Facilitator Information

(All you need to know about the Moon to survive the day)

Why does our Moon shine?

Just like the planets, our Moon does not produce its own light. It “shines” because it reflects the Sun's light. At times, our Moon reflects so much light that it makes viewing parts of the night sky challenging!

Why does our Moon's shape change?

Our Moon's shape doesn't really change — it only appears that way! The “amount” of Moon that we see as we look from Earth changes in a cycle that repeats about once a month (29.5 days). The relative positions of our Sun, Earth, and Moon, cause these changes.

As our Moon orbits around Earth, the side facing the Sun is always illuminated, just like Earth's daylight side is illuminated by the Sun.

What we see *from Earth*, however, is a different story. Starting with the dark new Moon, we see the light part of the Moon “grow” from a sliver to a half to a full Moon — and then the illuminated part decreases, becoming thinner until there is no visible Moon in the sky and we are at the new Moon part of the cycle again.

We have a “new Moon” when our Moon's orbit around Earth moves it between Earth and the Sun. From Earth, the Moon's surface looks dark because the illuminated side is facing away from Earth. As our Moon continues its orbit counterclockwise around Earth (viewed from above the north pole), more and more of the illuminated part of the Moon becomes visible to us, until it reaches the “full Moon” stage. A full Moon occurs when the Moon has moved in its orbit so that Earth is “between” the Moon and the Sun.

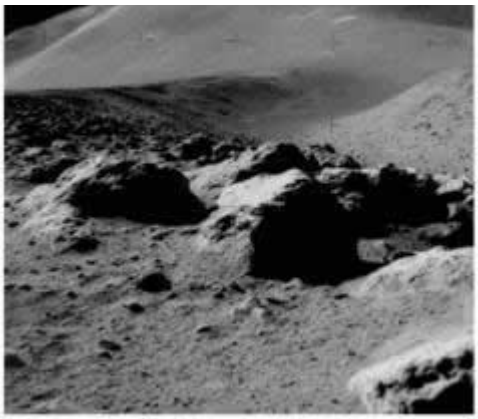
Between the new and full Moon, the amount of Moon we see grows — or waxes from its right side toward its left side. As it passes the full Moon stage, the amount of illumination decreases — or wanes — from right to left. Finally, the Moon returns to its position between the Earth and the Sun, and on Earth we observe the new Moon again.

In the southern hemisphere, illumination of the Moon increases from the left to the right side in the waxing phase and the dark part increases in coverage from left to right in the waning phase, which is opposite of the northern hemisphere. No matter where on Earth an observer is, however, the phases of the Moon occur at the same time.

What is our Moon like?

Our Moon has relatively young dark smooth lowlands (mare), and ancient light rough highlands (terrae). The highlands are covered with craters from asteroid and comet impacts; there are fewer craters on the younger lowlands.

The surface is covered with crushed rock material called regolith — in some cases deeper than 15 meters (50 feet). Regolith is rock that has been pulverized by the impacts.



The Moon has no atmosphere, so there is no wind and the sky is dark — like the Earth's sky on a clear night. There are extreme temperatures: 130°C (265°F) during the day and –155°C (–250°F) at night. There is no flowing water at the surface of the Moon; any existent water is frozen in the areas that are permanently shadowed; these are the only areas not exposed to the Sun's heat during part of the lunar day.

Space is filled with radiation, primarily from our Sun; this radiation is deadly to humans unless they are protected from it. While Earth's atmosphere and magnetic field offers us protection from incoming solar radiation, the Moon has virtually no magnetic field and so the radiation levels are very high.

Because it is less dense and smaller than Earth, the Moon has less gravity. The surface gravity is 1/6 Earth's gravity. Our Moon is tilted on its axis only a tiny amount, so there essentially are no seasons. The Moon orbits Earth once every 27 days — and turns on its axis once every 27 days. This means that the lunar "day" is equal to a lunar "year." It also means that the near side faces Earth constantly. Astronauts would experience daylight for almost two Earth weeks and then darkness for the same time.

How did the Moon form?

How Did Our Moon Form?

Most scientists now believe that about 4.5 billion years ago, shortly after the planets in our solar system formed, a planetary body - half the size of Earth - collided with Earth. The impactor broke apart and pieces of the impactor and Earth's outer layers were blown out into orbit around Earth. Over a short time — perhaps a hundred years or less, these pieces collided and stuck together — accreted — to form our Moon.

The heat from accretion caused the Moon, or at least its outer layer, to melt, creating a magma ocean. Eventually the crust cooled. For the first 600 million years of its existence, large asteroids continued to strike the Moon and the planets in our solar system, creating the large basins and craters we see on the Moon. After about 3.9 billion years, much of the "debris" in the solar system had been swept up into the planets and their Moons, and impact strikes were smaller and less frequent.

While cool on the outside, the interior was still hot. Molten rock would still rise to the Moon's surface and break through cracks or erupt at volcanos. The lava filled the basin and crater floors — the low areas on the Moon. It cooled quickly, forming fine-grained dark, volcanic rocks called basalt; basalt is the most common type of volcanic rock we find Earth. When you look at the Moon, you can see the large, somewhat circular, dark basins. These are the basalt-filled ancient impact basins. In spite of this exciting beginning and history, the Moon has been geologically inactive for at least the last billion years.

What will it be like to live and work on the Moon?

If humans are to live on the Moon, even for brief periods, they will need a wide range of support systems. They'll need a place to work, rest, and live that protects them from the cold and dangerous radiation of the space environment. They will need power, light, air, food, water, and heat. They'll need robust transportation and equipment able to operate in low temperatures and the hostile environment of space. They will need to be able to communicate with Earth, other colonies, and shuttles.

They will also need to deal with health issues. Reduced gravity is a challenge to people living on the Moon with one-sixth Earth's gravity. Under reduced gravity conditions, there is less "load" on bones and muscles, so living organisms lose bone mass, muscle tissue, and fluids. Even the heart — a muscle — loses mass because it does not have to work as hard. Humans on the Moon must exercise to maintain their bone and tissue mass so that they can return to Earth's gravity and function well. More research is needed to understand the effects of reduced gravity on the human body — and how to counter these effects.

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Any habitat would have to provide shelter from the extreme temperatures and from incoming radiation. Moon bases may include subsurface buildings to increase protection from radiation and micrometeorites.

There probably would be three basic types of modules: habitation, laboratory, and support modules. The habitat would have sleeping quarters, a kitchen (or galley), and bathroom facilities. Windows would have to be small and made of multiple thick glass sheets to block cosmic radiation. Laboratory modules would be used for conducting experiments. A colony would also need several types of support modules and facilities, including a greenhouse to grow food; a power plant — either solar or nuclear; a place to store construction equipment and do maintenance; a central control, life support, and communications center; resource utilization facilities for processing mined materials; and a landing/launch pad.

The colony team would initially include scientists and engineers. These individuals would probably have many other capabilities, such as medical training and construction training. As the colony grew, other personnel would need to be added. They would conduct research and experiments in the laboratories, work on colony construction, maintain the base, and mine resources. Medical specialists, cooks, safety specialists, administrative staff, and cleaning crews would be needed to support the efforts. These crews would be replaced on a regular basis in the same way as teams who work at Antarctic bases on Earth.

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