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Highlands Astronomical Society

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# A Daytripper's Guide to Touring The Moon

To be used in conjunction with the skyran Moon exhibition in Stromness Academy during September 2018

*(part of Orkney International Science Festival)*

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## 1 The Moon

The Moon is a little more than one quarter the size of Earth

The Moon's diameter is 2,160 miles (3,476 km)

The Moon's total surface area is 14,658,000 sq. mi (37,932,000 sq. km)

The Moon rotates at ten miles per hour

Average distance between the Earth and the Moon is about 239,000 miles

The Moon's gravity is 1/6 that of Earth

The speed in which the moon orbits the earth is at 2,300 miles an hour

Temperatures on the moon range from -233°C to +123°C

The Moon's gravity affects the oceans on earth

Only one side of the Moon is visible from earth at any given time

The Moon orbits around the Earth every 29 days

It takes the Moon the same amount of time to rotate on its axis that it takes to orbit around the Earth

During the Cold War, the United States had considered detonating nuclear weapons on the Moon to demonstrate its power to the Russians.

The Impact Theory is the currently accepted thinking on the formation of the Moon

According to this theory, when still very young the Earth collided with another planet two to three times the size of Mars.

The other planet was destroyed in the collision, ejecting a huge cloud of debris into Earth orbit.

This debris gradually coalesced to form what is today the Moon.

The impact theory would explain why the density of the Moon is similar to that of Earth's mantle, why it lacks an iron core and why the Moon appears to have been extensively molten at one time in its past.

## 2 The Far Side of The Moon

References are often made to the "dark side" of the Moon.

This popular term refers to the fact that the same physical half of the Moon, the "near side", is always facing Earth, which in turn means that there is a far side or so-called "dark side" that is never facing Earth and can only be seen from space.

Why are we limited to seeing only 50 percent?

The Earth rotates on its own axis, so theoretically, the Moon should also do the same, allowing us to get a full picture of the planetoid.

The **speed** at which the Moon rotates has led to this particular phenomenon.

Millions of years ago, the Moon spun at a much faster pace than it does now.

The gravitational influence of the Earth has gradually acted upon the Moon to slow its rotation down.

This influence slowed the rotational period of the Moon to match that of its orbit – about 27.3 days (sidereal period)– and it is now "locked in" to this period.

*Note that to observers on Earth a full Moon cycle takes 29.5 days (synodic period), because we are effectively a "moving platform" rather than viewing from a point outside our solar system.*

If the Moon didn't spin at all, then it would show its far side to the Earth while moving around our planet in orbit.

However, since the rotational period is exactly the same as the orbital period, the same portion of the Moon's sphere is always facing the Earth.

One reason that the far side of the Moon is frequently referred to as the "dark side" is because many people mistakenly think that it never sees any light from the Sun.

In that sense the term "dark side" is wrong and misleading.

Since the Moon is constantly rotating on its own axis, there is no area of the planetoid which is in permanent darkness, and the far side of the Moon is only completely devoid of sunlight during a Full Moon – when the Sun is facing the Moon with the Earth in between.

### 3 A Wee Bit More Than Half

A little bit more than half of the Moon's surface is actually observable from Earth.

The Moon's orbit is elliptical, and not circular, so the speed of its orbital travel increases and decreases depending on how close it is to our planet.

The rotational speed of the Moon is constant however – and this difference between orbital speed and rotational speed means that when the Moon is farthest from the Earth, its orbital speed slows down just enough to allow its rotational speed to overtake it, giving observers a small glimpse of the usually hidden area.

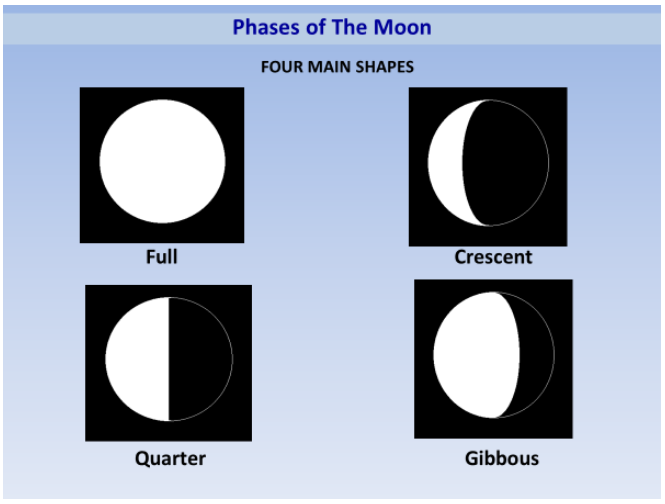
The term for this "rocking" motion of the Moon is called **libration** and it allows for 59 percent of the Moon to be seen in total (over time).

## 4 Phases of The Moon

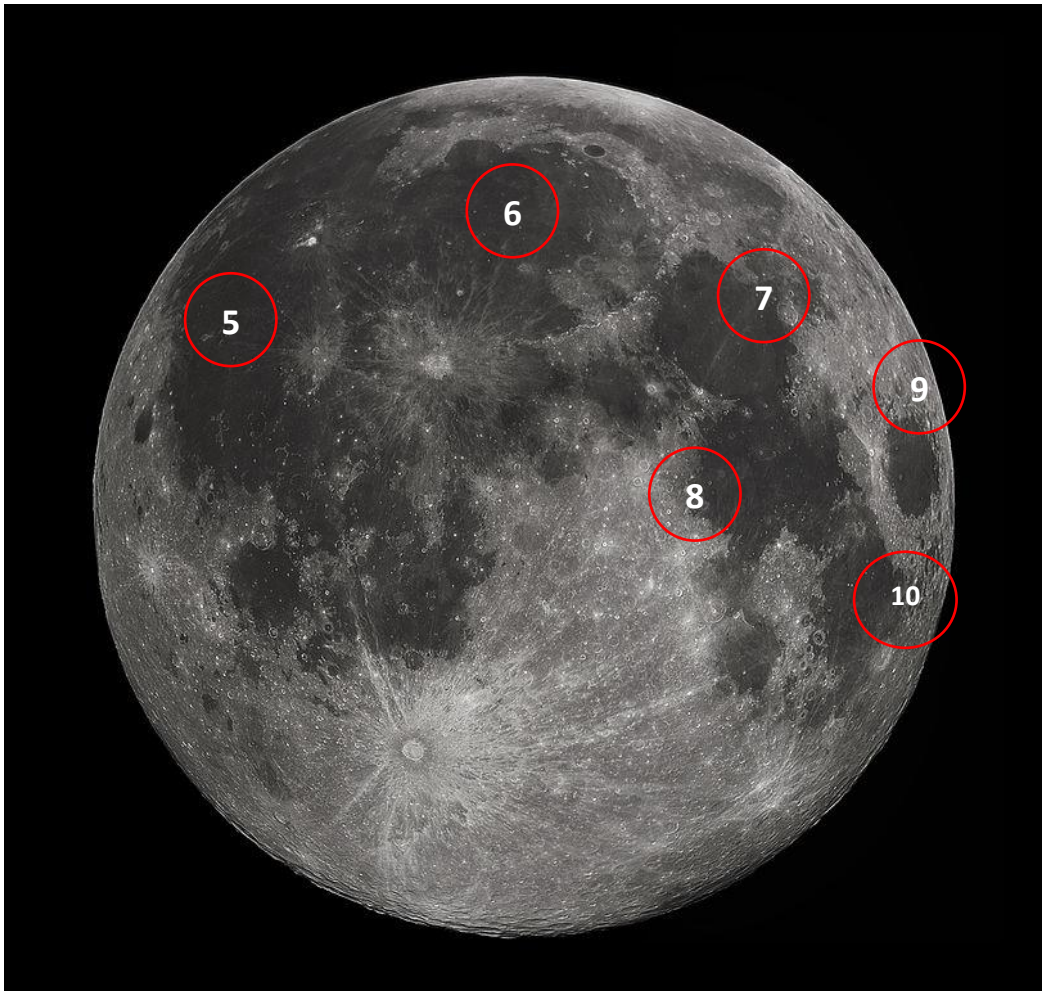
Moonlight is reflected sunlight. Half the Moon's surface is always reflecting light.

From Earth we see different amounts of the Moon's lit surface.

The amount seen is called a "phase"



**5, 6, 7, 8, 9, 10 Mare Procellarum, Imbrium, Serenitatis, Tranqullitatis, Crisium, Fecunditatis, Nectaris, Nubium**




Lava flood plains from volcanic activity. Origins of the original basins varied.

5 Mare Procellarum: Ocean of Storms; largest maria (1,600 miles NS, 1.5M sq mi)

6 Mare Imbrium: Sea of Rains; largest crater in solar system (flooded with lava)

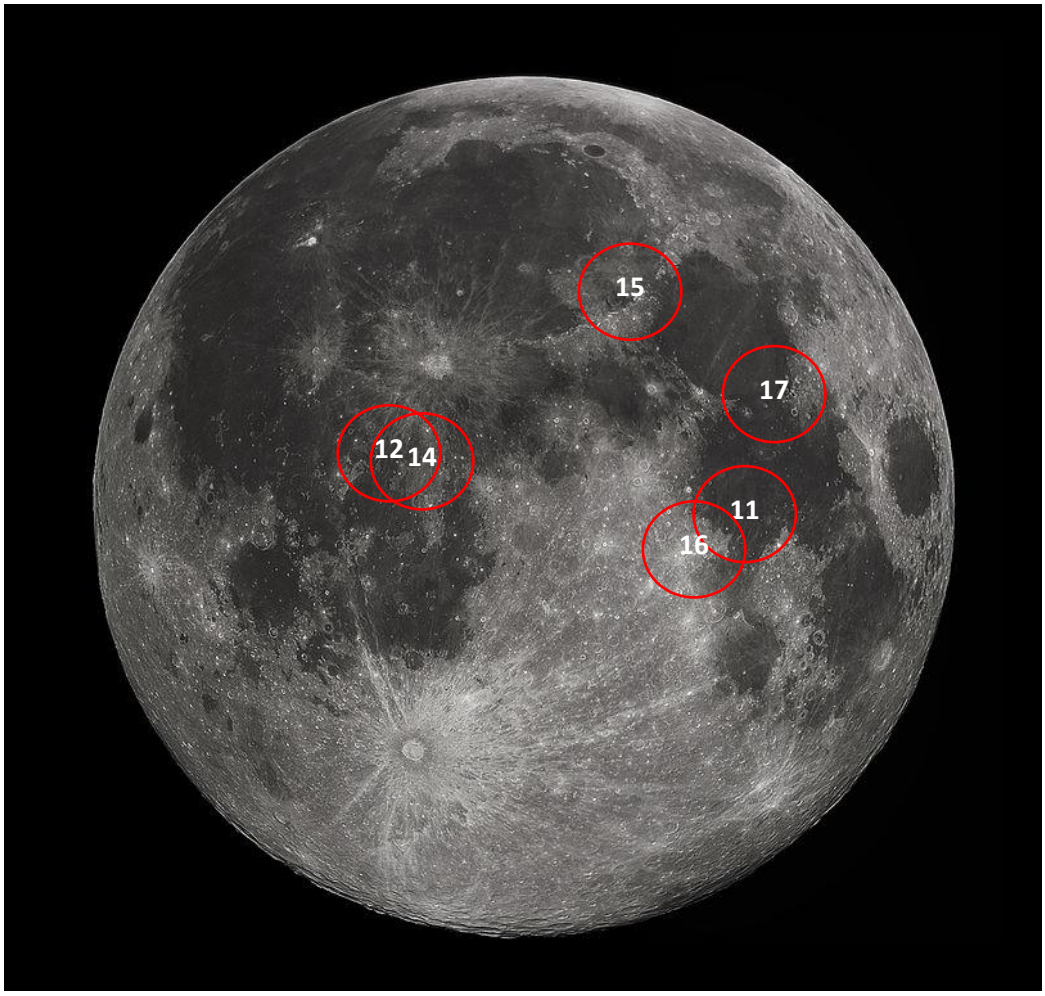
7 Mare Serenitatis: Sea of Serenity; a mascon (mass concentration, or gravitational high, anomalous gravitational region on the Moon)

8 Mare Tranquillitatis: Sea of Tranquillity; slight bluish tint compared to rest of Moon due to metal content in rocks

9 Mare Crisium: Sea of Crises; mascon in its centre

10 Mare Fecunditatis: Sea of Fertility; first automated sample return via Luna 16 probe in September 1970

**11 Apollo 11 Moon Landing & Craters Armstrong, Aldrin, & Collins**




**12, 14, 15, 16, 17 Apollo Moon Landing Sites**

12 Apollo 12: Conrad, Gordon, & Bean; first precise landing, 2 EVAs, returned parts of Surveyor 3 probe

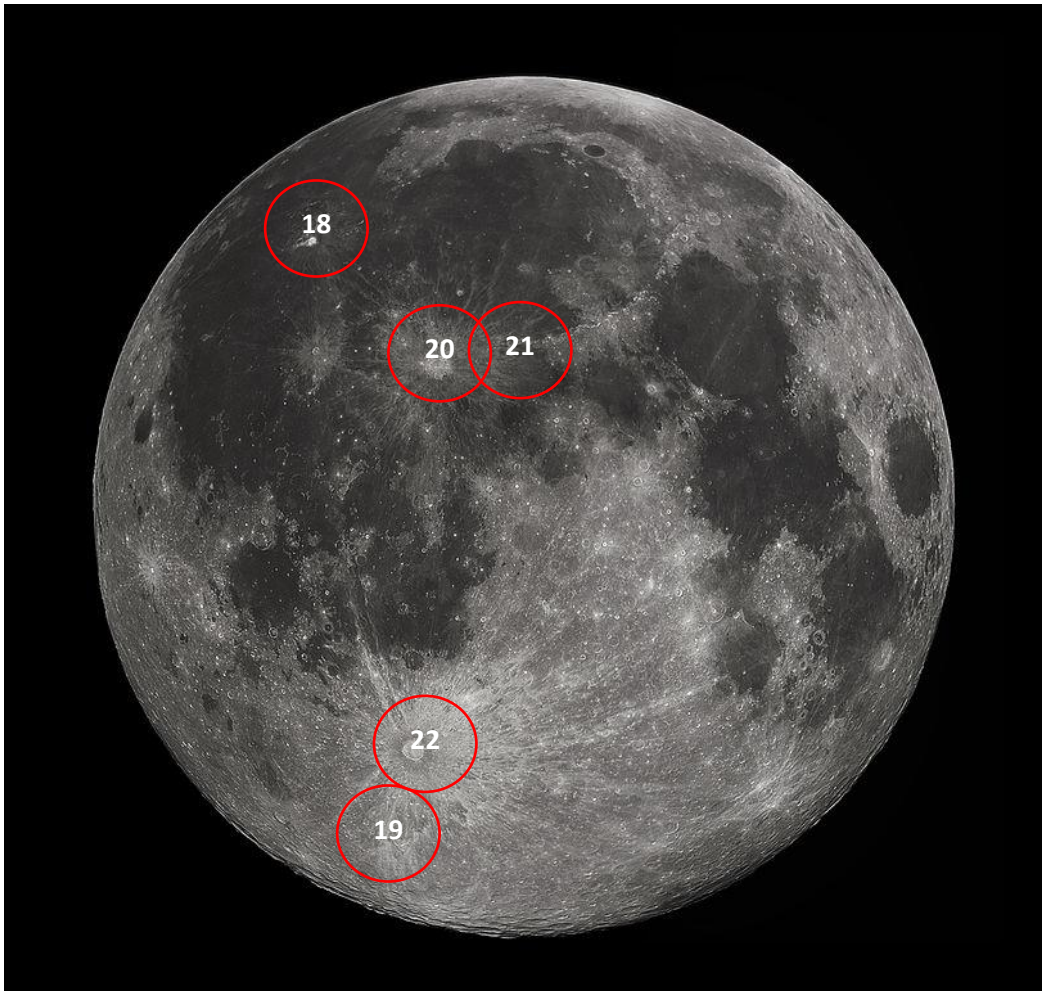
14 Apollo 14: Shepard, Roosa, Mitchell, first colour broadcast TV, 2 EVAs, first materials science experiments in space

15 Apollo 15: Scott, Worden, Irwin; first extended LM stay (3 days), first use of lunar roving vehicle (LRV), 3 EVAs + 1 deep space EVA

16 Apollo 16: Young, Mattingly, Duke; 3 lunar EVAs + 1 deep space EVA

17 Apollo 17: Cernan, Evans, Schmitt; first professional geologist on Moon, first night launch, 3 lunar EVAs + 1 deep space EVA, last ever humans on another planet(oid)

**18, 19, 20, 21, 22 Nearside Craters: Aristarchus, Clavius, Copernicus, Eratosthenes, Tycho**




Aristarchus: impact crater, brightest formation on lunar surface (double the albedo of most lunar features), deeper than Grand Canyon

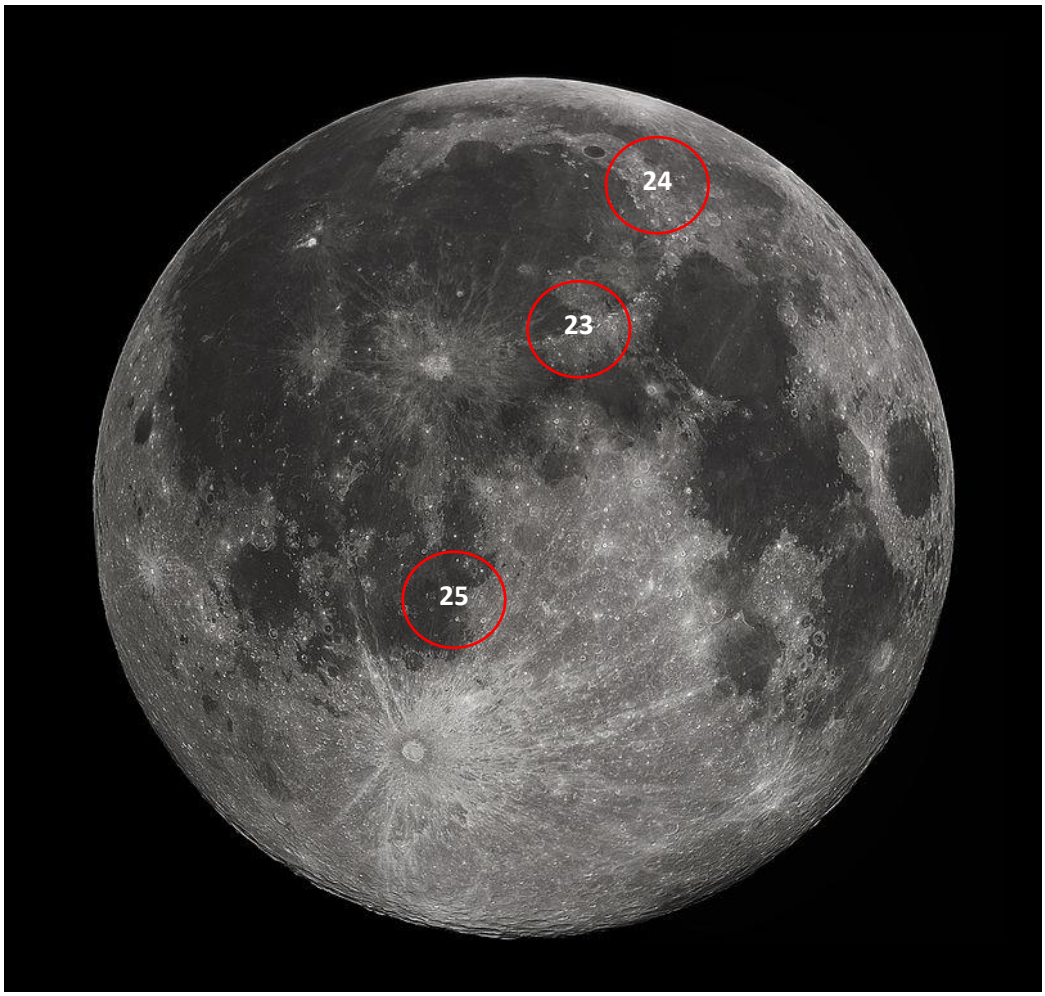
Clavius: 2nd largest crater on near side, one of oldest formations on the Moon but still well preserved, "pock-marked" with many other craters of different sizes

Copernicus: prominent ray system, relatively young & well-preserved, terraced rim walls with landslides, three isolated mountain peaks in its floor

Eratosthenes: deep lunar impact crater, terraced inner wall, three very distinct central mountains

Tycho: prominent lunar impact crater, 108 million years old, smaller craters surrounding it formed from large chunks of ejecta from its formation, ray system

**23 Apennine Mountains 24 Montes Alpes & Alpine Valley 25 Rupes Recta**

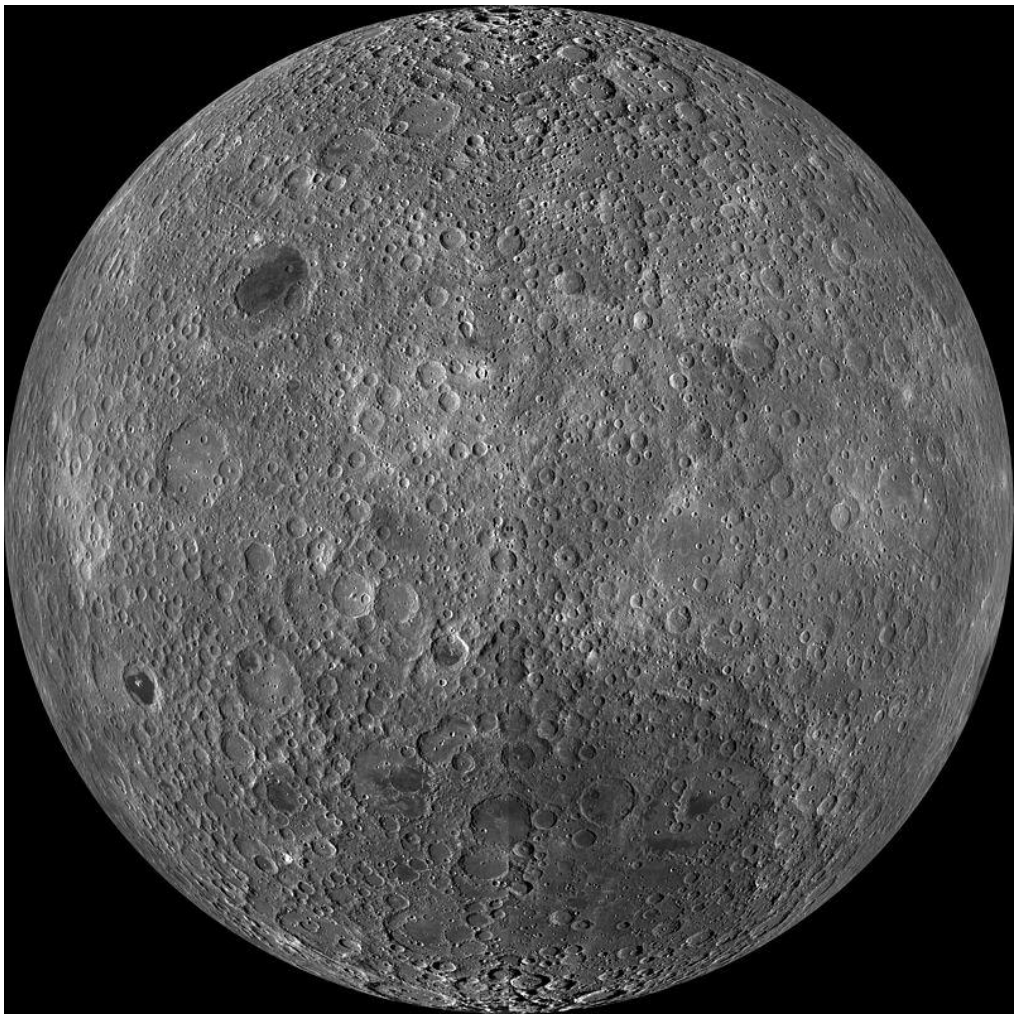



23 Apennine Mountains: distinct rugged mountain range bounding Mare Imbrium, formed about 3.9 billion years ago

24 Montes Alpes & Alpine Valley: a wide rift valley separates the NW mountains from the rest, extends to form a narrow cleft reaching the edge of Mare Frigoris

25 Rupes Recta: "Straight Cliff" or "Straight Wall"; linear fault, most well-known escarpment on the Moon (popular with observing amateur observors), 110km long, 2-3km wide, 240-300m high

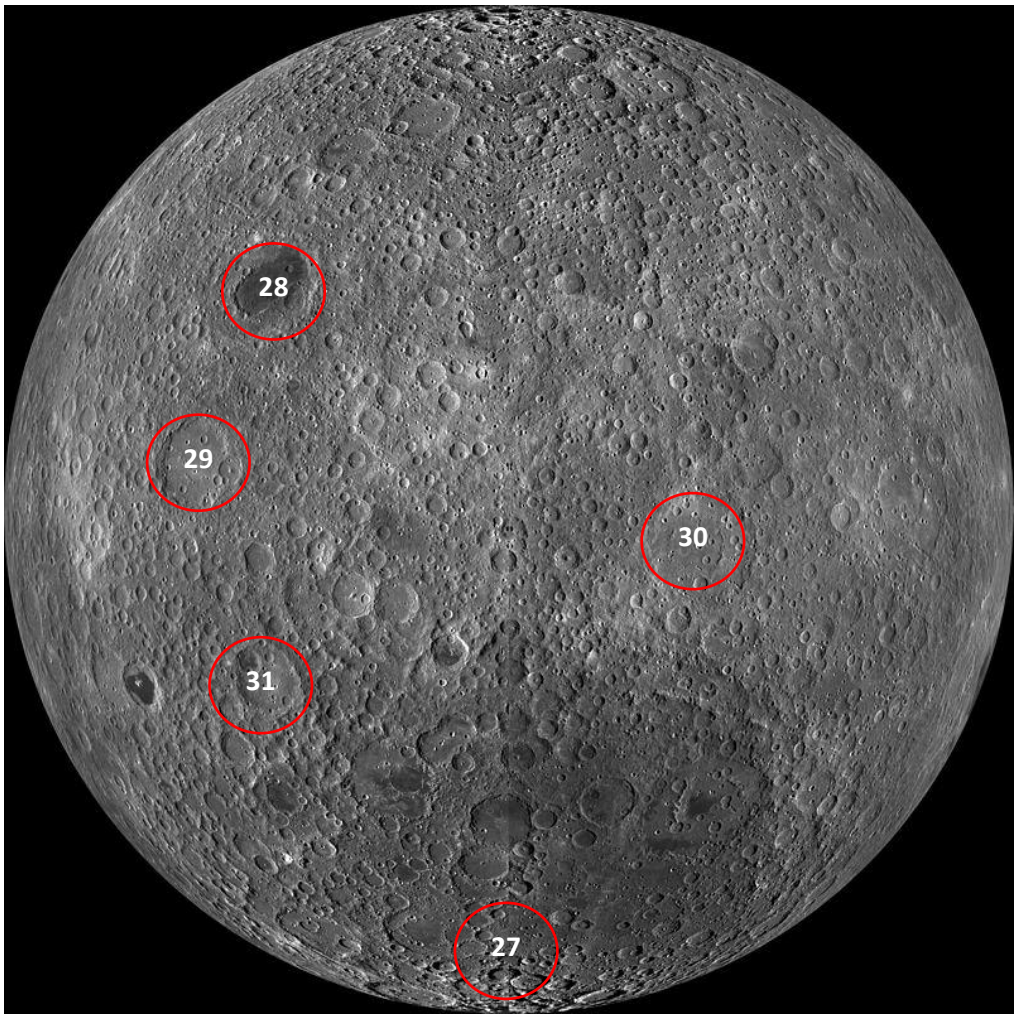
**26 Far Side of Moon**




Always faces away from Earth, rugged with a multitude of impact craters, relatively few flat lunar maria (only 1% compared to nearside at 31%). Like the near-side, it experiences two weeks of sunlight followed by two weeks of light.

18% is visible to Earth due to libration, the remaining 82% remained unobserved until 1959 when the Soviet Union's Luna 3 space probe photographed it. The Apollo 8's mission crew were the first humans to directly view this region in 1968.

The Lunar Reconnaissance Orbiter (LRO) is currently orbiting and mapping the Moon in great detail.




**27 South Pole-Aitken Basin**

One of the largest known impact craters in the solar system. 1,600 miles diameter, 8.1 miles deep

**28 Mare Moscoviense**

"Sea of Moscow". Sits in the Moscoviense Basin (which has a mascon at its centre). Very deep and likely allowed mare volcanism – the crust is thicker on the far side of the Moon and made it harder for lavas to reach the surface.


**29 Mendeleev Crater**

Nearly level interior contains a number of craters in a rough pentagon formation

**30 Korolev Crater**

Within its interior there are the remains of a second, inner ring

**31 Gagarin Crater**

Named after the first man in space (12th April 1961) Yuri Alexseyevich Gagarin. Six craters falling within its perimeter have been named after pioneers of Russian aviation and aeronautics.

**32 Earth**

If we peek around the right hand side as we look at this far side of the Moon we can see our Earth *(the green illuminated Exit sign in this case!)* indicating it is time for us to pack our bags and venture back home