THE STAR

THE NEWSLETTER OF THE
MOUNT CUBA ASTRONOMICAL GROUP
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OUR PROGRAMS ARE HELD THE SECOND TUESDAY OF EACH MONTH AT 7:30 P.M. UNLESS INDICATED OTHERWISE
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NOVEMBER MEETING
TUESDAY THE 11TH 7:30 p.m.

OCTOBER MEETING REVIEW:

Dave Groski gave a presentation on the Spilhaus Space Clock. This is such an interesting devise that I shall cover it in more detail under the Points of Interest section of the STAR. Dr. Hank Bouchelle once again gave a truly informative talk on not one but several topics related to Astronomy and Physics in general. Since he covered such a varied group of topics, I shall also cover them in the Points of Interest section.

Phenomena: Knock! Knock! Is Anyone home?

Hank Bouchelle

Cinematic depictions of the events accompanying an alien visit are almost uniformly dire. Alien intentions are almost always destructive, deadly, or intended to enslave. They destroy entire populations, and unleash weapons that easily turn Earth to dust. Reports of personal interactions with aliens frequently relate queasy adventures in proctology.

It is a bit strange, then, that many people, especially among the scientific community, spare no effort or cost to detect alien messages or the electronic fingerprint of signals that are not produced by the nature. Around our planet are vast arrays of antennae exquisitely tuned to what are most likely the frequencies alien civilizations might prefer?

Beginning about 25 years ago, signals carrying our radio and television programs were beginning to stream past regions of space that are the closest in which life may be found. (Were Earth itself at that distance, our equipment is capable of detecting and making whatever sense the signals might contain.) Thus, for about 25 years, any alien civilizations in existence have received runs and endless re-runs of presidential assassinations and the conduct of numerous wars. They would also have Technicolor renderings of the treatment alien visitors could expect were they to drop by for a chat.

Frankly, a visit by space aliens, with memories of these broadcasts in mind, gives me the willies. I suspect that I would try to persuade those guys that I had just arrived myself.

There is hope that we will not be called to account, and it arises from a perverse interpretation of the Drake Equation. (http://www.seti.org/drakeequation) This celebrated mathematical statement offers a handle on the likelihood of other life in the cosmos. The Drake Equation manipulates the overwhelmingly large numbers of stars and possible planets and galaxies to suggest that such large numbers make it likely that we are not alone. For example, there are more or less 400 billion stars in our Galaxy. And there are assuredly billions of galaxies around us. The Drake Equation suggests a likelihood of suitable conditions on possible planets and in such huge numbers that it is difficult to imagine that there is NOT life elsewhere.

However, at this time, the sample size with which we work is one: Earth. About half a billion years ago (give or take a billion or two) an object the size of Mars crashed into Earth. This object's less dense material and much of what was then Earth's surface

were ejected into space to become the Moon. The relatively dense core of that object sank and combined with Earth's core. Earth's original surface and its primordial atmosphere were blasted away. The timing and magnitude of such an event surely had an impact on the circumstances that eventually led to a planet with people. The Drake Equation does not take into account the importance of events that may be unique in the entire Universe.

<u>THIS ISSUE OF THE STAR:</u>

The Moon.

<u>OBSERVATIONS FROM THE CONFORTABLE CHAIR</u>
Hank Bouchelle Co-Chair MCAG

<u>ASTRONOMICAL TERMS AND NAMES OF THE MONTH:</u>

The Mission of the Mt. Cuba Astronomy Group is to increase knowledge and expand awareness of the science of astronomy and related technologies.

When reading the articles in the STAR, you will come across various terms and names of objects you may not be familiar with. Therefore, in each edition of the STAR, we will review terms as well as objects related to Astronomy and related technologies. These topics are presented on a level that the general public can appreciated.

From time to time, I like to be a bit of a little rascal. So I'm going to turn the table on each of you and ask for your definition of anthropocentric arbitrariness. My hope is the teachers in the group will use this as extra credit for there students.

Regolith: A layer of loose, heterogeneous material covering solid rock. It includes dust, soil, broken rock, and other related materials and is present on Earth, the Moon, Mars, some asteroids, and other terrestrial planets and moons.

Quadrature: the position of a body (moon or planet) such that its elongation is 90° or 270°; i.e. the earth-sun-body angle is 90°

<u>NOVEMBER'S SKY:</u>

1-7 Mercury reaches greatest elongation from the Sun on November 1 and remains well-positioned for viewing in the eastern sky before dawn until November 7. The planet reaches magnitude -0.6 and appears half-lit in a small telescope. The planet plays cat and mouse with the slightly fainter white star Spica in the constellation Virgo.

6 Full Moon, 22:23 UT. ("Beaver Moon" or "Frosty Moon")

14 Last Quarter Moon, 15:16 UT.

14 Jupiter reaches greatest western quadrature, the point at which it lies 90º west of the Sun as seen from Earth. The planet rises near midnight by mid month and lies well overhead in the "Sickle of Leo" in the early morning hours. The planet reaches a brilliant magnitude -2.2 by month's end.

17 Look for the Leonid meteor shower early this morning. The Moon is not around to obscure faint meteors, so this is a good year to see the Leonids. Look for 15-20 meteors per hour. They can appear anywhere in the sky, but they trace their path back to a point in the constellation Leo. The Leonids are usually modest in number. But they have been known to surprise to the upside.

18 Saturn disappears from the evening sky as it reaches conjunction with the Sun. The planet moves slowly into the morning sky over the rest of November.

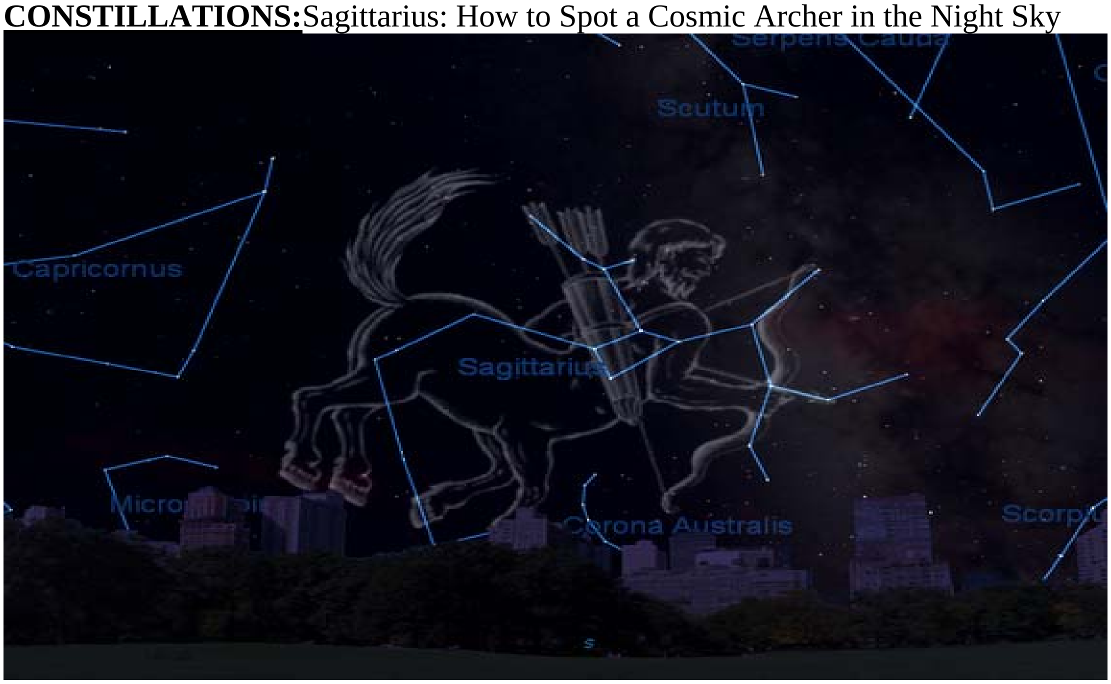
22 New Moon, 12:32 UT.

25 Look for Mars near the waxing crescent Moon after sunset in the southwest. The planet shines at 1st magnitude and spends most of the month in Sagittarius. It's too far to give up much detail in a telescope.

29 First Quarter Moon, 10:06 UT.

30 Venus slowly makes an appearance in the western sky, setting not long after the Sun all month. Though it shines at magnitude -3.6, the planet is hard to see in the twilight sky without a pair of binoculars.

CONSTILLATIONS: Sagittarius: How to Spot a Cosmic Archer in the Night Sky



On these mid fall evenings after the sun has set, look low in the southern sky for the classical Archer: the constellation Sagittarius.

Although the Archer is often depicted in allegorical star atlases as a centaur (half man, half horse), long ago, he was not a centaur at all but simply a standing Archer looking with some apprehension toward the Scorpion immediately to the west.

It is said that the wisest and kindliest of all the centaurs was Chiron. It was he who educated many of the most famed heroes of antiquity: Jason of the Golden Fleece, Achilles, Hercules and Aesculapius. The story goes that in laying out the zodiac, Chiron made one figure in his own likeness: Sagittarius.

Although tracing out an archer-centaur among Sagittarius' stars is somewhat daunting, visualizing it as a teapot is quite easy. As star pictures go, it's one of the best. About 40 years ago, the late astronomy author George Lovi (1939-1993) pointed out that stargazers could even augment Sagittarius' tea service with a cosmic teaspoon and lemon as well. The teaspoon is made from stars in northern Sagittarius, while the lemon is an alternate rendition of the faint constellation Corona Australis, the Southern Crown, which lies directly beneath the Teapot.

Now is also the best time to enjoy viewing the summer Milky Way. Although it's never visible from large cities with lights, smoke and haze, it can still be readily viewed from distant suburbs and rural locations.

Before the invention of the telescope, the true nature of the Milky Way was a mystery. Binoculars and telescopes reveal that our galaxy consists of dense clouds of individual stars. Several of these clouds of stars, surrounded by a few dark regions for contrast, can be seen with binoculars in the area of the Milky Way about halfway between the star Altair and Sagittarius.

Besides an archer or a teapot, the stars of Sagittarius can also be visualized as an upside-down dipper, which, in older astronomy books, goes by the name Milk Dipper. Supposedly, the bowl of this dipper was dipping into the Milky Way. In fact, when you look in the direction of Sagittarius, you're looking toward the center of the Milky Way, appearing as a veritable cloud of stars.

Here lies the "hub", or central condensation, of our own galaxy — an area of density and complexity. Even to the unaided eye, the view is one of excitement and beauty. Sweep through this part of the sky with binoculars, and you'll find concentrations of a staggering number of stars.

FROM THE WORLD OF ASTRONOMY:

The Moon is the Earth's only natural satellite. Although not the largest natural satellite in the Solar System, it is, among the satellites of major planets, the largest relative to the size of the Distance to Earth: 238,900 miles (384,400 km)

Orbital period: 27 days
Gravity: 1.622 m/s²
Age: 4.527 billion years
Circumference: 6,784 miles (10,917 km)
Orbits: Earth

Earth's Moon: Formation, Composition and Orbit

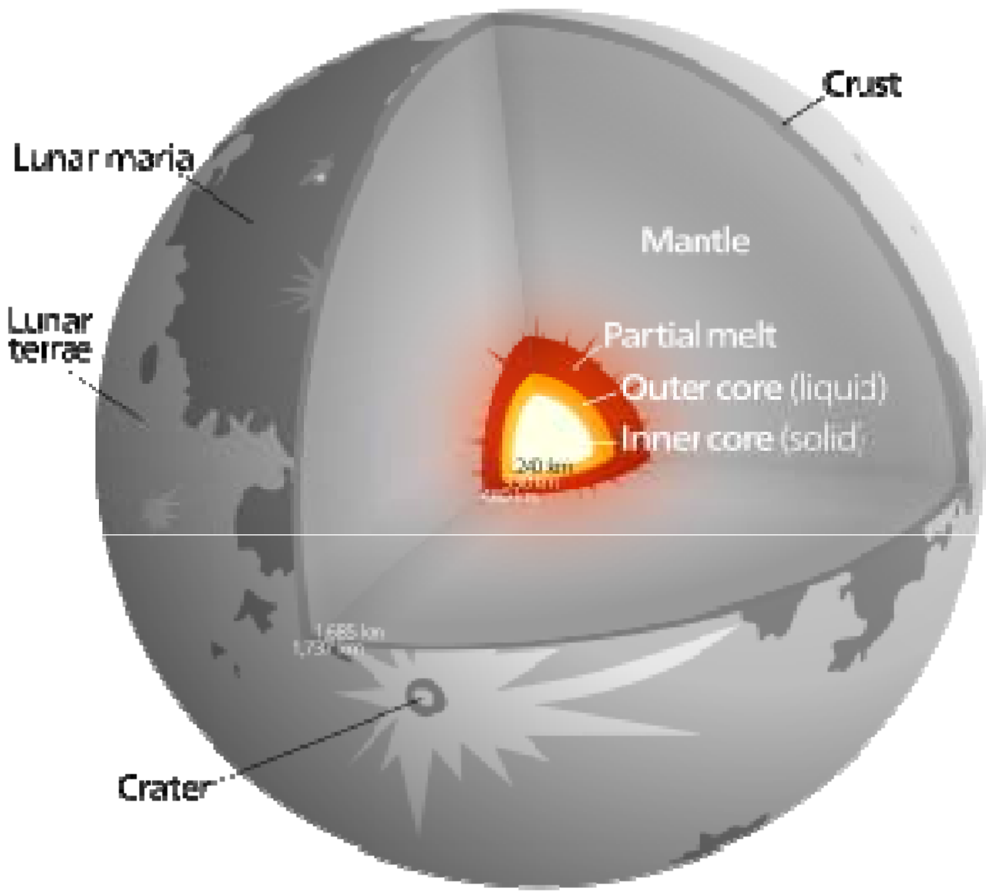
The moon is the easiest celestial object to find in the night sky — when it's there. Moon phases and the moon's orbit are a mystery to many. Because it takes 27.3 days both to rotate on its axis *and* to orbit Earth, the moon always shows us the same face. We see the moon because of reflected sunlight. How much of it we see depends on its position in relation to Earth and the Sun.

Though a satellite of Earth, the moon is bigger than Pluto. Some scientists think of it as a planet (four other moons in our solar system are even bigger), though that viewpoint has never caught on officially. There are various theories about how the moon was created, but recent evidence indicates it formed when a huge collision tore a chunk of Earth away.

Physical characteristics of Earth's moon

Formation **The leading explanation for how the moon formed was that a giant impact knocked off the raw ingredients for the moon off the primitive molten Earth and into orbit. Scientists have suggested the impactor was roughly 10 percent the mass of Earth, about the size of Mars.**

Internal structure



The moon very likely has a very small core just 1 to 2 percent of the moon's mass and roughly 420 miles (680 km) wide. It likely consists mostly of iron, but may also contain large amounts of sulfur and other elements.

Its rocky mantle is about 825 miles (1,330 km) thick and made up of dense rocks rich in iron and magnesium. Magmas in the mantle made their way to the surface in the past and erupted volcanically for more than a billion years — from at least four billion years ago to fewer than three billion years past.

The crust on top averages some 42 miles (70 km) deep. The outermost part of the crust is broken and jumbled due to all the large impacts it has received, a shattered zone that gives way to intact material below a depth of about 6 miles (9.6 km).

Surface composition

Like the four inner planets, the moon is rocky. It's pockmarked with craters formed by asteroid impacts millions of years ago. Because there is no weather, the craters have not eroded.

The average composition of the lunar surface by weight is roughly 43 percent oxygen, 20 percent silicon, 19 percent magnesium, 10 percent iron, 3 percent calcium, 3 percent aluminum, 0.42 percent chromium, 0.18 percent titanium and 0.12 percent manganese.

Atmosphere of the moon

The moon has a very thin atmosphere, so a layer of dust — or a footprint — can sit undisturbed for centuries. And without much of an atmosphere, heat is not held near the planet, so temperatures vary wildly. Daytime temperatures on the sunny side of the moon reach 273 degrees F (134 C); on the dark side it gets as cold as minus 243 F (minus 153 C).

Orbital characteristics

Average distance from Earth: **238,855 miles (384,400 km)**

Perigee (closest approach to Earth): **225,700 miles (363,300 km)**

Apogee (farthest distance from Earth): **252,000 miles (405,500 km)**

Orbit/Earth relationship

Tidal effects

The moon's gravity pulls at the Earth, causing predictable rises and falls in sea levels known as tides. To a much smaller extent, tides also occur in lakes, the atmosphere, and within the Earth's crust.

High tides are when water bulges upward, and low tides are when water drops down. High tide results on the side of the Earth nearest the moon due to gravity, and it also

happens on the side farthest from the moon due to the inertia of water. Low tides occur between these two humps.

The pull of the moon is also slowing the Earth's rotation, an effect known as tidal braking that increases the length of our day by 2.3 milliseconds per century. The energy that Earth loses is picked up by the moon, increasing its distance from the Earth, which means the moon gets farther away by 3.8 centimeters annually.

The moon's gravitational pull might have been key to making Earth a livable planet by moderating the degree of wobble in Earth's axial tilt, which led to a relatively stable climate over billions of years where life could flourish.

Eclipses

During eclipses, the moon, Earth and sun are in a straight line, or nearly so. A lunar eclipse takes place when Earth gets directly or almost directly between the sun and the moon, and Earth's shadow falls on the moon. A lunar eclipse can occur only during a full moon. A solar eclipse occurs when the moon gets directly or nearly directly between the sun and Earth, and the moon's shadow falls on us. A solar eclipse can occur only during a new moon.

Seasons

The Earth's axis of rotation is tilted in relation to the ecliptic plane, an imaginary surface through Earth's orbit around the sun. This means the Northern and Southern hemispheres will sometimes point toward or away from the sun depending on the time of year, varying the amount of light they receive and causing the seasons.

The tilt of Earth's axis is about 23.5 degrees, but the tilt of the moon's axis is only about 1.5 degrees. As such, the moon virtually has no seasons. This means that some areas are always lit by sunlight, and other places are perpetually draped in shadow.

Exploration & research

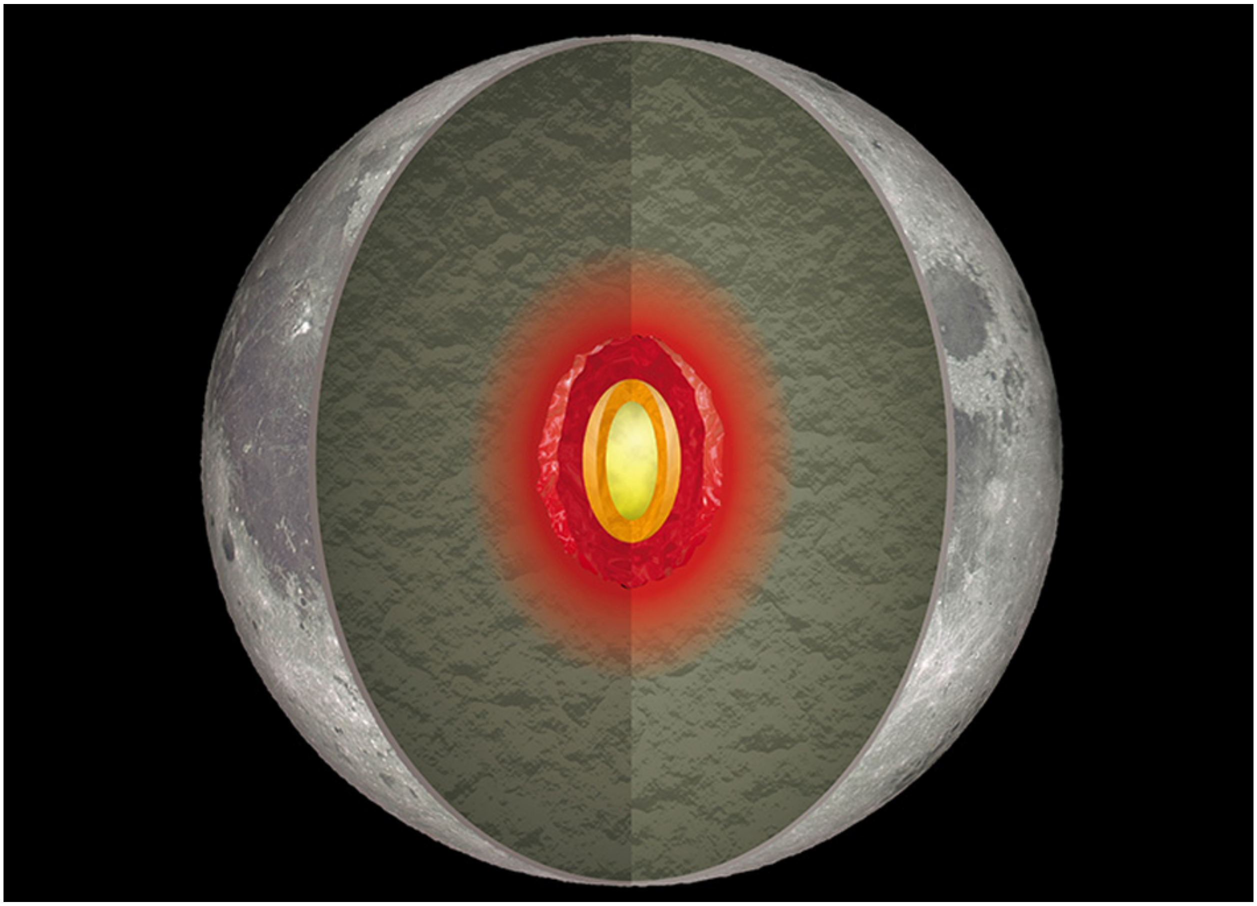
The moon, the brightest object in the night sky, has created a rhythm that has guided humanity for millennia — for instance, calendar months are roughly equal to the time it takes to go from one full moon to the next. Some ancient peoples believed the moon was a bowl of fire, while others thought it was a mirror that reflected Earth's lands and seas, but ancient Greek philosophers knew the moon was a sphere orbiting the Earth whose moonlight reflected sunlight. The Greeks also believed the dark areas of the moon were seas while the bright regions were land, which influenced the current names for those places — "maria" and "terrae," which is Latin for seas and land, respectively.

The legendary scientist Galileo Galilei was the first to use a telescope to make scientific observations of the moon, describing a rough, mountainous surface in 1609 that was quite different from the popular beliefs of his day that the moon was smooth.

In 1959, the Soviet Union sent the first spacecraft to impact the moon's surface and returned the first photographs of its far side. In 1969, the United States landed the first astronauts on the moon, undoubtedly the most famous of NASA's achievements, and their efforts returned 842 pounds (382 kg) of rocks and soil to Earth for study. It remains the only extraterrestrial body that humanity has ever visited.

After a long interlude, lunar exploration resumed in the 1990s with the U.S. robotic missions Clementine and Lunar Prospector. Both missions suggested water might be present at the lunar poles, hints the joint launch of the Lunar Reconnaissance Orbiter and the Lunar Crater Observation and Sensing Satellite (LCROSS) helped prove were real in 2009.

Still Hot Inside the Moon - Tidal Heating in Deep Mantle



Moon's core

An international research team has found that there is an extremely soft layer deep inside the Moon and that heat is effectively generated in the layer by the gravity of the Earth.

These results were derived by comparing the deformation of the Moon as precisely measured by Kaguya (SELENE, Selenological and Engineering Explorer) and other probes with theoretically calculated estimates. These findings suggest that the interior of

the Moon has not yet cooled and hardened, and also that it is still being warmed by the effect of the Earth on the Moon. This research provides a chance to reconsider how both the Earth and the Moon have been evolving since their births through mutual influence until now.

When it comes to clarifying how a celestial body like a planet or a natural satellite is born and grows, it is necessary to know as precisely as possible its internal structure and thermal state. How can we know the internal structure of a celestial body far away from us? We can get clues about its internal structure and state by thoroughly investigating how its shape changes due to external forces. The shape of a celestial body being changed by the gravitational force of another body is called tide.

For example, the ocean tide on the Earth is one tidal phenomenon caused by the gravitational force between the Moon and the Sun, and the Earth. Sea water is so deformable that its displacement can be easily observed. How much a celestial body can be deformed by tidal force, in this way, depends on its internal structure, and especially on the hardness of its interior. Conversely, it means that observing the degree of deformation enables us to learn about the interior, which is normally not directly visible to the naked eye.

The Moon is no exception; we can learn about the interior of our natural satellite from its deformation caused by the tidal force of the Earth. The deformation has already been well known through several geodetic observations. However, models of the internal structure of the Moon as derived from past research could not account for the deformation precisely observed by the above lunar exploration programs. Therefore, the research team performed theoretical calculations to understand what type of internal structure of the Moon leads to the observed change of the lunar shape.

What the research team focused on is the structure deep inside the Moon. During the Apollo program, seismic observations were carried out on the Moon. One of the analysis results concerning the internal structure of the Moon based upon the seismic data indicates that the satellite is considered to consist mainly of two parts: the "core," the inner portion made up of metal, and the "mantle," the outer portion made up of rock.

The research team has found that the observed tidal deformation of the Moon can be well explained if it is assumed that there is an extremely soft layer in the deepest part of the lunar mantle. The previous studies indicated that there is the possibility that a part of the rock at the deepest part inside the lunar mantle may be molten. This research result supports the above possibility since partially molten rock becomes softer. This research has proven for the first time that the deepest part of the lunar mantle is soft, based upon the agreement between observation results and the theoretical calculations.

Furthermore, the research team also clarified that heat is efficiently generated by the tides in the soft part, deepest in the mantle. In general, a part of the energy stored inside a celestial body by tidal deformation is changed to heat. The heat generation depends on the softness of the interior. Interestingly, the heat generated in the layer is expected to be

nearly at the maximum when the softness of the layer is comparable to that which the team estimated from the above comparison of the calculations and the observations. This may not be a coincidence. Rather, the layer itself is considered to be maintained as the amount of the heat generated inside the soft layer is exquisitely well balanced with that of the heat escaping from the layer.

Whereas previous research also suggests that some part of the energy inside the Moon due to the tidal deformation is changed to heat, the present research indicates that this type of energy conversion does not uniformly occur in the entire Moon, but only intensively in the soft layer. The research team believes that the soft layer is now warming the core of the Moon as the core seems to be wrapped by the layer, which is located in the deepest part of the mantle, and which efficiently generates heat. They also expect that a soft layer like this may efficiently have warmed the core in the past as well.

Concerning the future outlook for this research, Dr. Yuji Harada, the principle investigator of the research team, said, "I believe that our research results have brought about new questions. For example, how can the bottom of the lunar mantle maintain its softer state for a long time? To answer this question, we would like to further investigate the internal structure and heat-generating mechanism inside the Moon in detail. In addition, another question has come up: How has the conversion from the tidal energy to the heat energy in the soft layer affected the motion of the Moon relative to the Earth, and also the cooling of the Moon? We would like to resolve those problems as well so that we can thoroughly understand how the Moon was born and has evolved."

Another investigator, Prof. Junichi Haruyama of Institute of Space and Aeronautical Science, Japan Aerospace Exploration Agency, mentioned the significance of this research, saying, "A smaller celestial body like the Moon cools faster than a larger one like the Earth does. In fact, we had thought that volcanic activities on the Moon had already come to a halt. Therefore, the Moon had been believed to be cool and hard, even in its deeper parts. However, this research tells us that the Moon has not yet cooled and hardened, but is still warm. It even implies that we have to reconsider the question as follows: How have the Earth and the Moon influenced each other since their births? That means this research not only shows us the actual state of the deep interior of the Moon, but also gives us a clue for learning about the history of the system including both the Earth and the Moon."

Credit: Keith Cowing Space Ref.com

10 Things You Might Not Know About the Moon

1) There's actually four kinds of lunar months

Our months correspond approximately to the length of time it takes our natural satellite to go through a full cycle of phases. From excavated tally sticks, researchers have deduced that people from as early as the Paleolithic period counted days in relation to the

moon's phases. But there are actually four different kinds of lunar months. The durations listed here are averages.

1. Anomalistic – the length of time it takes the moon to circle the Earth, measured from one perigee (the closest point in its orbit to Earth) to the next: 27 days, 13 hours, 18 minutes, 37.4 seconds.

2. Nodical – the length of time it takes the moon to pass through one of its nodes (where it crosses the plane of the Earth's orbit) and return to it: 27 days, 5 hours, 5 minutes, 35.9 seconds.

3. Sidereal – the length of time it takes the moon to circle the Earth, using the stars as a reference point: 27 days, 7 hours, 43 minutes, 11.5 seconds.

4. Synodical – the length of time it takes the moon to circle the Earth, using the sun as the reference point (that is, the time lapse between two successive conjunctions with the sun – going from new moon to new moon): 29 days, 12 hours, 44 minutes, 2.7 seconds. It is the synodic month that is the basis of many calendars today and is used to divide the yea

2) We see slightly more than half of the moon from Earth

Most reference books will note that because the moon rotates only once during each revolution about the Earth, we never see more than half of its total surface. The truth, however, is that we actually get to see more of it over the course of its elliptical orbit: 59 percent (almost three-fifths). ['Supermoon' Full Moons Explained]

The moon's rate of rotation is uniform but its rate of revolution is not, so we're able to see just around the edge of each limb from time to time. Put another way, the two motions do not keep perfectly in step, even though they come out together at the end of the month. We call this effect libration of longitude.

So the moon "rocks" in the east and west direction, allowing us to see farther around in longitude at each edge than we otherwise could. The remaining 41 percent can never be seen from our vantage point; and if anyone were on that region of the moon, they would never see the Earth.

3) It would take hundreds of thousands of moons to equal the brightness of the sun

The full moon shines with a magnitude of -12.7, but the sun is 14 magnitudes brighter, at -26.7. The ratio of brightness of the sun versus the moon amounts to a difference of 398,110 to 1. So that's how many full moons you would need to equal the brightness of the sun. But this all a moot point, because there is no way that you could fit that many full moons in the sky.

The sky is 360 degrees around (including the half we can't see, below the horizon), so there are over 41,200 square degrees in the sky. The moon measures only a half degree across, which gives it an area of only 0.2 square degrees. So you could fill up the entire sky, including the half that lies below our feet, with 206,264 full moons — and still come up short by 191,836 in the effort to match the brightness of the sun.

4) The first- or last-quarter moon is not one half as bright as a full moon

If the moon's surface were like a perfectly smooth billiard ball, its surface brightness would be the same all over. In such a case, it would indeed appear half as bright.[Phases of the Moon Explained]

But the moon has a very rough topography. Especially near and along the day/night line (known as the terminator), the lunar landscape appears riddled with innumerable shadows cast by mountains, boulders and even tiny grains of lunar dust. Also, the moon's face is splotched with dark regions. The end result is that at first quarter, the moon appears only one eleventh as bright as when it's full.

The moon is actually a little brighter at first quarter than at last quarter, since at that phase some parts of the moon reflect sunlight better than others.

5) A 95-percent illuminated moon appears half as bright as a full moon

Believe it or not, the moon is half as bright as a full moon about 2.4 days before and after a full moon. Even though about 95 percent of the moon is illuminated at this time, and to most casual observers it might still look like a "full" moon, its brightness is roughly 0.7 magnitudes less than at full phase, making it appear one-half as bright.

6) The Earth, seen from the moon, also goes through phases

However, they are opposite to the lunar phases that we see from the Earth. It's a full Earth when it's new moon for us; last-quarter Earth when we're seeing a first-quarter moon; a crescent Earth when we're seeing a gibbous moon, and when the Earth is at new phase we're seeing a full moon.

From any spot on the moon (except on the far side, where you cannot see the Earth), the Earth would always be in the same place in the sky.

From the moon, our Earth appears nearly four times larger than a full moon appears to us, and – depending on the state of our atmosphere – shines anywhere from 45 to 100 times brighter than a full moon. So when a full (or nearly full) Earth appears in the lunar sky, it illuminates the surrounding lunar landscape with a bluish-gray glow.

From here on the Earth, we can see that glow when the moon appears to us as a crescent; sunlight illuminates but a sliver of the moon, while the rest of its outline is dimly visible

by virtue of earthlight. Leonardo da Vinci was the first to figure out what that eerie glow appearing on the moon really was.

7) Eclipses are reversed when viewing from the moon

Phases aren't the only things that are seen in reverse from the moon. An eclipse of the moon for us is an eclipse of the sun from the moon. In this case, the disk of the Earth appears to block out the sun.

If it completely blocks the sun, a narrow ring of light surrounds the dark disk of the Earth; our atmosphere backlighted by the sun. The ring appears to have a ruddy hue, since it's the combined light of all the sunrises and sunsets occurring at that particular moment. That's why during a total lunar eclipse, the moon takes on a ruddy or coppery glow.

When a total eclipse of the sun is taking place here on Earth, an observer on the moon can watch over the course of two or three hours as a small, distinct patch of darkness works its way slowly across the surface of the Earth. It's the moon's dark shadow, called the umbra, that falls on the Earth, but unlike in a lunar eclipse, where the moon can be completely engulfed by the Earth's shadow, the moon's shadow is less than a couple of hundred miles wide when it touches the Earth, appearing only as a dark blotch.

8) There are rules for how the moon's craters are named

The lunar craters were formed by asteroids and comets that collided with the moon. Roughly 300,000 craters wider than 1 km (0.6 miles) are thought to be on the moon's near side alone.

These are named for scholars, scientists, artists and explorers. For example, Copernicus Crater is named for Nicolaus Copernicus, a Polish astronomer who realized in the 1500s that the planets move about the sun. Archimedes Crater is named for the Greek mathematician Archimedes, who made many mathematical discoveries in the third century B.C.

The custom of applying personal names to the lunar formations began in 1645 with Michael van Langren, an engineer in Brussels who named the moon's principal features after kings and great people on the Earth. On his lunar map he named the largest lunar plain (now known as Oceanus Procellarum) after his patron, Phillip IV of Spain.

But just six years later, Giovanni Battista Riccioli of Bologna completed his own great lunar map, which removed the names bestowed by Van Langren and instead derived names chiefly from those of famous astronomers — the basis of the system which continues to this day. In 1939, the British Astronomical Association issued a catalog of officially named lunar formations, "Who's Who on the Moon," listing the names of all formations adopted by the International Astronomical Union.

Today the IAU continues to decide the names for craters on our moon, along with names for all astronomical objects. The IAU organizes the naming of each particular celestial feature around a particular theme.

The names of craters now tend to fall into two groups. Typically, moon craters have been named for deceased scientists, scholars, explorers, and artists who've become known for their contributions to their respective fields. The craters around the Apollo crater and the Mare Moscoviense are to be named after deceased American astronauts and Russian cosmonauts.

9) The moon encompasses a huge temperature range

If you survey the Internet for temperature data on the moon, you're going to run into quite a bit of confusion. There's little consistency even within a given website in which temperature scale is quoted: Celsius, Fahrenheit, even Kelvin.

We have opted to use the figures that are quoted by NASA on its Website: The temperature at the lunar equator ranges from an extremely low minus 280 degrees F (minus 173 degrees C) at night to a very high 260 degrees F (127 degrees C) in the daytime. In some deep craters near the moon's poles, the temperature is always near minus 400 degrees F (minus 240 degrees C).

During a lunar eclipse, as the moon moves into the Earth's shadow, the surface temperature can plunge about 500 degrees F (300 degrees C) in less than 90 minutes.

10) The moon has its own time zone

It is possible to tell time on the moon. In fact, back in 1970, Helbros Watches asked Kenneth L. Franklin, who for many years was the chief astronomer at New York's Hayden Planetarium, to design a watch for moon walkers that measures time in what he called "lunations," the period it takes the moon to rotate and revolve around the Earth; each lunation is exactly 29.530589 Earth days.

For the moon, Franklin developed a system he called "lunar mean solar time," or Lunar Time (LT). He envisioned local lunar time zones similar to the standard time zones of Earth, but based on meridians that are 12-degrees wide (analogous to the 15-degree intervals on Earth). "They will be named unambiguously as '36-degree East Zone time,' etc., although 'Copernican time,' 'West Tranquillity time' and others may be adopted as convenient." A lunar hour was defined as a "lunour," and decilunours, centilunours and millilunours were also introduced.

Interestingly, one moon watch was sent to the president of the United States at the time, Richard M. Nixon, who sent a thank you note to Franklin. The note and another moon watch were kept in a display case at the Hayden Planetarium for several years.

Quite a few visitors would openly wonder why Nixon was presented with a wristwatch that could be used only on the moon.

Forty years have come and gone without the watch becoming a big seller.

Credit Space.com

The Moon Smells: Apollo Astronauts Describe Lunar Aroma

The moon has a distinctive smell. Ask any Apollo moonwalker about the odiferous nature of the lunar dirt and you'll get the same answer.

With NASA's six Apollo lunar landing missions between 1969 and the end of 1972, a total of 12 astronauts kicked up the powdery dirt of the moon, becoming an elite group later to be tagged as the "dusty dozen."

From the modest 2.5 hour "moonwalk" of Apollo 11 to the forays totaling just over 22 hours outside a spacecraft on Apollo 17, NASA's Apollo landing crews could not escape tracking lunar material inside their moon Lander homes.

That fresh lunar regolith smell

“All I can say is that everyone's instant impression of the smell was that of spent gunpowder, not that it was 'metallic' or 'acrid'. Spent gunpowder smell probably was much more implanted in our memories than other comparable odors," said Apollo 17's Harrison "Jack" Schmitt, a scientist-astronaut who walked the moon's surface in December of 1972.

Schmitt said that he believed all the moonwalkers agreed and commented at the time that, when they took their helmets off, 'fresh' regolith (the scientific name for moon dirt) in the cabin air smelled like spent gunpowder. [Apollo Quiz: Are You A Moon Landing Expert?]

"For what it is worth, I always have suspected that the olfactory sensors are reacting to a variety of unsatisfied electron bonds as one would have in both just fired gunpowder and lunar dust newly introduced in the cabin," Schmitt said. "By the way, the time from starting re-pressurization [of the lunar Lander] to my first comment about gunpowder was almost exactly seven minutes."

Mucus membranes in space

Larry Taylor, director of the Planetary Geosciences Institute at the University of Tennessee in Knoxville, agrees with Schmitt's take. He served in the "back-room" at NASA's Johnson Space Center in Houston during the Apollo 17 mission, and was one of those who directly advised the astronauts on the moon during their trots across the lunar landscape.

"When the entire subject of the dust smell came up several years ago, I put forth that what the astronauts were smelling, that is, what their mucus membrane sensed, was highly activated dust particles with 'dangling bonds,'" Taylor said.

Taylor said that when a geologist smashes a rock here on Earth, that person will smell some odor that has been generated by the smashing of minerals, thereby creating the so-called dangling bonds.

But on the moon, the dangling bonds can exist for a long time, Taylor said. And because lunar rock and soil is roughly 43-percent oxygen, most of these unsatisfied bonds are from oxygen.

"In a nut-shell, I believe that the astronauts all smelled unsatisfied dangling bonds on the lunar dust … which were readily satisfied in a second by the lunar module atmosphere, or nose membrane moisture," Taylor told Space.com.

Grab specimen

Apollo 11 lunar module pilot Buzz Aldrin also recalls the smell of the moon. As Armstrong and Aldrin re-entered and re-pressurized the Eagle lunar lander, their suits and equipment were soiled by lunar dust. That dust has a definite odor, he said.

"It was like burnt charcoal," Aldrin said, "or similar to the ashes that are in a fireplace, especially if you sprinkle a little water on them."

Aldrin also noted yet another lunar dust episode on the Apollo 11 mission.

"Before we left Earth, the lunar dust was considered by some alarmists as very dangerous, in fact pyrophoric, capable of igniting spontaneously in air," Aldrin said. "The fact that the lunar dust had been so void of contact with oxygen, as soon as we re-pressurized our lunar module cabin it might start to heat up, smolder, even burst into flames. At least that was the worry of a few. A late-July firework display on the moon was not something advisable."

So Aldrin and Armstrong staged an ad hoc moon dust test. They did it using a so-called "grab sample," a lunar sample collected quickly by Armstrong and stashed in his spacesuit pocket in case there was a problem that forced the moonwalkers to depart the scene in a hurry.

That grab specimen was placed on the cylindrical flat top of the Eagle's ascent engine cover. And as the cabin began to fill with air, both Armstrong and Aldrin waited to see if the lunar sample would indeed smoke and smolder.

"If it did, we'd stop pressurization, open the hatch and toss it out. But nothing happened. We got back to the business of readying for departure from the moon," Aldrin said.

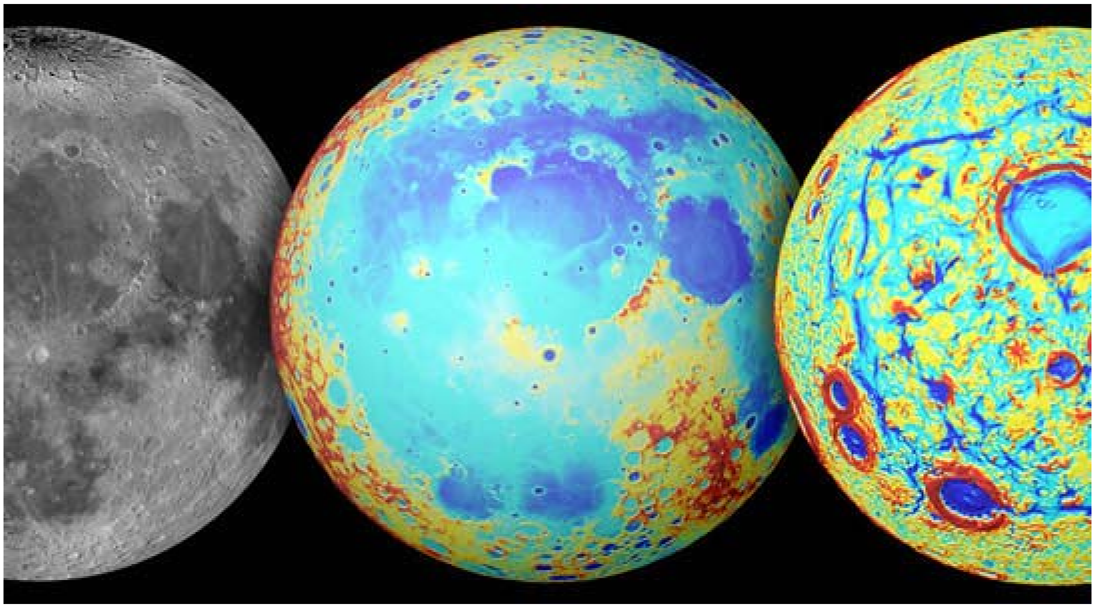
A reactive lunar nature

It was Thomas Gold, a professor of astronomy at Cornell University who died in 2004, that first flagged the explosive potential of moon rock, said Donald Bogard, a Heritage Fellow at the Lunar Planetary Institute in Houston, Texas.

From 1971 until his retirement from NASA in 2010, Bogard was a principal investigator in NASA's lunar and meteorite research programs and was a member of the science team that performed quarantine testing of Apollo lunar samples between 1969 and 1971.

"Tommy Gold was partly correct when he warned NASA prior to Apollo 11 that the lunar dust brought into the lunar module might spontaneously combust and produce a safety issue. I was called into a JSC meeting prior to Apollo 11 to discuss this possibility," Bogard said. "Gold had realized the likely reactive nature of lunar material surfaces, but had over-emphasized their reactive effects."

NASA's GRAIL Mission Solves a Lunar Mystery Almost as Old as the Moon Itself



Earth's moon as observed in visible light (left), topography (center, where red is high and blue is low), and the GRAIL gravity gradients (right). The Procellarum region is a broad region of low topography covered in dark mare basalt. The gravity gradients reveal a giant rectangular pattern of structures surrounding the region. Image Credit: NASA/GSFC/JPL/Colorado School of Mines/MIT

Using new data obtained by NASA's GRAIL mission, astronomers discovered that a volcanic plume, not an asteroid, likely created the moon's largest basin.

Early theories suggested the craggy outline of a region of the moon's surface known as Oceanus Procellarum, or the Ocean of Storms, was caused by an asteroid impact. If this theory had been correct, the basin it formed would be the largest asteroid impact basin on the moon. However, mission scientists studying GRAIL data believe they have found evidence the craggy outline of this rectangular region — roughly 1,600 miles (2,600 kilometers) across — is actually the result of the formation of ancient rift valleys.

"The nearside of the moon has been studied for centuries, and yet continues to offer up surprises for scientists with the right tools," said Maria Zuber, principal investigator of NASA's GRAIL mission, from the Massachusetts Institute of Technology, Cambridge. "We interpret the gravity anomalies discovered by GRAIL as part of the lunar magma plumbing system — the conduits that fed lava to the surface during ancient volcanic eruptions."

The surface of the moon's nearside is dominated by a unique area called the Procellarum region, characterized by low elevations, unique composition, and numerous ancient volcanic plains.

The rifts are buried beneath dark volcanic plains on the nearside of the moon and have been detected only in the gravity data provided by GRAIL. The lava-flooded rift valleys are unlike anything found anywhere else on the moon and may at one time have resembled rift zones on Earth, Mars and Venus. The findings are published online in the journal Nature.

Another theory arising from recent data analysis suggests this region formed as a result of churning deep in the interior of the moon that led to a high concentration of heat-producing radioactive elements in the crust and mantle of this region. Scientists studied the gradients in gravity data from GRAIL, which revealed a rectangular shape in resulting gravitational anomalies.

"The rectangular pattern of gravity anomalies was completely unexpected," said Jeff Andrews-Hanna, a GRAIL co-investigator at the Colorado School of Mines in Golden, Colorado, and lead author of the paper. "Using the gradients in the gravity data to reveal the rectangular pattern of anomalies, we can now clearly and completely see structures that were only hinted at by surface observations."

The rectangular pattern, with its angular corners and straight sides, contradicts the theory that Procellarum is an ancient impact basin, since such an impact would create a circular basin. Instead, the new research suggests processes beneath the moon's surface dominated the evolution of this region.

Over time, the region would cool and contract, pulling away from its surroundings and creating fractures similar to the cracks that form in mud as it dries out, but on a much larger scale.

The study also noted a surprising similarity between the rectangular pattern of structures on the moon, and those surrounding the south polar region of Saturn's icy moon Enceladus. Both patterns appear to be related to volcanic and tectonic processes operating on their respective worlds.

"Our gravity data are opening up a new chapter of lunar history, during which the moon was a more dynamic place than suggested by the cratered landscape that is visible to the naked eye," said Andrews-Hanna. "More work is needed to understand the cause of this newfound pattern of gravity anomalies, and the implications for the history of the moon."

Launched as GRAIL A and GRAIL B in September 2011, the probes, renamed Ebb and Flow, operated in a nearly circular orbit near the poles of the moon at an altitude of about 34 miles (55 kilometers) until their mission ended in December 2012. The distance between the twin probes changed slightly as they flew over areas of greater and lesser gravity caused by visible features, such as mountains and craters, and by masses hidden beneath the lunar surface.

The twin spacecraft flew in a nearly circular orbit until the end of the mission on December 17, 2012, when the probes intentionally were sent into the moon's surface. NASA later named the impact site in honor of late astronaut Sally K. Ride, who was America's first woman in space and a member of the GRAIL mission team.

GRAIL's prime and extended science missions generated the highest resolution gravity field map of any celestial body. The map will provide a better understanding of how Earth and other rocky planets in the solar system formed and evolved.

The GRAIL mission was managed by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, for NASA's Science Mission Directorate in Washington. The mission was part of the Discovery Program managed at NASA's Marshall Space Flight Center in Huntsville, Alabama. GRAIL was built by Lockheed Martin Space Systems in Denver.

POINTS OF INTEREST:

As per Hanks email, I think this just may be an interesting and fun event to get active in.

Register to Enter the Name Exo Worlds contest*

The IAU invites all public organizations with an interest in astronomy to register on the IAU Directory for World Astronomy website for the NameExoWorlds contest, where in early 2015 they will be able to suggest names for Exoplanets and their host stars. For the first time in history the public will then be able to vote for the official name of stars and planets. The IAU Directory for World Astronomy will function as a permanent platform for the global astronomical community.

The deadline for registration for the contest is 31 December 2014. Details of the

registration procedure can be found on the website. Eligible organizations include: planetariums, science centers, amateur astronomy clubs, online astronomy platforms, and also non-profit organizations such as high schools or cultural clubs interested in astronomy.

Details: http://www.iau.org/news/pressreleases/detail/iau1406/

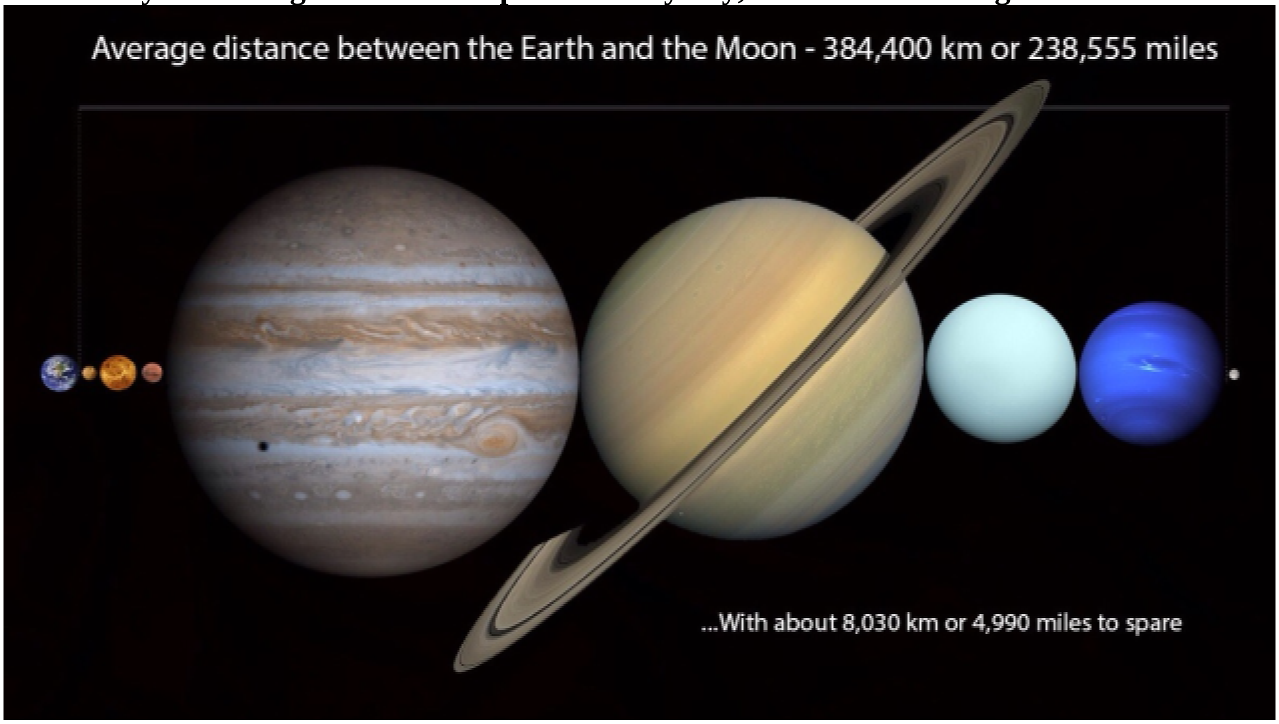
I would be willing to advise every one of new Exoplanets as they are made public. I will then submit them as required and see what happens.

Please review this link and let me know what you think.

Paul

You Can Fit Every Planet In The Solar System Between Earth And The Moon

Not exactly something Astronomers ponder every day, but it is interesting trivia.



The average distance from the Earth to the Moon is 384,400 km., that leaves us with 4,392 km to spare.

So what could we do with the rest of that distance? Well, we could obviously fit Pluto into that slot. It's around 2,300 km across. Which leaves us about 2,092 km to play with. We could fit one more dwarf planet in there (not Eris though, too big).

The amazing Wolfram-Alpha can make this calculation for you automatically: total diameter of the planets. Although, this includes the diameter of Earth too.

Check it out.

Planet	Average Diameter (km)
Mercury	**4,879**
Venus	**12,104**
Mars	**6,771**
Jupiter	**139,822**
Saturn	**116,464**
Uranus	**50,724**
Neptune	**49,244**
Total	**380,008**

As stated earlier, the following is a write up on Dave Groski's October talk.

Below is a Spilhaus Space Clock. (Astronomical Clock)

An astronomical clock is a clock with special mechanisms and dials to display astronomical information, such as the relative positions of the sun, moon, zodiacal constellations, and sometimes major planets.

The term, Astronomical Clock, is loosely used to refer to any clock that shows, in addition to the time of day, astronomical information. This could include the location of the sun and moon in the sky, the age and phase of the moon, the position of the sun on the ecliptic and the current zodiac sign, the sidereal time, and other astronomical data such as the moon's nodes (for indicating eclipses) or a rotating star map. The term should not be confused with *astronomical regulator,* a high precision but otherwise ordinary pendulum clock used in observatories.

Astronomical clocks usually represent the solar system using the geocentric model. The center of the dial is often marked with a disc or sphere representing the earth, located at the center of the solar system. The sun is often represented by a golden sphere shown rotating around the earth once a day around a 24 hour analog dial. This view accords both with daily experience and with the philosophical world view of pre-Copernican Europe.

Dr. Athelstan Spilhaus, (which the above clock is name after) Dean, Institute of Technology, University of Minnesota, is well known to scientists the world over. He is listed in "American Men of Science" as a meteorologist, an oceanographer, and as the inventor of the bathythermograph, an invention which contributed substantially to our submarine warfare success in WW II.

Through his meteorological work, Dr. Spilhaus has long had a keen interest in astronomical clock, their history and function. Years ago he conceived the idea of a compact space clock utilizing modern materials not available to early clockmakers. Over a period of six years he developed the simple, unique gearing for the various discs of the space dial. He built several models, and finally produced a design for a clock that is considered by many to be a breakthrough in the art and science of clock making.

When Dr. Spilhaus gave Edmund Scientific Co. the opportunity to manufacture and market the clock, they eagerly accepted the privilege. Edmund Scientific Co. has for over 21 years,been a well known source of supply for scientists, teachers, hobbyists, and amateur astronomers. In the manufacturing of this unique instrument, everything consistent with good engineering practice has been done.

The first clocks Edmund made were consistent with good engineering practices. However, as it so often happens, Edmund began to make cost effective changes to the clock by using plastic gears instead of steel or brass gears. If your interested in buy a Spilhaus Clock, you can find them on ebay. May I suggest that you purchase one of the older ones. If you choose to purchase a newer one be sure to buy some gears with it.

NOW FOR HANK BOUCHELLE'S PRESENTATION

Once again, Hank gave a very interesting presentation. He spent some time on Sun and Moon rise and set times around the world and spoke of what these time meant relative to being in each place.

He also gave a very informative talk on Planck Time which is believed to be the shortest duration of time,10 to the -43 seconds. In physics, the Planck time (t_P) is the unit of time in the system of natural units known as Planck units. It is the time required for light to travel, in a vacuum, a distance of 1 Planck length. The unit is named after Max Planck, who was the first to propose it. So just what is a Planck Unit? 53.025 X 10 to the -36 feet.

Planck time is derived from the field of mathematical physics known as dimensional analysis, which studies units of measurement and physical constants. The Planck time is the unique combination of the gravitational constant G, the relativity constant c, and the quantum constant h, to produce a constant with units of time. They are often semi-humorously referred to by physicists as "God's units" because eliminate anthropocentric arbitrariness from the system of units, unlike the meter and second, which exist for purely historical reasons and are not derived from nature. Some challenges to Planck's Time have been mounted. For example, in 2003 during the analysis of the Hubble Space Telescope Deep Field images, some scientists speculated that where there are space-time fluctuations on the Planck scale, images of extremely distant objects should be blurry. The Hubble images, they claimed, were too sharp for this to be the case. Other scientists disagreed with this assumption however, with some saying the fluctuations would be too small to be observable, others saying that the speculated blurring effect that was expected was off by a very large magnitude.

If you know of anyone who is interested in Astronomy or someone who would like to learn more, please do not hesitate to extend and invitation to them to attend our meetings. If they have an interest in joining, our application is below.

Mount Cuba Astronomical Group
Membership Form

The Mission of the Mt. Cuba Astronomy Group is to increase knowledge and expand awareness of the science of astronomy and related technologies. Benefits include:

Monthly newsletter that includes details about the groups activities and articles on astronomy as well as other related subjects.

Monthly programs on subjects and topics of astronomical interest.

Free or discounted subscriptions to astronomy related publications.

Free registration to MCAG workshops and classes.

Mention Mount Cuba Astronomical Group and receive a 5% discount at Manor Books in New Castle (http://www.yelp.com/biz/manor-used-books-New Castle)

Name____

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Phone (optional)_____________________________________

Mail to: Carolyn Stankiewicz
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