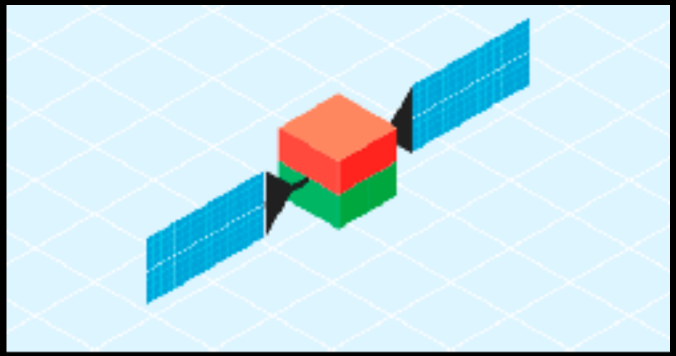
Internet Encoder: Used to broadcast the internet to people around the world.

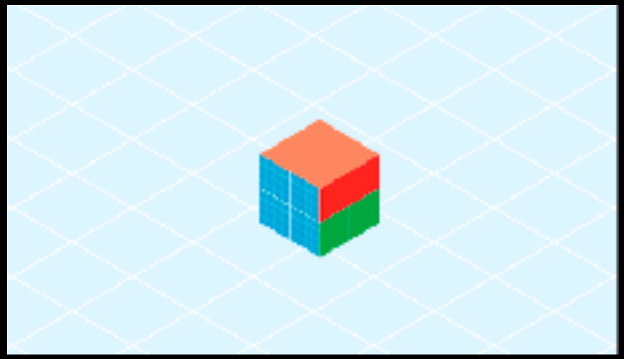
Radio Dish: Used for controlling the satellite and transmitting data to the ground

POWER SOURCES

All satellites require electricity to run. The more instruments onboard, the more power a satellite will require. Here are some possible power sources:

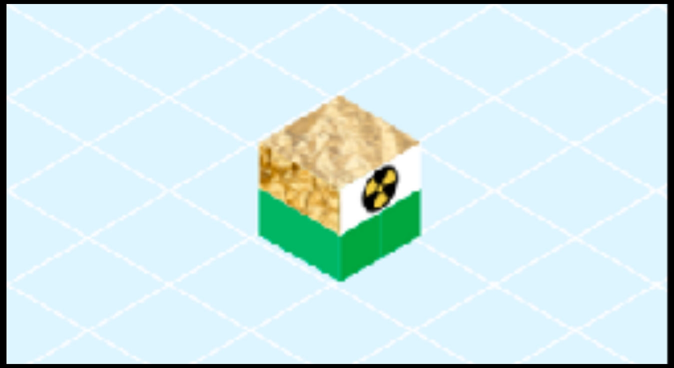
Deployed solar panels: Extend from edge of satellite, collecting sunlight to provide power.

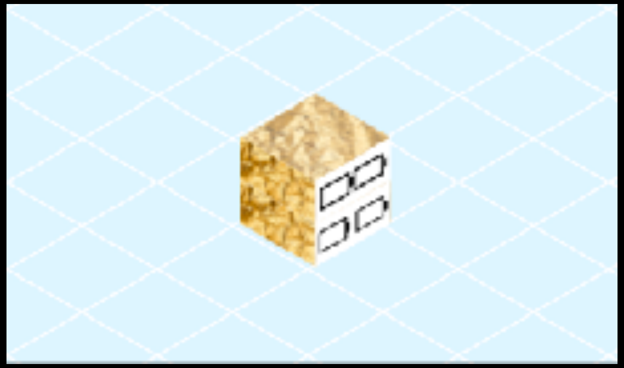




Mounted solar panels: Cover the surface of satellite, collecting sunlight to provide power.

RTG: Uses nuclear technology to provide power. Due to safety concerns, it can't be used in low-Earth orbit.

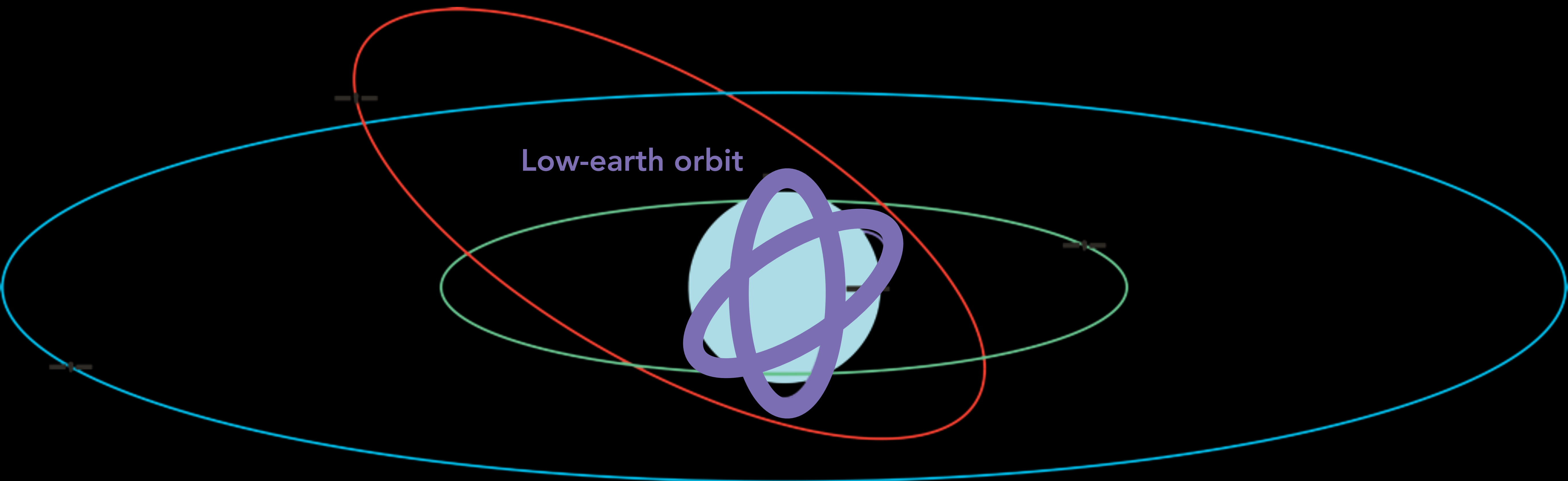




Batteries: Stores power from solar panels to allow operation when not in sunlight.

SATELLITE ORBITS

Satellites orbit Earth at different heights, speeds, and paths.



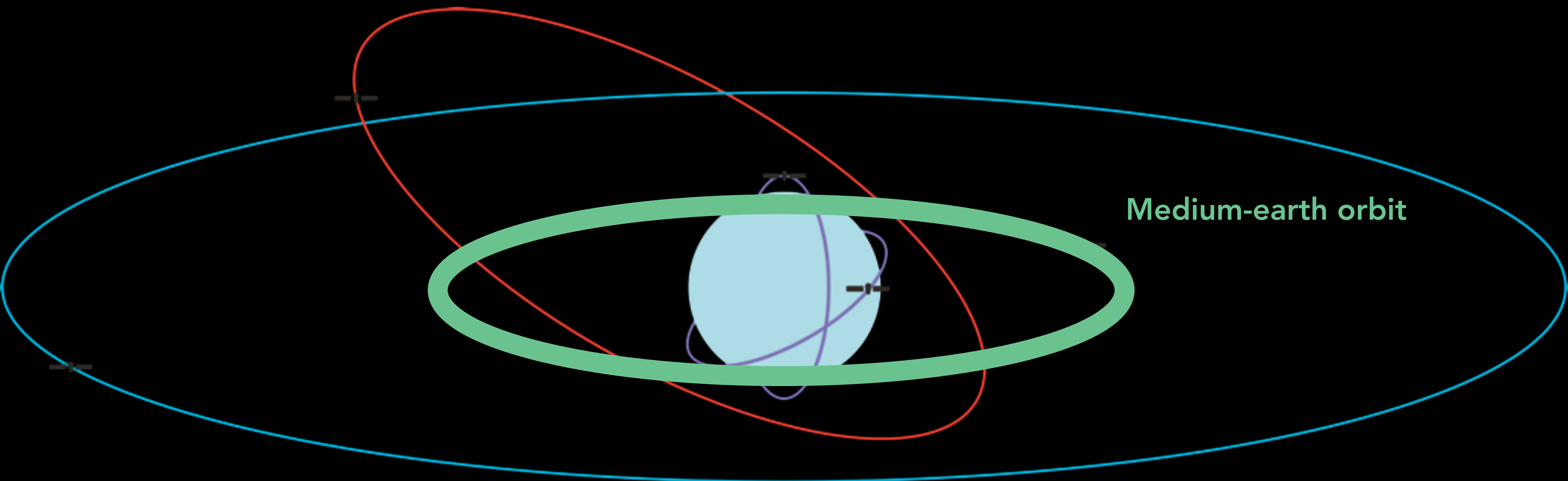
Altitude: 400km

Period: 90 mins

- See the surface of the Earth in high detail
- Pass over a different part of the Earth in each orbit.
- Cheaper than other orbits and they can be reached for repairs.

SATELLITE ORBITS

Satellites orbit Earth at different heights, speeds, and paths.



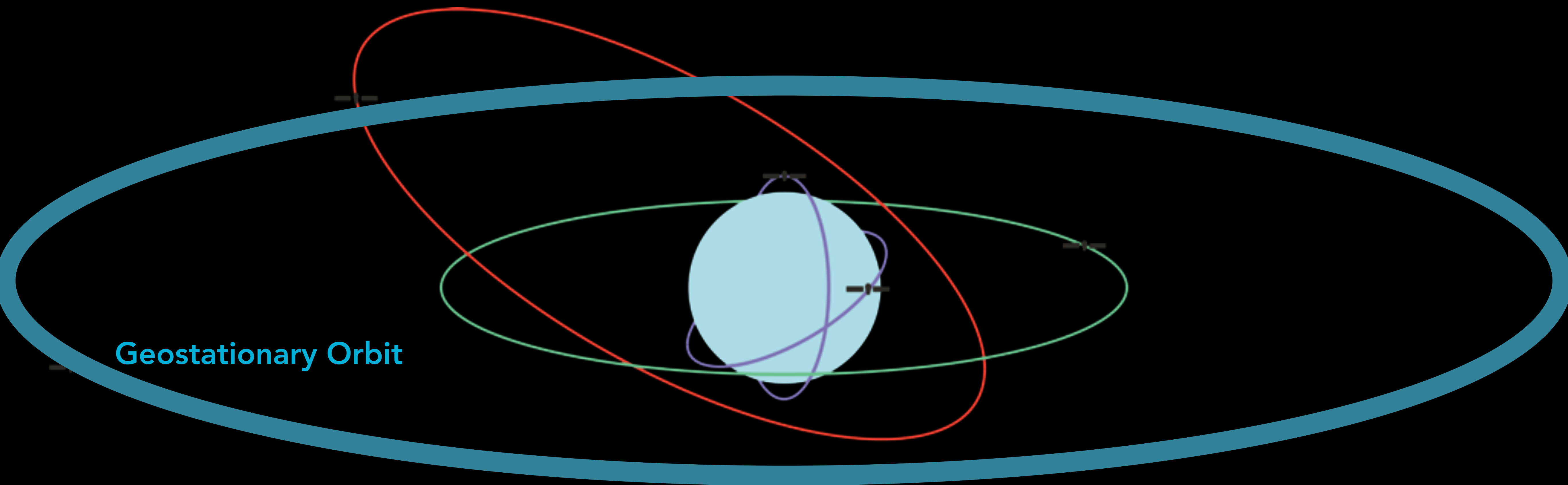
Altitude: 2,000km

Period: 2 hours

- Higher above the Earth than low-Earth orbits, but lower than geostationary orbits.
- Cover a different part of Earth in each orbit.
- See a larger area in less detail than low-Earth orbits.

SATELLITE ORBITS

Satellites orbit Earth at different heights, speeds, and paths.



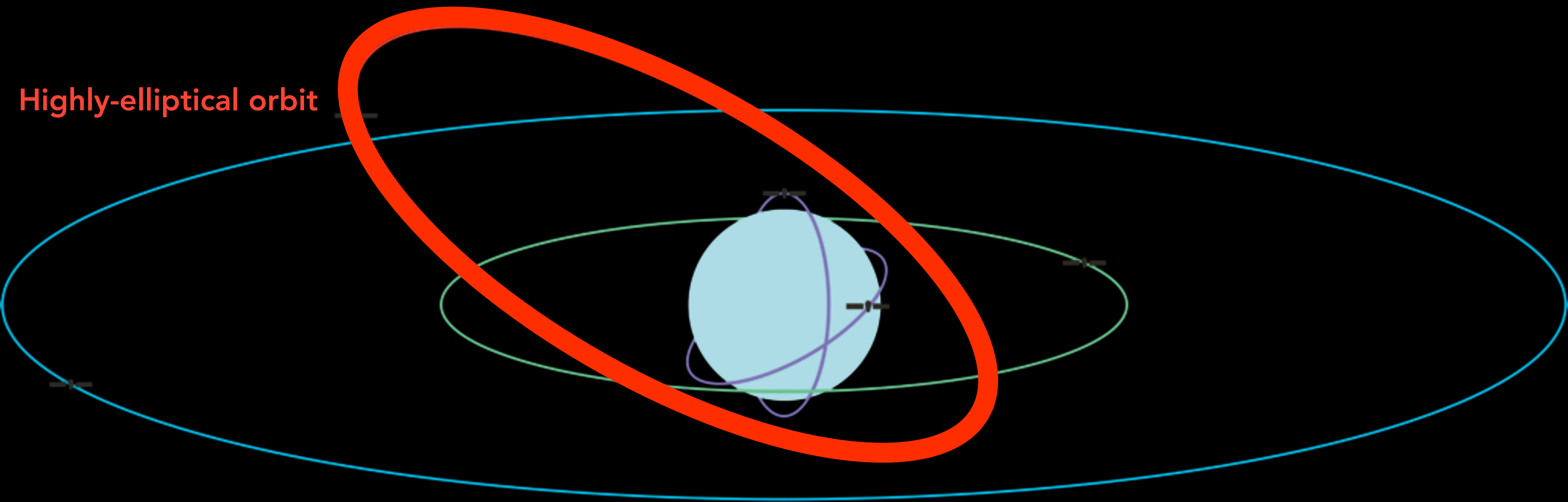
Altitude: 37,786km

Period: 24 hours

- Stay above the same location on Earth near the equator and complete a full orbit in 24 hours.
- Much higher above the Earth's surface than other orbits, so can see the entire hemisphere in less detail.

SATELLITE ORBITS

Satellites orbit Earth at different heights, speeds, and paths.



Altitude: 20,000km

Period: 12 hours

- Elliptical orbit that is closer to the Earth at one point in their orbit than anothe
- Useful for covering areas including polar regions.
- More than one satellite can be used for continuous coverage of an area.

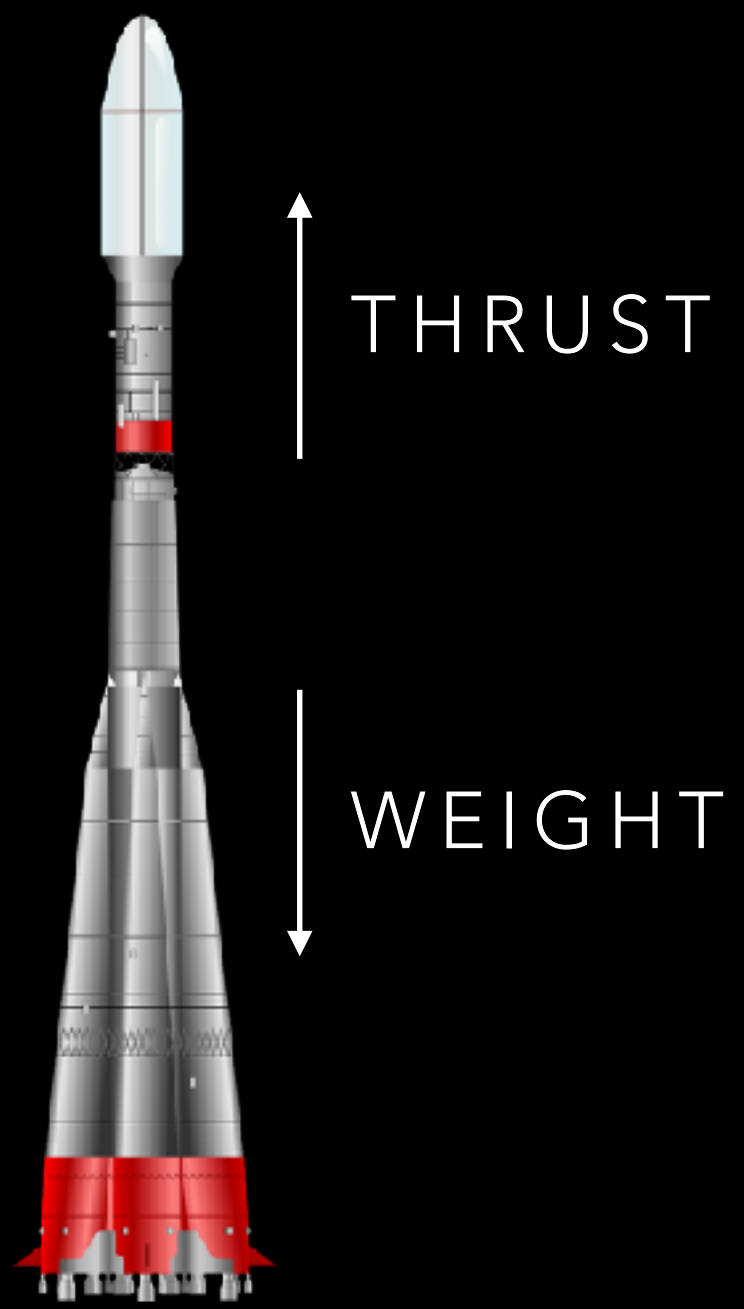
LAUNCHING A SATELLITE

Launching satellites is a very complex business which involves years of hard work and a lot of money. A few things that must be taken into account are:

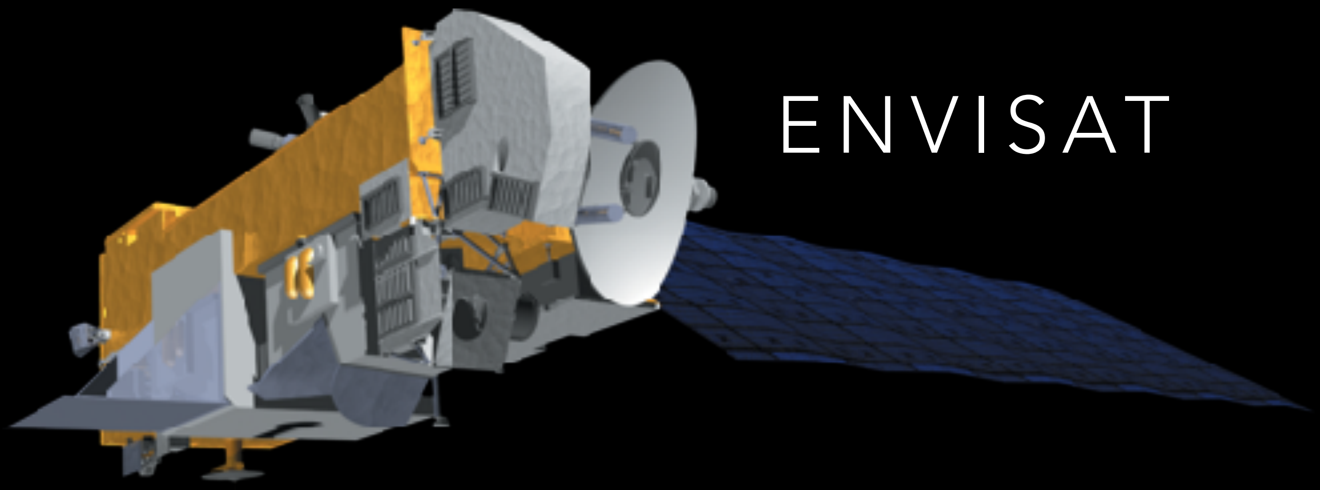
1. The rocket must be large enough to carry the satellite (also called the "payload")

2. Two main forces act on a rocket: **Thrust** upwards and **Weight** downwards

3. The heavier a satellite the more thrust is needed to launch it into orbit.



SATELLITE EXAMPLES (EARTH OBSERVATION)



ENVISAT

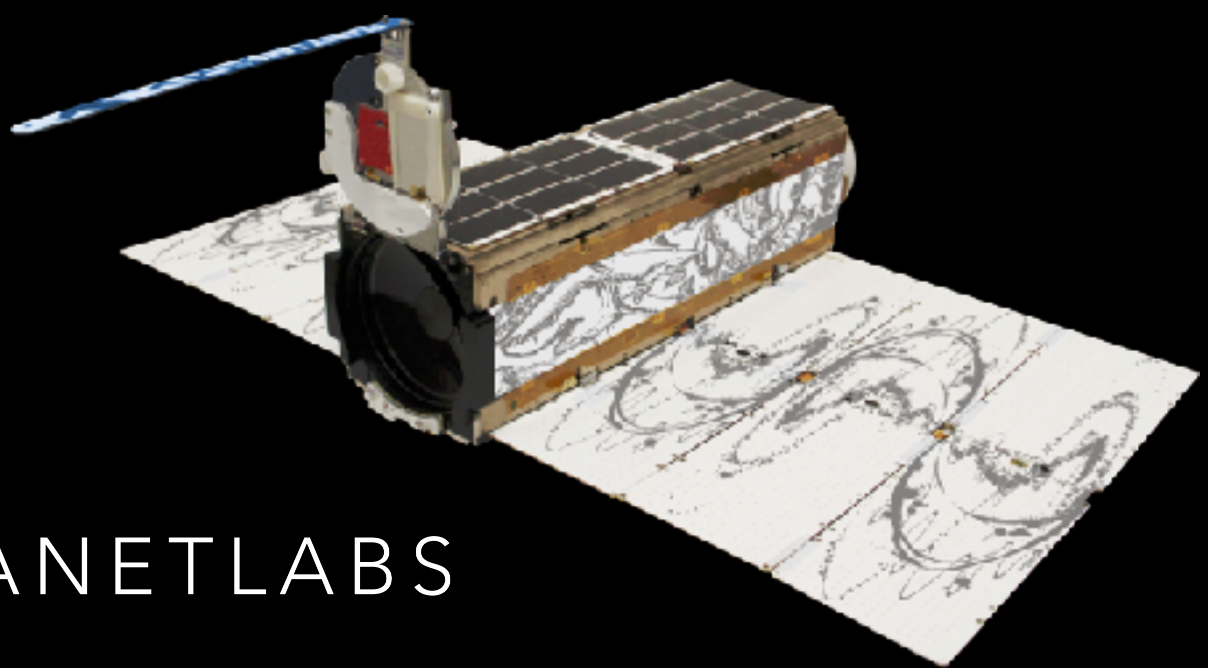
ATMOSPHERE AND OCEAN MONITORING

DIMENSIONS: 2.5 × 2.5 × 10 M (LARGE)

MASS: 8,211 KG

ORBIT: LOW-EARTH ORBIT

INSTRUMENTS: 9



PLANETLABS

DISASTER MONITORING **CUBE** SAT

DIMENSIONS: 10 X 10 X 34 CM (MINI)

MASS: 5 KG

ORBIT: LOW-EARTH ORBIT

INSTRUMENTS: 4

SATELLITE EXAMPLES (NAVIGATION)

GALILEO SATELLITE CONSTELLATION

NAVIGATION SATELLITES

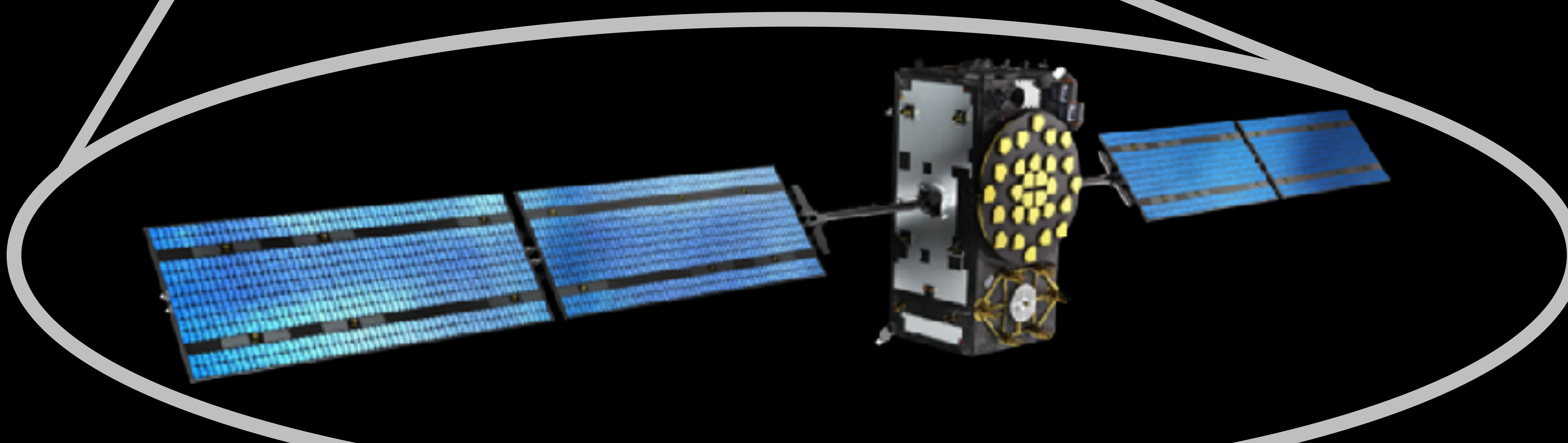
SATELLITES: 34

DIMENSIONS: ~2.5 x 14.5 x 1.5 M

MASS: ~700 KG

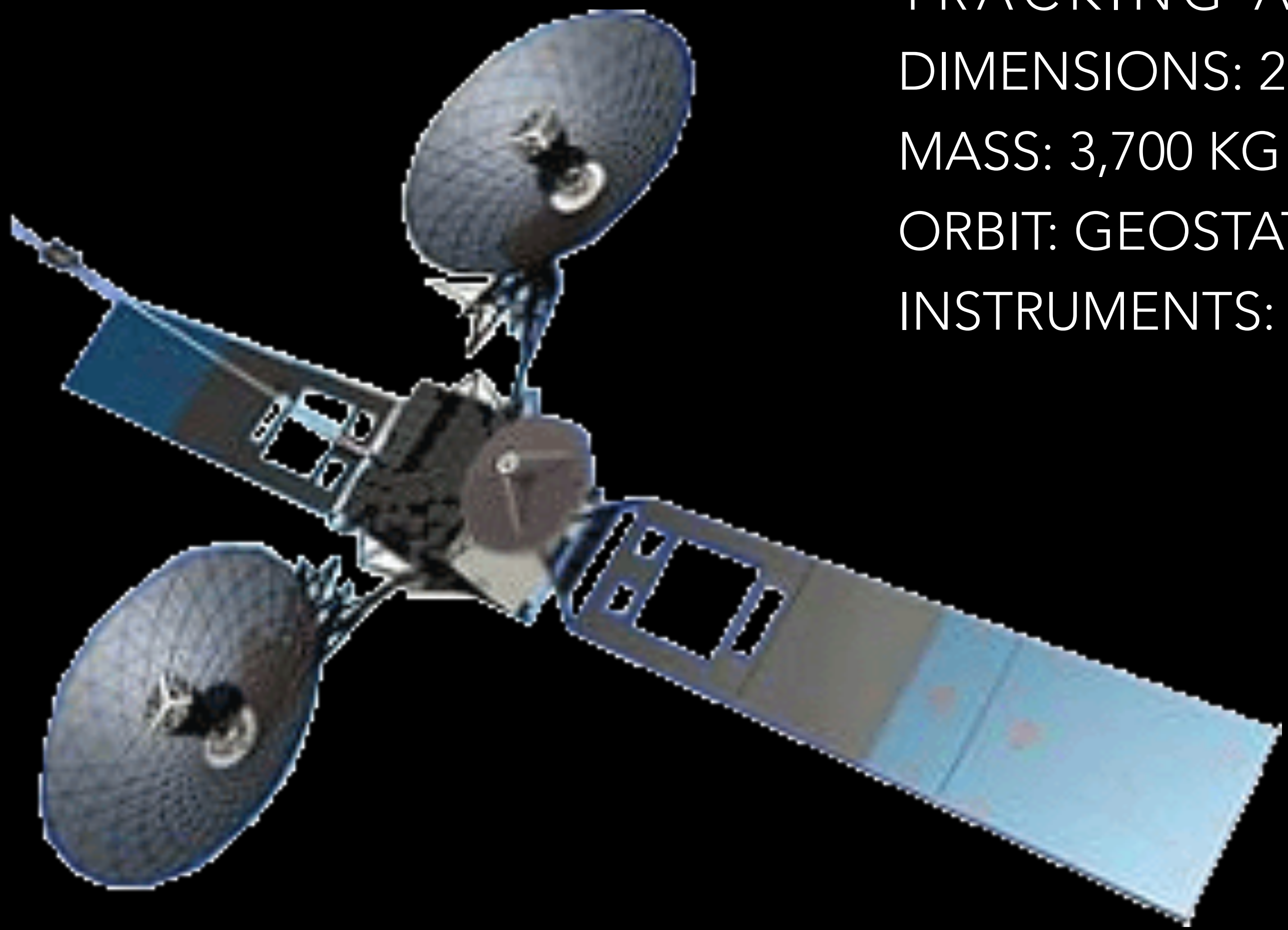
ORBIT: MEDIUM-EARTH ORBIT

INSTRUMENTS: 11



SATELLITE EXAMPLES (COMMUNICATION)

TDRS-M



TRACKING AND DATA RELAY

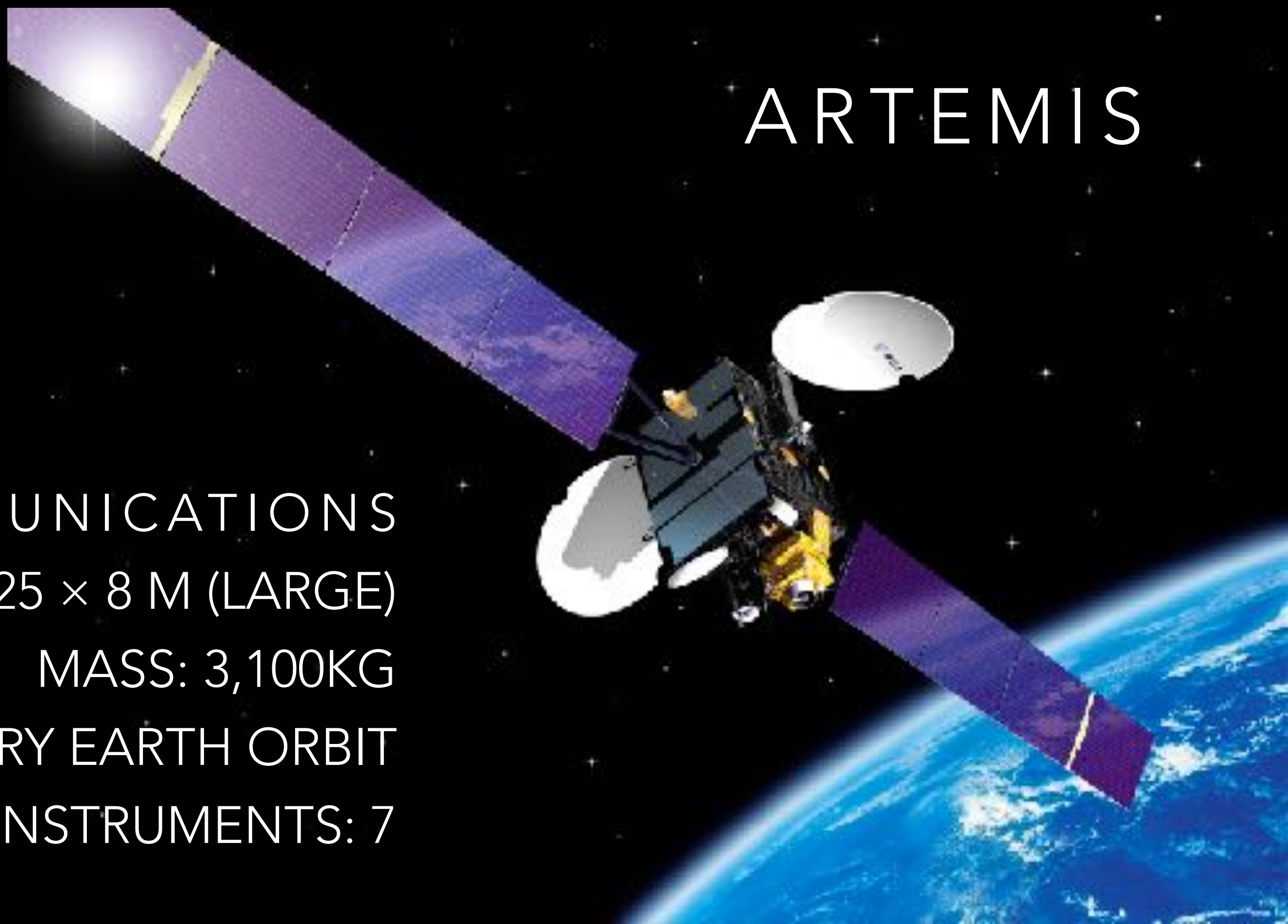
DIMENSIONS: 21 × 13 M (LARGE)

MASS: 3,700 KG

ORBIT: GEOSTATIONARY EARTH ORBIT

INSTRUMENTS: 7

ARTEMIS



TELECOMMUNICATIONS

DIMENSIONS: 4.8 × 25 × 8 M (LARGE)

MASS: 3,100KG

ORBIT: GEOSTATIONARY EARTH ORBIT

INSTRUMENTS: 7