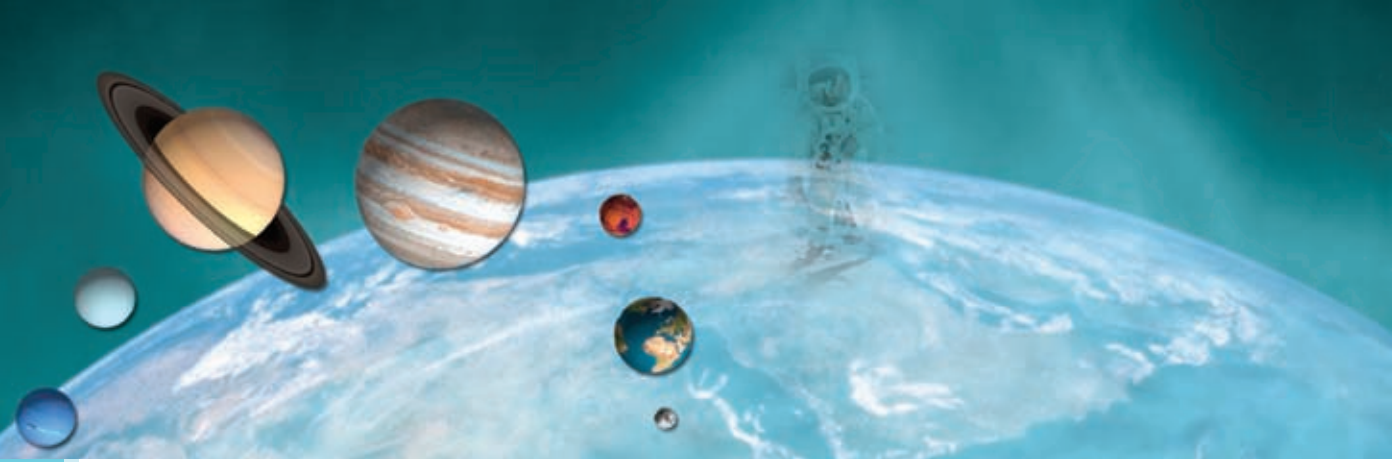


1 The Solar System



The objective of this unit is to study the composition and functions of the Solar System.



Have you carefully observed the sun, moon and the other celestial bodies in the sky? There is evidence that man had shown an interest in knowing about them since ancient times. At present man can explore more than what is visible to the naked eye, as scientists have invented modern equipment to observe the sky.

It has been discovered that there are eight planets, shapeless pieces of planets called asteroids, various celestial bodies such as dwarf planets and natural satellites revolving around the sun. When all these things are taken together; we consider them as a system. This is called the solar system. It is believed that the solar system has been formed 4600 million years ago, by combining dust and particles of gases together.

When we observe the night sky with our naked eye we can see a multitude of stars. Stars are celestial bodies that emit light and heat. Thus they are sources of energy. They can be seen shining or twinkling in the night sky.

The sun is a star that emits light and heat.



However, the other celestial bodies such as planets, natural satellites and asteroids, though they do not emit light, are visible in the night sky as they reflect the sunlight. They are seen with a "Monotonous light that does not twinkle".

Observe the cloudless, clearly visible night sky and get the above information confirmed.

Composition of the Solar System

The Sun and the other celestial bodies which are bound by the gravitational force of the sun belongs to the Solar System.

The celestial bodies found in the Solar System are listed below,

- The Sun, the main body of the Solar System
- Planets, the largest celestial bodies
- Smaller planets or Dwarf planets
- Natural Satellites of the planets
- Millions of other rock particles or debris
 - » Asteroids
 - » Comets
 - » Meteoroids

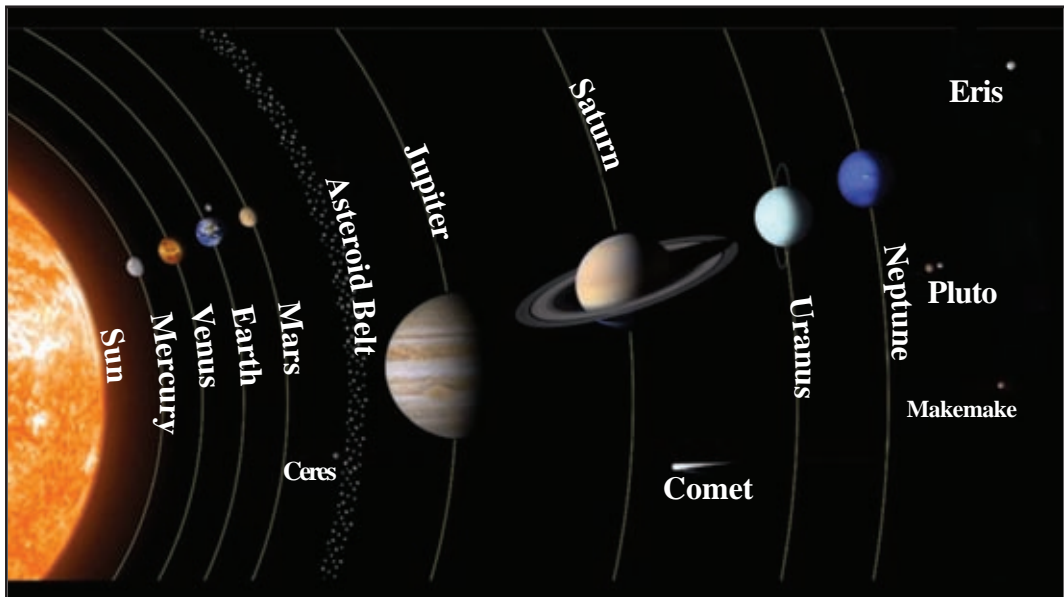


Fig. 1.1 - Solar system

Source - <http://www.retecool.com/wp-content/uploads/2015/09/solarsystem-21.jpg>

The sun

The sun is the main source that provides energy for the existence of life on Earth. The sun lies at the centre of the solar system. A massive amount of heat is generated at the core of the sun as a result of fusion and thermonuclear reactions. The temperature of the centre of the sun is about 15,000,000°C (15 million °C) while the surface temperature is about 6000°C.

Several important facts about the sun are given below;

- It holds 99.86 percent of the total mass of the solar system or the substances that belong to the whole system.
- Its extent is 109 times of the diameter of the Earth. The diameter is 1.4 million kilometres.
- It is a source of energy and it provides energy and heat to all the planets in the solar system.
- Solar storms occur on the surface of the Sun and on such occasions flames would burst out from the sun.
- The sun revolves around its own axis. The time taken for one rotation is 25.4 Earth days.

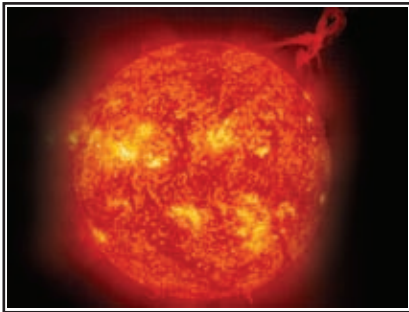


Fig. 1.2 - The sun

Source - <http://nssdc.gsfc.nasa.21/02/2016>

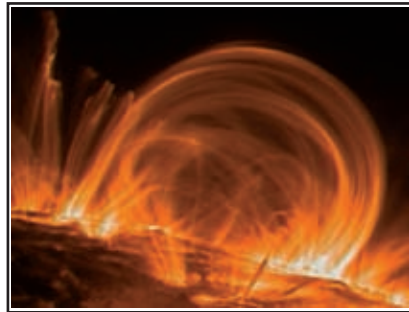


Fig. 1.3 - the Coronal loops that gives out heat on the sun's crust

Activities

1. Name the types celestial bodies that belong to the solar system.
2. Explain how planets and stars differ from each other.
3. Write four specific features of the sun.
4. Prepare an article for a wall paper about the sun, using information from books, newspapers, magazines and the internet.

Planets

Spherical objects that are moving on orbits around the sun are called planets.



The solar system consists of 8 main planets. They are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Between Mars and Jupiter there is a belt of asteroids. Planets have been divided into two categories as interior planets and outer planets.

- **Inner planets**

The planets located between the sun and the belt of asteroids are known as inner planets. (Study Fig. 1.1) They are composed of rocks made up of silicate and metal materials. Mercury, Venus, Earth and Mars belong to the category of interior planets.

- **Outer planets**

The planets located out of the belt of asteroids are known as outer planets. Mars, Jupiter, Saturn, Uranus, and Neptune belong to this category. They are basically gaseous in composition. (Hydrogen and Helium)

Mercury

- Mercury is the closest planet to the sun.
- It is the smallest member of the solar system. It is a bit larger than the moon, satellite of the Earth in size.
- The temperature is extremely hot due to its close proximity to the Sun and slow rotation. The surface temperature is about 167°C .
- There are craters on the surface due to volcanic eruptions.
- It has no atmosphere. Therefore, there is a high risk of falling asteroids and meteors.
- Mercury has no satellites.



Fig. 1.4 - Mercury

Source - www.windows2universe.org/ 13.02.2016

Venus

- Venus is the second planet according to the distance, from the Sun.
- It is the closest planet to the Earth.
- It is the planet with the highest surface temperature (464°C).
- It is somewhat smaller than the Earth in size.
- It is the planet most clearly visible in the night sky.
- The surface of the planet is covered by a thick layer of clouds. Therefore, its surface cannot be seen well. It is visible brightly in the sky due to the reflection of the Sun's rays by this thick layer of clouds.
- The rotation from East to West is a special feature of this planet.
- The main gas found in this planet is Carbon dioxide (96%).
- During one period of the year it is clearly visible in the eastern sky before dawn and during another period, in the western sky after sunset. Hence, Venus is called the morning star as well as the evening star.
- Venus has no satellites.



Fig. 1.5 Venus

Source - www.windows2universe. 13.02.2016

Earth

- Earth is the planet which we live on.
- It is the third planet from the sun in distance and it is the largest among the inner planets.
- It is visible as an attractive celestial object in blue when it is seen from outer space. Hence, it is called the "blue planet".
- According to the information found upto date, it is the only planet with life.



Fig. 1.6 - The Earth a photography taken from Appollo 17

Source - www.windows2universe.

- Existence of water, congenial atmospheric composition and the gravitational power are the reasons for the existence of life on Earth.
- The Earth has one natural satellite called the moon.

Mars

- Mars is the fourth planet from the sun according to distance.
- It is called the Red Planet since it is visible as a reddish object in the night sky.
- We can see Mars with the naked eye as it is the second closest planet to the Earth.
- There is a thin atmosphere and carbon dioxide is the predominant gas.
- Mars has two satellites called Phobos and Deimos.



Fig. 1.7 - Mars

Source - www.windows2universe.org
/13.02.2016

Jupiter



Fig. -1.8 - Jupiter

Source - <http://nssdc.gsfc>.

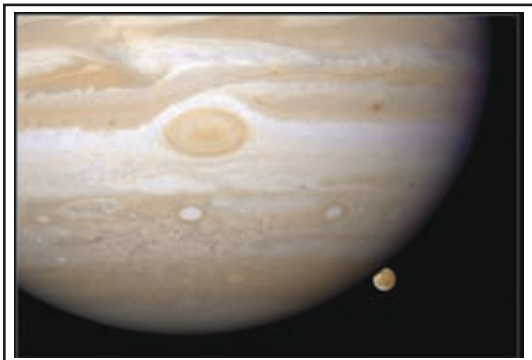


Fig. 1.9 - A close photo shot of the surface of Jupiter

Source - www.windows2universe.org/our_so

- Outer planets begin with Jupiter.
- Among the planets, Jupiter is the fifth planet from the sun and it is the largest planet in the solar system.

- The diameter of the Jupiter is 1,42,984km and it is 10 times than the diameter of the Earth.
- The regions like black stripes as well as bright regions can be seen on the surface of Jupiter.(See fig.1.8)
- Among the planets in the solar system, Jupiter has the highest gravitational force.
- Jupiter has the largest number of natural satellites. According to the observations upto date, it has 67 natural satellites.

Saturn

- Saturn is the sixth planet from the Sun.
- It is the second largest planet and it is about nine times the size of the Earth.
- Saturn has an attractive set of "rings " around it. These rings are formed of ice particles of different sizes.
- Saturn has 62 natural satellites.



Fig. 1.10 - Saturn

Source - Image courtesy of NASA, ESA, J. Clarke (Boston University), and Z. Levay (STScI)

Uranus

- Uranus is the seventh planet from the Sun.
- It is the third largest planet in the solar system.
- It has been found that Uranus too has a thin set of rings around it.
- It has 27 satellites.

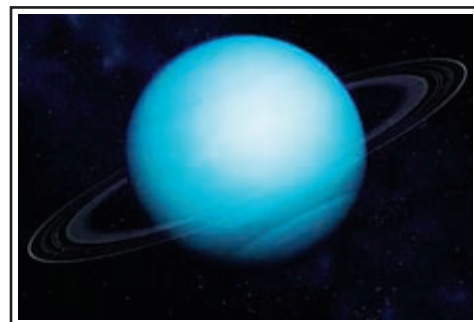


Fig. 1.11 - Uranus

Source - http://s3.amazonaws.com/kidz-world_photo

Neptune

- Neptune is the eighth planet and the one farthest from the sun.
- It is seen in blue.
- It is four times larger than the Earth.
- Neptune is extremely cold due to the long distance from the sun.
- It has 14 natural satellites.

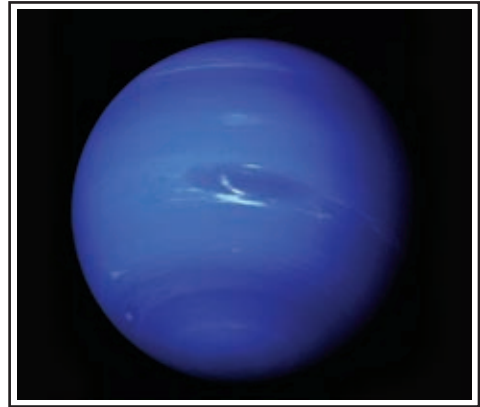


Fig. 1.12 - Neptune

Facts about planets in brief

Table 1.1 - Facts about planets

Planet	Diameter	Rotation period	Period of Revolution	Mean temperature	No of satellites
	km	Hours	Days	Celsius	
Mercury	4879	1407.6	88	167	0
Venus	12104	*5832.5	224.75	464	0
Earth	12756	23.9	365.2	15	1
Mars	6792	24.6	687	-65	2
Jupiter	142984	9.9	4331	-110	67
Saturn	120536	15.7	10747	-140	62
Uranus	51118	*17.2	30589	-195	27
Neptune	49528	16.1	59800	-200	14

Source - <http://nssdc.gsfc.nasa.gov/planetary/factsheet> 21/02/2016

* Rotates from east to west.

Activities

1. Name the planets in the solar system in the order from the Sun.
2. Categorize them as interior and outer planets.
3. Present the composition of the solar system in a diagram.

Assignment

1. Prepare a brochure including information about planets.
2. Using materials that could be easily found, prepare a model of the solar system with Teacher's advice.

Dwarf Planets

The small planets which have no fixed orbits are known as dwarf planets. At present five planets have been identified as dwarf planets. (International Astronomical Association 2006) However, Scientists believe that there may be more than five. The five dwarf planets are shown in the picture below.



Fig. 1.13 - Dwarf Planets

Source - <http://www.the-dialogue.com/wp-content/uploads/2016/02/ensystem>

Natural satellites

The small celestial objects that orbit around planets are called natural satellites. So far, scientists have identified 173 such satellites that belong to the main planets and 8 that belong to the dwarf planets.

Table 1.2 - Number of natural satellites in the solar system

Planets	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptun
No. of satellites	0	0	1	2	67	62	27	14
Dwarf planets	Ceres	Pluto	Haumea	Make make	Eris			
No. of satellites	0	5	2	0	1			

Source - <http://nssdc.gsfc.nasa.gov/planetary/factsheet> 21/02/2016

Asteroids

Asteroids are usually considered as fragments of rock left over when forming the solar system. They are formed with hard rocks and they are of different shapes and sizes. More than millions of asteroids can be found between the orbits of Mars and Jupiter. (Observe fig. 1.1)

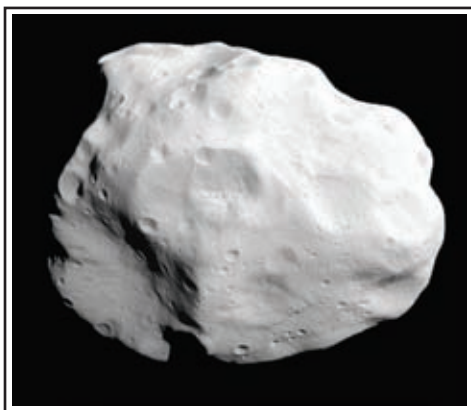


Fig. 1.14 - Asteroids

Activities

1. State the number of natural satellites with the planets in the solar system according to the information found so far.
2. Describe what dwarf planets are and name the dwarf planets found so far.

Beliefs connected with the solar system

Different beliefs exist in the society regarding the impacts of the Sun, the Moon and the other planets on the lives of people.



Several such beliefs are mentioned below.

- Worshiping Sun and the Moon considering them as gods.
- Emergence of the Astrology on the basis of the movements of the Sun and the Moon and other planets.
- Holding ritualistic activities known as 'Shanthe karma', due to the belief that planets have malefic or bad effects.
- The preparation of the horoscope on the basis of the locations of planets at the time of the birth and prevalence of the belief in society that many things are determined by the influence of planets.
- There are various ceremonies on the basis of the Sun and the Moon. (Thaipongal festival, Sinhala and Hindu New Year festival and Ramalan Festival)



Fig. 1.15 - Sinhala new year festival



Fig. 1.16 - Tamil new year festival

- Organization of traditional farming activities based on the influence of the Sun and the Moon. Accordingly, they have the belief that they would reap a good harvest, receive rain on time and have less harm from pests.
- Considering the direction when collecting the parts of herbal plants used for Ayurvedic treatment and the belief that it has the influence of the moon.

Though it is difficult to come to a definite conclusion about these beliefs, they have a practical importance.

New knowledge about the solar system

- The early man used to explore the unseen universe even at the time that science was not developed. New information about the solar system and the universe is continuously added due to the explorations and observations done for a long period since past.
- Galileo Galilee used telescope to observe the universe for the first time in 1610 AC. He was able to reveal more information about the universe not known so far, through the observation conduct using his telescope.



Fig. 1.17 - Galileo Galilee



Fig. 1.18 - Telescope prepared by Galileo Galilee

Person like Claudius Ptolemy, Nicolas Copernicus, Johannes Kepler and Isaac Newton too were enthusiastic in finding information about the universe in the past.

The launching of an artificial satellite to explore information about space in 1957 A.D by USSR (Russia) is an important event in the history. Thereafter United States of America established the National Aeronautics and Space Administration (NASA) and launched several satellites. Images taken by these satellites have helped in broadening the knowledge about the universe.

It was believed that the solar system has nine planets, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto including our living planet Earth. But, in 2006

the International Astronomical Institute declared Pluto as a dwarf planet. Hence, here after it is considered that the solar system has eight planets. It was accepted that there are celestial objects called dwarf planets among other planets that belong to the solar system.

Recently, the "Caltech" Astronomical Institute in U.S.A. revealed information about a ninth planet which is ten times larger than the Earth. This planet has been named as Planet 9. But, it has not been proved yet as a member of the solar system.

As a result of continuous exploratory activities, the knowledge about the space is changing day by day.



Fig. 1.19 - Neil Armstrong's first step on moon



Fig. 1.20 - Launching of a rocket

Activities

1. Prepare a list of the modern discoveries about the solar system.
2. Mention four beliefs found in the Sri Lankan society on the basis of the sun and the moon.
3. State some other beliefs that you are aware of and have heard from your elders which are not included in the text book.

Sources

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Glossary

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- Astrology ජ්‍යෝතිෂ විද්‍යාව $\textcircled{R} \acute{A} \ddot{O} \acute{U} \backslash \ddot{O} i \nu \mu$