



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF AEROSPACE ENGINEERING

19AST101 – INTRODUCTION TO AEROSPACE ENGINEERING I YEAR II SEM

UNIT-II SPACE VEHICLE

TOPIC: Gravitational field on space vehicle

NAME: Mr.N.Venkatesh., M.Tech
Assistant Professor
Aerospace Engineering
SNS College of Technology





Gravity



Weight and mass



Planets and satellites



Summary activities



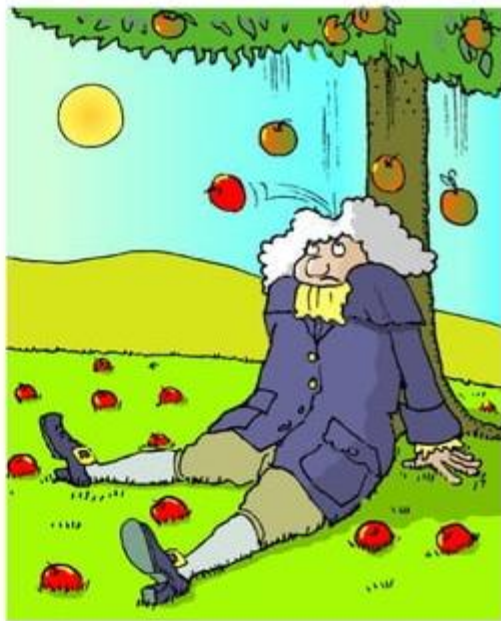
Gravity is the most important force in the universe!

It is an attractive force that makes apples fall from trees and the planets orbit the Sun.

Sir Isaac Newton was a scientist who was interested in forces and gravity.

He did **not** discover gravity – gravity and its effects existed long before Newton.

Newton did discover how to **calculate** the force of gravity on objects. His work was so important that the unit of force is named after him!



Gravity is an attractive force that acts between all objects that have mass. The size of the force depends on the mass of the object.

All objects produce a gravitational force. This is a massive force for huge masses such as a planet.

Think about it:

When you jump, the gravitational force of the Earth pulls you down. Your gravitational force is also pulling the Earth towards you – you just don't notice this effect because your mass is so much smaller than Earth's!

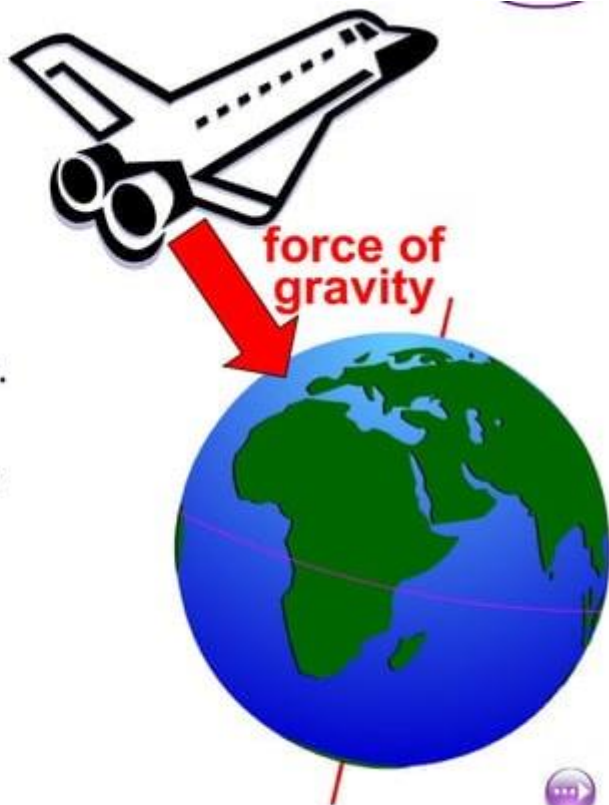


The force of gravity between two objects depends on the **mass** of the objects and also the **distance** between them.

Spacecraft produce a very large force, called **thrust**, to overcome the force of gravity.

As a spacecraft gets further away from Earth, the force of gravity gets smaller.

Why do spacecraft lose their large fuel tanks and booster rockets once they have left the Earth's surface?



9J Gravity and Space



Gravity



Weight and mass



Planets and satellites



Summary activities



Mass and weight are not the same!

- ✳ **Mass** is the **amount of matter** in an object and is measured in **kilograms**. Mass is not a force.

Mass will have the same value anywhere in the Universe, including space.

- ✳ **Weight** is a **force** and is caused by the pull of gravity acting on a mass . Like other forces, weight is measured in **newtons** and has both magnitude and direction.

Weight has different values depending on where you are in the Universe.

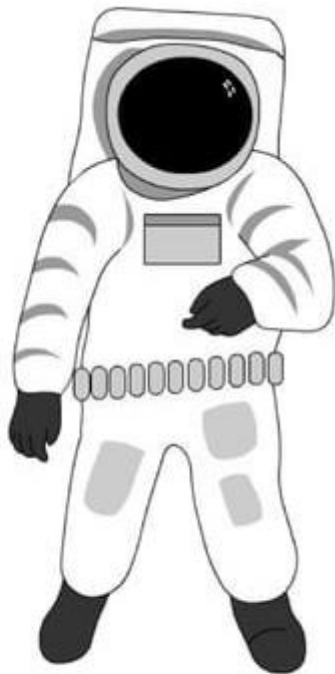


The force of gravity is less on the Moon than it is on Earth. This is because the Moon has a smaller mass than the Earth.

Any object will weigh less on the Moon than it does on Earth.

An astronaut could jump 20 feet into the air on the Moon because gravity is less.

However, the astronaut still has the same body and the same mass: he just weighs less because gravity is weaker on the Moon.



A scientist should **never** say:

*“She **weighs** 50 kilograms,”*

but should always say:

*“She has a **mass** of 50 kilograms”.*

Alternatively, the scientist could say:

“The gravitational force acting on her mass is about 500 newtons”.

This is the same as saying:

“Her weight is about 500 newtons”.



What are the differences between weight and mass?

weight	mass
?	?
?	?
?	?

measured
in newtons



solve



9J Gravity and Space



Gravity



Weight and mass



Planets and satellites



Summary activities



The Sun is a massive object at the centre of the Solar System.

The mass of the Sun is about 333,000 times the mass of the Earth, so the Sun exerts a massive gravitational pull.



The attractive gravitational force between the Sun and each of the planets keeps them moving in orbits around the Sun.

The shape of a planet's orbit around is an **ellipse** (oval).

What would happen to the planets if there was no gravity from the Sun?



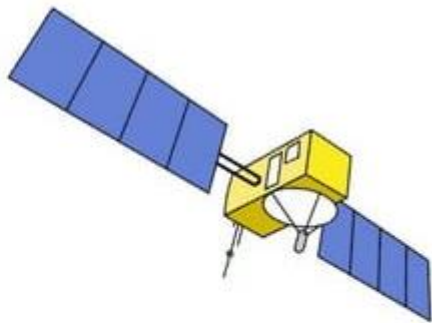
A **satellite** is any object that orbits another object.

The Moon is a **natural satellite** of the Earth, which is kept in orbit by the attraction of the Earth's gravity.

An **artificial satellite** is an object made by and put into orbit by humans.

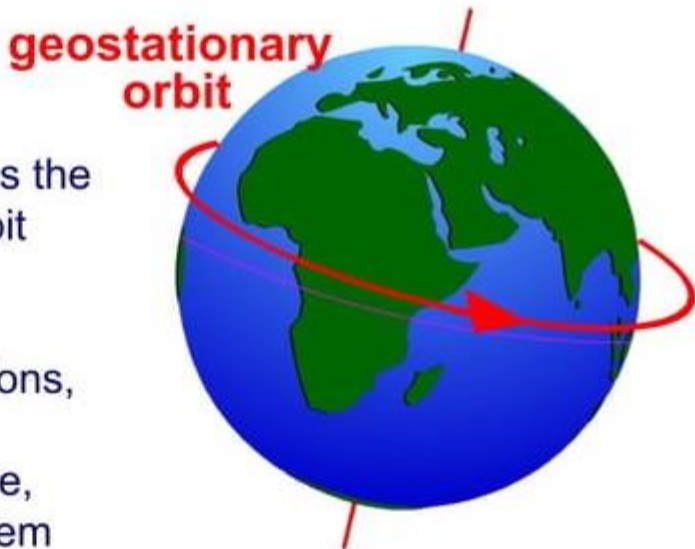
There are lots of artificial satellites in orbit around the Earth and they have many different uses.

Artificial satellites can have different type of orbits.



Geostationary satellites:

- Stay above the same point on Earth.
- Speed of orbit matches the Earth's rotation, so orbit time is 24 hours.
- Used for communications, satellite TV, weather forecasting, intelligence, global positioning system (GPS).



Polar orbit satellites:

- Low orbit around the Earth passing over North and South poles.
- Earth rotates underneath them as they orbit.
- Used for large-scale mapping and global weather monitoring.



Which type of satellite?

geostationary	polar orbit
?	?
?	?
?	?

Speed of orbit matches
Earth's rotation.



solve



Astronomical satellites, such as the Hubble Space Telescope (HST), are large telescopes placed in a high orbit far from the effects of the Earth's atmosphere.



These satellites can 'see' much further into space and give us images of stars and galaxies many light years away, like this cartwheel galaxy.



Meteorites, the Solar Wind and 'space junk' all travel very quickly through space and can damage satellites.



Astronauts need to 'space-walk' in order to fix them.



1. Give two uses of *artificial satellites*.
2. What is meant by a '*geostationary*' orbit?
3. What problems do satellites encounter in space?
4. Why can the Hubble Space Telescope 'see' much further into space and produce much clearer images than telescopes on Earth?
5. Why do astronauts have to wear 'space suits' when repairing satellites?



9J Gravity and Space



Gravity



Weight and mass



Planets and satellites



Summary activities



- **ellipse** – An oval shape which is the shape of a planet's orbit around the Sun.
- **Earth's gravity** – The force of attraction which pulls objects towards the centre of the Earth.
- **gravity** – The force of attraction between any two objects that have mass.
- **mass** – The amount of matter that an object is made of, measured in kilograms (kg).
- **newton** – The unit used to measure force (N).
- **orbit** – The path of a planet around the Sun, or the path of a satellite around a planet.
- **satellite** – Any object that orbits another object.
- **weight** – The amount of force with which gravity acts on an object, measured in newtons (N).



How quickly can you unscramble
anagrams of words about

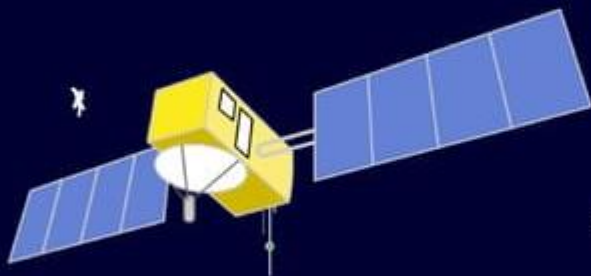
g r a v i t y
a n d
s p a c e ?

Click "start" for the first of eight anagrams.

start



Will you go into orbit in this quiz
about gravity and space?



start

