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THE YOUNG ASTRONOMERS NEWSLETTER

MOON'S GEOLOGICAL FEATURES

Thanks to the Apollo astronauts and many types of lander probes and orbiters, we are learning more about the geological make-up of the Moon. After being formed from debris released as the result of a collision of a body (called Theia) with the Earth about 4.5 billion years ago, the Moon remained molten for perhaps a billion years. The outer crust eventually hardened but was subsequently subjected to meteor impacts. The underlying magma remained liquid due to heat generated by radioactive elements. The magma was released periodically through fractures caused by Moon quakes and by impacts of meteors. The liquid magma spread out into wide planes, called *flood basalts*, or more commonly called *maria*. The extent of maria formation on the Moon's nearside is greater than on the far side (not directly visible from Earth). This is believed to be due to the greater thickness of the crust on the far side, which reduces the upward penetration of the lava.

The nearside is noted for its abundance of maria, while the far side is noted for its elevated, highlands structures. The Moon's core is probably solid and iron-rich, similar to the Earth's. The solid core is believed to be surrounded by a molten, irony shell. Outside of the core is the mantle, which is covered by the crust. Even though the Moon has a small iron core, it has almost no global magnetic field.

The center of mass of the Moon is offset toward the Earth from its geometric center by a couple of kilometers. This helps to anchor the Moon so that it shows just one side facing the Earth.

Analysis of Moon rocks brought back by the Apollo astronauts shows a remarkably similar chemical composition to Earth. This has led to some questioning of the Theia collision hypothesis. One would expect there to be elemental profiles of the incoming foreign body. The Moon has the second highest density of the moons in the Solar System. First is Io. (SKy & Tel. April, 2016 and Space.Com).

CONFIRMING THE DEFINITION OF A PLANET

A planet is:

>An object that orbits the Sun (or one or more stars).

>Has enough mass so that self-gravity forces it to take on a spherical shape.

>Has cleared the neighborhood around its orbit.

>(a proposal to add) Has mass less than 13 Jupiters (to rule out brown dwarfs).
(Astron. Mag., March 2016).

ALMA OBSERVES DISTANT GALAXIES

ALMA (Atacama Large Millimeter/submillimeter Array) located in high-altitude Chile, has been able to observe infant galaxies at a distance of 11.5 billion light years. The galaxies are clustered in a web of dark matter. They are monstrous galaxies with high star formation rates – thousands of times greater than nearby galaxies. The nine galaxies appear to be clustered within a "great wall" of dark matter filaments. (Astron. Mag., April, 2016).

LOOK-BACK RECORD BY THE HUBBLE

Astronomers have set a look-back record using the Hubble Space Telescope. Yale University astrophysicist, Pascal Oesch and his team discovered a galaxy at a distance of 13.4 billion light years. This is both a distance and a time measure, meaning that the galaxy existed at the universe's infancy. The finding shattered

what was known as the "cosmic distance record".

The galaxy, labeled GN-z11, appears as a fuzzy, dark red splotch. But originally, it was blue. This intensely active galaxy has undergone an extreme redshift due to the expansion of the universe. This places the time-frame for GN-z11 at only about 400 million years after the Big Bang. (New York Times, Mar. 4, 2016).

PLUTO INFO

As of the end of December, 2015, less than half of the information about Pluto and its moons has been transmitted from the New Horizons probe. Imaging has shown that the dwarf planet has broad-based shield volcanoes with wide bases and gentle slopes. These are cryovolcanoes that erupt slurries of melted ices. Pluto's atmosphere turns out to be colder and more compact than expected. Very little in the form of gases is escaping into space (Astron. Mag., March and April, 2016).

EUROPA MISSION

If various forms of life can exist in deep ocean rifts on Earth, at extremes of temperature and pressure and minimal sunlight, couldn't life forms also exist in water worlds like Jupiter's moon Europa? Earth and Europa are also similar in that their deep ocean bottoms also exhibit spouting volcanos. Europa is believed to have a shell of ice that blankets a large salty ocean.

NASA and Jet Propulsion Laboratory (JPL) are planning a Europa mission with a tentative launch date in 2022, and use the super-sized Space Launch System (SLS). The mission will include at least 45 flybys by the orbiter, plus congress is providing extra funds for a lander. The lander will adopt the soft landing technology, "Sky Crane" used to place the Curiosity rover on Mars. Once on the surface, the lander will use its instruments to look for clues that suggest the presence of living organisms. (Astron. Mag., April, 2016).

RUNAWAY STARS

Astronomers have discovered dozens of stars travelling through space at a much faster pace than the surrounding stars. These are called Runaway Stars. Astronomers have developed a technique that looks for the infrared heat that is emitted from the bow shock that is blasted out the front of the star, much like the shock wave in front of a high performance jet. Speeds have been calculated to be in the vicinity of 30 kilometers per second (67,000 mph). The star, Zeta Ophiuchi zips along at 24 km/sec. (Sky and Tel., April, 2016).

THE HUNT FOR PLANET NINE

Astronomers have not yet found Planet Nine which was proposed by Caltech astronomers, Michael Brown and Konstantin Batygin. Surveys by excellent telescopes such as the Hubble, WISE and Keck have, so far, not revealed any object which could cause the clustering behavior of six icy objects orbiting out beyond the Kuiper Belt. One problem is that the likely area for finding Planet Nine has the dense star field of the Milky Way as a background. The hope for the long term, is that the Large Synoptic Survey Telescope (LSST) will be able to detect such a remote object. The LSST is expected to be operational by 2022 and will utilize excellent resolution and CCD photo technology. (Sci.News, Feb. 20, 2016).

BIRTHDAYS IN APRIL

Christaan Huygens (Dutch): b. April 14, 1629. Discovered rings of Saturn, Saturn's moon, Titan, invention of the pendulum clock.
Jan Hendrik Oort (Dutch): b. April 28, 1900. Detected and explained the rotation mechanics of the Milky Way.

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ASTRONOMICAL EVENTS FOR APRIL 2016

Moon phases: First quarter: Thurs. 4/14; New: Thurs. 4/7; Full: Fri. 4/22; Last quarter: Sat. 4/30

Meteor shower: Lyrid meteors: Fri. 4/22

Planets: Mars and Saturn in the Southeast in Scorpius, April 24, 4 hours after sunset.

Jupiter: Up all month in Leo.

Hard to see Mercury in western evening twilight. Venus rises in East, around 1 hour before the Sun. Also hard to see.

WORD SEARCH: Astronomical Behaviors

R B O L G T R A N S I T
A T R F M P S F O B C H
D E B L S U N U V I O P
I V I A P L B S A N E R
A H T R I S U I B A L E
T I D E R A C O S R I C
I D O T A R S N L Y R E
O C C U L T A T I O N S
N H E C L I P S E M V S
D O P P L E R T G S L I
M I S R O T A T I O N O
P H O A C C R E T I O N

ACCRETION
BINARY
DOPPLER
ECLIPSE
FLARE
FUSION
NOVA
OCCULTATION
ORBIT
PRECESSION
PULSAR
RADIATION
ROTATION
SPIRAL
TIDE
TRANSIT

Classroom discussion: what is a supernova? What is the relationship of a supernova and a nebula?

Calculator corner: The angle of the Sun across the sky changes throughout the year. This is what creates the seasons. The Sun's angle in the sky changes because the Earth's axis is tilted from the vertical by 23.5 degrees. As the Earth orbits the Sun, sometimes the Earth's north pole is tipped toward the Sun (our summertime) and sometimes the pole is tipped away from the Sun (our wintertime). It is useful to be able to calculate the angle of the Sun (relative to the horizontal horizon) at various times of the year. This is important for planning the tilt of solar panels, or maybe, where to locate your garden. The altitude angle of the Sun at noon on a given day can be calculated if you know the declination of the Sun and if you know your latitude (for Winston Salem, it is about 36^o). The altitude of the Sun can be calculated from the equation: **Alt = 90^o - L (+ or -) D** where **L** is the observer's latitude, and **D** is the declination of the Sun. The value for **Alt** is the noon angle of the Sun in degrees. The declination of the Sun is known for the Winter Solstice (-23.5^o); the Equinoxes (0^o); and the Summer Solstice (+23.5^o). So, what is the altitude of the Sun on the Summer Solstice? **Alt = 90 – 36 + 23.5 = 77.5^o .** You can find the declination of the Sun for any day by looking at an **Analemma** or you can find a chart on the internet**.** Calculate the noontime angle of the Sun in London (latitude 51.5^o) on the Winter Solstice. (Answer is: Alt = 90 – 51.5 - 23.5) = 15 degrees.)

Mini facts: Tycho Brahe (1546 – 1601) was a Danish astronomer who made careful studies of the planets which allowed Johannes Kepler formulate his three laws. Brahe lost part of his nose in a dual with his third cousin, over who was the better mathematician. Bob Patsiga, editor