**The Moon - Our Closest Neighbour**

The Moon is our closest astronomical neighbour and the brightest object in the night sky. It has no light of its own, however, and instead reflects light from the Sun. It is therefore sideways that enables us to see the craters on the Moon. The Moon is the Earth's only natural satellite. From here it appears almost as big as the Sun. In fact, it is only slightly smaller than the size of the Earth. Nevertheless, it is the most studied object in space, and the only one, apart from our own planet, on which human harbour has existed. The phases of the Moon have been used in the past as calendars since prehistoric times. Its gravitational pull causes most of the Earth's tidal activity (the tides). Two spacecraft have been sent to the Moon. The last men to walk on the Moon were Apollo 11 astronauts Neil Armstrong and Buzz Aldrin. ‘Eagle’ landed on the Moon with just 45 seconds of fuel to spare. Neil Armstrong and Buzz Aldrin descended from the command module and used the Lunar lander to ‘walk on the Moon’. Apollo 15 was the first mission to use a Moon Rover, enabling the astronauts to explore a much wider area than the previous missions. Four months later, Apollo 12 made a successful landing, and astronauts Charles Duke and Alan Bean successfully explored a new area on the Moon. Apollo 14 was the first mission to use the Lunar Rover to explore a much wider area than the previous missions. While the Americans continued their manned missions, in 1971 Russia landed the Lunokhod robotic lunar rover. Lunokhod’s original mission was to survey sites for later manned landings. Instead it was used to maintain the lunar surface controlled by a six man team on earth. After some early tests, including several launch pad explosions, the Russians finally abandoned their manned landing programme in 1974.

**Observing the Moon**

The Moon has no atmosphere, no seasons and no life. The lack of atmosphere means there is no weather and no wind. This means that your telescope is virtually as good as if you were looking at a spacecraft. Viewing with a magnification of 50, on a night when our own atmosphere is weary, you are getting the same view that the Apollo astronauts had when passing just 2500 miles from it. Even with the naked eye, on a clear night an extraordinary amount of detail can be discovered. It is not the hardware, however, that impresses us; it is the impression that the Moon is larger when lower in the sky.

This is a psychological illusion. Some of the Moon’s most spectacular features are in the north-west quarter of which is covered by the vast Oceanus Procellarum and the adjacent dynamic basin of the Marius Hills. The latter resulted from an enormous impact comparatively late in the Moon’s history. You can see through a telescope that the two flows from the impact have flooded earlier craters. The prominent white spot just below it is the magnificent Copernicus crater. The Tycho crater is the Moon’s youngest large impact crater, and is more than 50 miles in diameter, with three-mile high walls. The rays that extend out from it in all directions were once streams of molten rock thrown up by the impact that originally made the crater. In July 1969 Apollo 11 landed on the lunar Tranquility Base, flanked by astronauts Neil Armstrong and Buzz Aldrin. Five other missions landed successfully.

**Moon Geology**

The lunar crust is about 60 miles thick in the highland regions, and considerably thinner under the mare basins. A small amount of the lunar crust, covering the mare basins, acts like the Earth’s outer core accounts for 4 per cent of its mass, but there is no liquid outer core. It is geologically young, apart from a few old maria (basins) and highland plateaus. Some, known as lunar highlands, are a mixture of rock fragments thrown up by the impacts that originally made the craters in the ocean of tranquility, some of which may be remnants of historic processes. Because there is no wind on the Moon, the landscape remains fixed, and features will remain unchanged for many centuries.
THE SPACE RACE

Like many advances in technology, the space programme has its roots in conflict. The German rockets that targeted Britain during World War II were created by Wernher von Braun, an SS officer and member of the Nazi party. Von Braun was the central figure in Germany’s pre-war rocket development program, responsible for the design and manufacture of the deadly V-2 combat rocket. After the war, he and some of his rocket team were taken to the United States as part of the then-secret Operation Overcast. In 1953, ten years after entering the country, von Braun became a naturalised U.S. citizen.

Von Braun worked on the American intercontinental ballistic missile (ICBM) program before joining NASA, where he served as director of NASA’s Marshall Space Flight Center and the chief architect of the Saturn V launch vehicle, the superbooster that propelled the Apollo spacecraft to the Moon. He is generally regarded as the father of the United States space program.

The space race began in 1957 when the Soviet Union launched the first artificial satellite. Soviet Premier Khrushchev wanted to show that communist technology was superior. President Kennedy wanted to beat the Soviets to the moon. Speaking about the prospect of sending astronauts to the moon in 1961, Kennedy said, “No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space. And none will be as difficult or expensive to accomplish.”

THE SPACE RACE TIMELINE

1957 The Soviet Union launches Sputnik, the first artificial Earth satellite. Sputnik is the Russian word for “traveler.”
1958 The United States launches its first satellite, Explorer 1. The National Aeronautics and Space Administration (NASA) is formed in the United States. NASA is the federal agency devoted to exploring space.
1959: Soviet Union’s Luna lander probe passes over the Moon. In the same year, Luna 3 lands (safely) on the Moon and Luna 3 photographic its far side. All three are unannounced.
1961 Soviet cosmonaut Yuri Gagarin becomes the first person to orbit the Earth.
1962 Alan Shepard Jr. becomes the first American astronaut in space.
1963 John Glenn, Jr. becomes the first American astronaut to orbit the Earth.
1963 The first woman in space is Soviet cosmonaut Valentina Tereshkova.
1965 President Kennedy commits the US to “the goal, before this decade is out, of landing a man on the Moon and returning him safe to the Earth.”
1966: Luna 9 (samarium) achieves the first soft landing on the Moon, announced US probe, Surveyor 1, also lands four months later.
1967: Apollo 4 explodes during launch-pad test, killing three astronauts: Edward White, Gus Grissom, and Roger Chaffee.
1968: Apollo 8 is the first manned mission to orbit the Moon.
1969: In a “dress rehearsal” mission two astronauts from Apollo 10 descend to within 10 kilometers of the lunar surface. Two months later, on 16 July, Apollo 11’s Lunar Excursion Module lands on the Moon. Neil Armstrong and Buzz Aldrin become the first men to walk on the Moon; Michael Collins remains on the main Apollo craft. Four months later, Apollo 12 (astronauts Conrad, Bean, Gordon) has a successful landing.
1970: Apollo 15’s early mission Apollo 16, 18, 19, and 20, missions; scheduled for 1973-1975, were cancelled to make funds available for the Space Shuttle program.
1971: Unmanned Soviet probe Luna 17 retrieves rock and dust from the Moon.
1971: Successful lunar landing missions by Apollo 14 (astronauts Shepard, Mitchell, and Bean) and Apollo 15 (Scott, Irwin, Worden).
1972: Successful lunar landing missions by Apollo 14 (Young, Duke, Mattingly) and Apollo 17 (Gennett, Schmitt, Stewart). The latter, in particular, yields large amounts of geological data—but marks the end of the Apollo program.
1974: Soviet Union abandons its manned Moon project.
1975: Unmanned Soviet probe Luna 24 (Zvyagintsev, Belyaev, Savvin) has a successful landing.
1977: Viking 2 has a successful landing.
1979: Voyager 1 and Voyager 2 (Sagert, Wilson, and Scott) sends the first mission to the outer solar system. Voyager 2 (Close, Thomas, and Neugebauer) becomes the first mission to leave our solar system.
1996: Mars Pathfinder lands on the surface of Mars, is the first mission to land on Mars since Viking II in 1976. The Pathfinder mission is designed to determine the habitability of the Martian surface, and to provide a base for future robotic missions to Mars.
1997: The Mars Climate Orbiter is launched.
1999: The Mars Atmosphere and Volatile EvolutioN (MAVEN) mission is launched.
2004: The Mars Exploration Rover Spirit lands on Mars. The purpose of the mission is to study the geological and chemical history of Mars.
2005: The Mars Reconnaissance Orbiter (MRO) is launched.
2006: The Mars Express spacecraft is launched.
2006: The Mars Reconnaissance Orbiter (MRO) is launched.
2006: The Mars Reconnaissance Orbiter (MRO) is launched.

LUNAR TIDES

Tides are created because the Earth and the Moon are attracted to each other, just like magnets are attracted to each other. The Moon’s pull on the Earth causes the ocean to bulge out in the direction of the Moon. The Moon’s gravitational pull is very strong compared to the Earth’s. The Moon’s gravity is stronger than the Earth’s gravity.

The Moon’s Gravity

The Moon is closer to the Earth than it is to any other planet in our solar system. This means that the Moon’s gravity is much stronger than the Earth’s. The stronger the Moon’s gravity, the stronger the pull on the Earth’s oceans.

The Moon’s Gravity

The Moon’s gravity is stronger than the Earth’s. The Moon’s gravity is called the “lunar gravity.” The lunar gravity is about 60% of the Earth’s gravity.

Tides are the periodic rise and fall of large bodies of water. Winds and currents move the surface water causing waves. The gravitational attraction of the Moon causes the oceans to bulge out towards the direction of the Moon. Another bulge occurs on the opposite side, since the Earth is also being pulled towards the Moon (and away from the water on the far side). Ocean levels fluctuate daily as the Sun, Moon, and Earth interact. As the Moon travels around the Earth, the combined gravitational forces cause the world’s oceans to rise and fall. Since the Earth is rotating while this is happening, two tides occur each day.

The Moon and the Tides

Tides are the periodic rise and fall of large bodies of water. Winds and currents move the surface water causing waves. The gravitational attraction of the Moon causes the oceans to bulge out towards the direction of the Moon. Another bulge occurs on the opposite side, since the Earth is also being pulled towards the Moon (and away from the water on the far side). Ocean levels fluctuate daily as the Sun, Moon, and Earth interact. As the Moon travels around the Earth, the combined gravitational forces cause the world’s oceans to rise and fall. Since the Earth is rotating while this is happening, two tides occur each day.

Types of Tides

When the Sun and the Moon are aligned, there are exceptionally strong gravitational forces, causing very high and very low tides which are called Spring tides. These are also called “neap” tides. When the Sun and Moon are out of alignment, the gravitational forces cancel each other out. When the Sun and Moon are aligned, the gravitational forces cancel each other out.

Neap Tides occur during the Moon’s quarter phases.

When the Sun and Moon are not aligned, the gravitational forces cancel each other out. When the Sun and Moon are aligned, the gravitational forces cancel each other out.

Spring Tides occur during the Moon’s new and full phases.