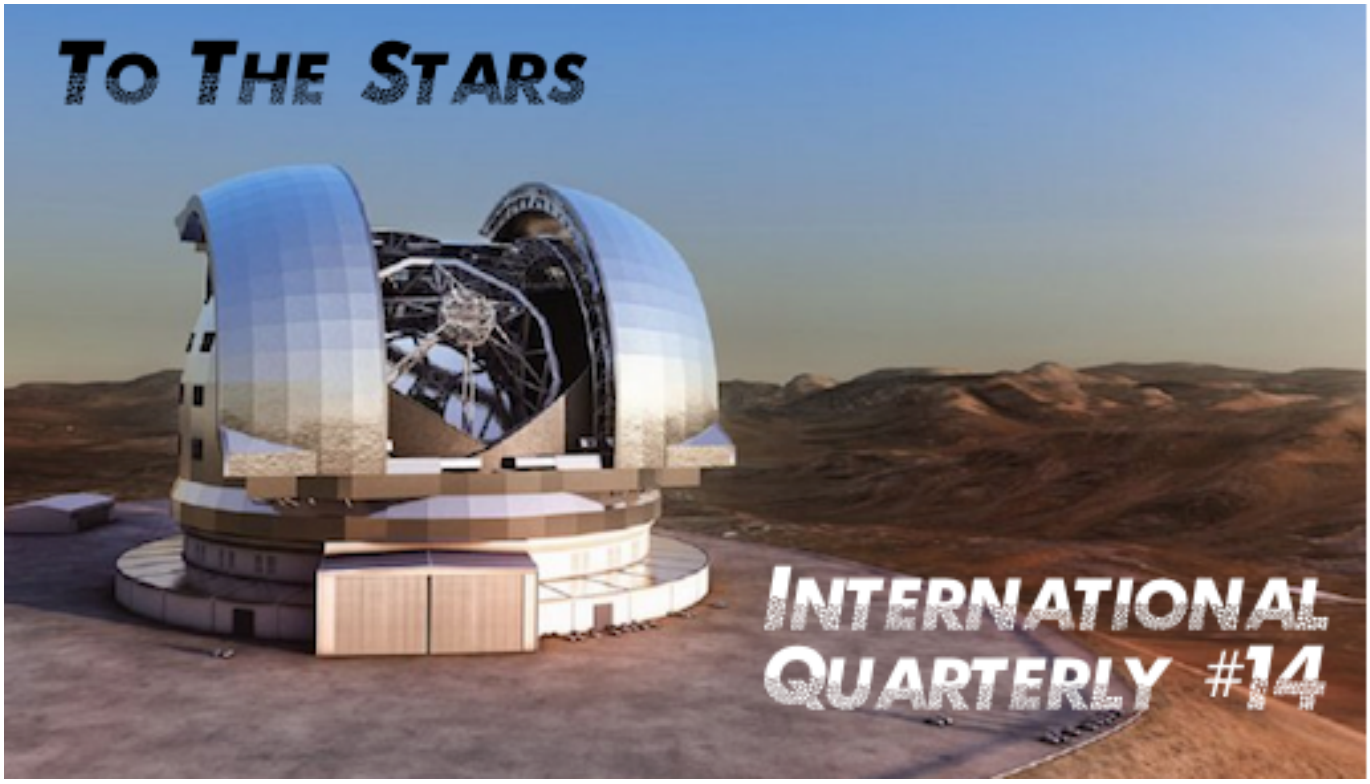


For a very long time, the 200" (5 meter) Telescope at Mount Palomar in southern California, was assumed to be the limit of mirror technology. But by one reveolution after another, some in making mirrors, others in combining images from multiple mirrors, that limit is now in the past. Above is what Europe's **"Extremely Large Telescope"** will look like when finishted in Northern Chile. **39 metres across – four times wider than today's biggest telescope** – and it will be "so powerful that astronomers will even be able to observe dark, rocky planets far beyond our solar system.":Read more: http://www.dailymail.co.uk/sciencetech/article-2158045/**Europe-votes-build-worlds-biggest-telescope-explore-distant-rocky-planets-build-Chile-darker**.html

INDEX

TTSIQ Sponsor Organizations

About The National Space Society – http://www.nss.org/

The National Space Society was formed in March, 1987 by the merger of the L5 Society and National Space institute. NSS has an extensive chapter network in the United States and a number of international chapters in Europe, Asia, and Australia. NSS hosts the International Space Development Conference in May each year at varying locations. NSS publishes **Ad Astra** magazine quarterly. NSS actively tries to influence US Space Policy.

About The Moon Society – http://www.moonsociety.org

The Moon Society was formed in 2000 and seeks to inspire and involve people everywhere in exploration of the Moon with the establishment of civilian settlements, using local resources through private enterprise both to support themselves and to help alleviate Earth's stubborn energy and environmental problems. The Society has a network of chapters in the US and has been an affiliate of NSS since 2005.

About Space Renaissance Initiative – http://www.spacerenaissance.org/

SRI's focus is on use of space resources to address the challenges of runaway population growth and increasing use of Earth resources at a non-sustainable pace. "The settlement of space would benefit all of humanity by opening a new frontier, energizing society, providing room and resources for the growth of the human race without despoiling Earth, creating a lifeboat for humanity that could survive even a planet-wide catastrophe."

About The Mars Foundation – http://marsfoundation.org/ – http://marshome.org/

The Foundation seeks to involved interested persons in the design of Mars outposts and settlements, maximizing use of building materials that can be produced on Mars, to illustrate the near-term feasibility of establishing a permanent human presence on Mars.

About Open Luna Foundation – http://openluna.org/missions

The OpenLuna Foundation aims to return to the moon through private enterprise. A stepped program of robotic missions, then a short series of manned missions to construct a small, approximately 8 person outpost .

About SEDS: Students for the Exploration and Development of Space – http://www.seds.org/

SEDS is an independent, student-based organization promoting the exploration and development of space by educating people about the benefits of space, via a network of interested students, providing an opportunity

About Moon Miners' Manifesto – http:www.MMM-MoonMinersManifesto.com

MMM, has been published 10 times a year since issue #1 December 1986 by the Milwaukee Lunar Reclamation Society chapter of the **National Space Society**. It has also served **the Moon Society** and its predecessor, Artemis Society International, since October 1995.

Most issues deal with the **opening of the Lunar frontier**, suggesting how pioneers can make best use of **local resources** and learn to **make themselves at home.** This will involve psychological, social, and physiological adjustment**.** Much of what will hold for the **Moon**, will also hold true for **Mars** and for space in general. There is one Mars theme issue each year, and occasionally **other space destinations** are discussed: the asteroids, Moon (Jupiter), Titan (Saturn), even the cloud tops of Venus, and interstellar destinations beyond.

Most of the "editor's summaries" of news articles will give the URL web **address** of the article, its **title** and date, and a **key image** if there is one. We leave it up to the reader to explore further.

– Peter Kokh, Editor, kokhmmm@aol.com

Get Space Mail: New Service Offers Daily Space Photos in Your Inbox

www.space.com/31462-service-delivers-daily-space-photos.html

ADVANCES IN ROCKETRY

Rocket Spaceflight proposed 3 decades earlier than previously thought

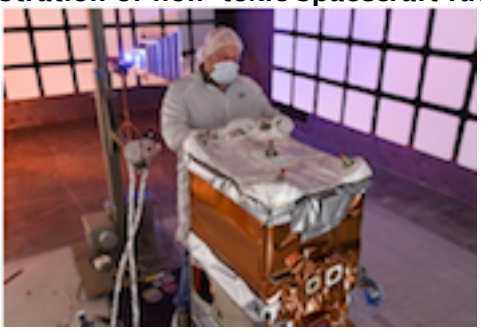
4 October, 2015 – http://link.rm0005.net/v/mb5er5PnC18IhQDohloBAQ2

A Scottish-Canadian teacher applied scientific principles to accurately describe the rocket as the best device for travelling in space in 1861.

Ball Aerospace Integration Milestone for Green Propellant Infusion

www.spacedaily.com/reports/prnewswire-space-news.html?rkey=20151005LA16865&filter=1639

First-ever U.S. demonstration of non-toxic spacecraft fuel set for 2016 launch



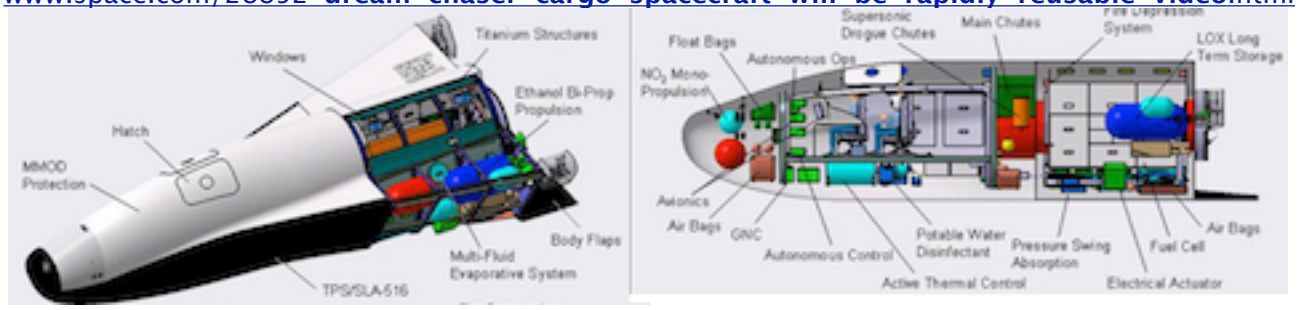
5 October, 2015 – **The Green Propellant Infusion Mission** to revolutionize spaceflight demonstrating √ improved overall propellant efficiency while √ reducing the toxic handling concerns associated with the traditional hydrazine propellant.

The Ball-led validation mission, will √ characterize the green fuel's performance on orbit during a 13-month mission that also hosts three experimental payloads. ##

Private Dream Chaser Space Plane Poised for New Flight Tests in 2016

8 October, 2015 – www.space.com/30782-**dream-chaser-space-plane-2016-tests**.html

www.space.com/28852-**dream-chaser-cargo-spacecraft-will-be-rapidly-reusable-video**.html



http://www.citizensinspace.org/wp-content/uploads/2013/01/LM_CEV.jpg

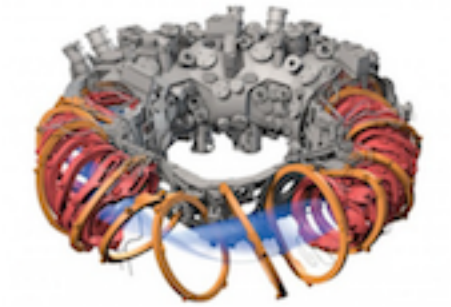
NASA's SLS Rocket Sheds Saturn V Color Scheme in Design Review

23 October, 2015 - www.space.com/30916-**nasa-space-launch-system-rocket-design**.html

NASA has revealed a reworked color scheme for the Space Launch System heavy-lift booster, removing the paint from one major component, while adding "racing stripes" to another.

The Bizarre Reactor that might save Nuclear Fusion

http://news.sciencemag.org/physics/2015/10/**feature-bizarre-reactor-might-save-nuclear-fusion**



21 October, 2015 - **Tokamaks' rebellious cousin** is stepping out of the shadows. In a gleaming research lab in Germany's northeastern corner, researchers are preparing to switch on a fusion device called a **stellarator**, the largest ever built. The €1 billion machine, known as Wendelstein 7-X (W7-X), appears now as a 16-meter-wide ring of gleaming metal bristling with devices of all shapes and sizes, innumerable cables trailing off to unknown destinations.

Stellarators have long been dark horses in fusion energy research because tokamaks are **better at keeping gas trapped and holding on to the heat needed to keep reactions ticking along**. They have many attributes that could make them much better prospects for a commercial fusion power plant: Once started, stellarators naturally purr along in a steady state, and they don't spawn the potentially metal-bending magnetic disruptions that plague tokamaks. But they are devilishly hard to build, making them perhaps even more prone to cost overruns and delays than other fusion projects.

W7-X could mark a turning point. ##

BAE Takes Stake in British Skylon Air-Breathing Rocket Venture

2 November, 2015 - www.space.com/30997-**bae-british-air-breathing-rocket-venture.html**

Defense technology giant BAE Systems plc on Nov. 2 said it had agreed to purchase a 20 % equity stake in single-stage-to-orbit engine designer Reaction Engines Limited (REL) and would provide the company with "industrial, technical and capital resources" for ground-based testing of a prototype. This follows the British government's decision in 2013 to invest 60 million British pounds ($92.5 million) in REL's SABRE, (Synergetic Air-Breathing Rocket Engine), and will accelerate REL's progress on the test article.

Billionaire Battle: Jeff Bezos, Elon Musk Square Off on Reusable-Rocket Test

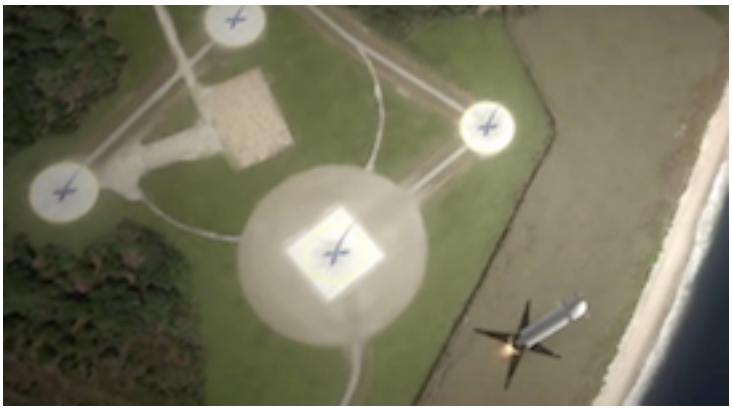
24 November, 2015 - www.space.com/31210-**bezos-musk-blue-origin-spacex**.html
http://www.thespacereview.com/article/2872/1

A Blue Origin rocket heads for a successful landing after an unmanned suborbital test flight from its West Texas launch site on Nov. 23, 2015 in this screen grab from a Blue Origin

On November 23, Blue Origin — a company established by Amazon.com, founder Jeff Bezos —launched a rocket into suborbital space and then brought it back down for a soft lanindon a pad in West Texas. The uncrewed test marked a big step toward full rocket reusability, which could open space to human exploration by dramatically lowering the cost of spaceflight. ##

Space-X May Try Land Based Rocket Landing in Florida

1 December, 2015 - www.space.com/31248-**spacex-may-try-land-based-rocket-landing**.html



SpaceX is developing reusable Falcon 9 rockets to make spaceflight more affordable. The company plans to land the first stage of its Falcon 9 rockets at its Landing Site 1 at the Cape Canaveral Air Force Station in Florida.

In February, SpaceX leased a former launch facility to create the first ever “landing pad”at the Cape Canaveral Air Force Station. It intends to transition from using the drone ship to landing on the pad as it advanced its plans for reusing its rockets. ##

SpaceX Lands Orbital Rocket Successfully in Historic First

23 December, 2015 - www.space.com/31420-**spacex-rocket-landing-success**.html
www.space.com/28167-**spacex-risky-reusable-rocket-landing-infographic**.html
www.youtube.com/watch?v=eX36bG3N7lQ - event viewed from helicopter
www.space.com/31444-**spacex-falcon-rocket-landing-epic-photos**.html
www.space.com/31440-**spacex-falcon9-rocket-landing-pictures**.html

The third attempt at a historic reusable-rocket milestone was the charm for SpaceX which brought the first stage of its Falcon 9 booster back down for a soft touchdown - history's first-ever rocket landing during an orbital launch.

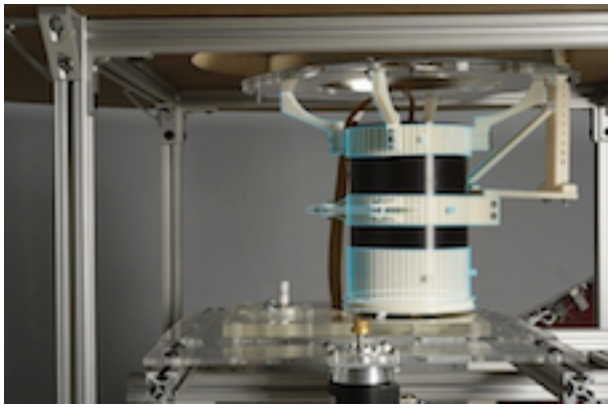
(Blue Origin, the company led by Amazon.com founder Jeff Bezos, landed its New Shepard booster successfully last month, but that occurred during a suborbital test.) The Falcon 9 mission also delivered 11 commercial satellites into orbit for SpaceX customer ORBCOMM.

The Falcon 9 blasted off at 8:29 p.m. EST on Dec. 22nd from Florida's Cape Canaveral Air Force Station, tasked with delivering to orbit 11 spacecraft for the satellite-communications company Orbcomm.

The two-stage Falcon 9 separated, and then the rocket's first stage performed a series three "boostback burns," coming down for a pinpoint touchdown at Cape Canaveral.

Air Force Funds 3D-Printing Study for Rocket Engines

1 December, 2015 - http://www.space.com/31102-**air-force-3d-printing-rocket-engines**.html



Johns Hopkins University will use its $545,000 Air Force award
to research additive 3-D printing of liquid rocket engine cooling chambers ##

US Air Force/Boeing X-37B Space Plane Wings Past 200 Days in Orbit

8 December, 2015 - www.space.com/31308-**air-force-space-plane-200-days-orbit**.html

Video included

"Fully reusable" - affordable access to orbit - then returned to Earth to be reflown

SpaceX, ULA Transforming Historic Launchpads for Commercial Crew Flights

www.space.com/31357-**spacex-ula-transforming-historic-launchpads-for-commercial-crew-flights**.html

11 December, 2015 - Two historic launch pads are being readied to support commercial crew launches for NASA. These are the pads from which the ApolloAstronauts left for the Moon (Complex 31 at Campe Canaveral Air Force Station), and from which Space Shuttles left for orbit to build and supply

the International Space Station (Pad 31A at Kennedy Space Center). The construction work includes lowering historic structures and raising the first new launch gantry to support crewed launches in more than 30 years.

Above: A new crew access tower rises beside a United Launch Alliance Atlas V rocket as the modifications continue to Pad 39A for SpaceX Falcon rocket crewed launches in the background. ##

Damaged Virginia Spaceport Launchpad Repaired for Private Rocket Launches

18 December, 2015 - www.space.com/31412-virginia-launchpad-private-rocket-launches.html

It's taken a year of repairs, but a commercial launchpad, Pad-0A at NASA's Wallops Flight Facility on Virginia's Eastern Shore is once again ready for private rocket launches bound for the International Space Station.

Just over a year ago — an Orbital ATK Antares rocket exploded in a brilliant fireball just after liftoff, destroying an unmanned Cygnus capsule crammed with NASA cargo. ##

CUBESAT NEWS

AUSSATS Cubesat Starts its Mission

www.esa.int/Education/CubeSats_-_Fly_Your_Satellite/AAUSAT5_CubeSat_starts_its_space_mission

9 October 2015 -

According to radio transmissions received by radio amateurs around the world, AAUSAT5 is alive and kicking! The **student-built** AAUSAT5 CubeSat was deployed from the International Space Station (ISS) on 5 October, together with ESA's technology demonstration CubeSat GomX-3. Both CubeSats have now started their mission in space.

The student-built AAUSAT5 CubeSat was deployed from the International Space Station (ISS) on 5 October at 16:05 CET, together with ESA's technology demonstration CubeSat GomX-3. Both CubeSats have now started their mission in space.

CubeSat to Demonstrate Miniature Laser Communications in Orbit

www.nasa.gov/press-release/**cubesat-to-demonstrate-miniature-laser-communications-in-orbit**

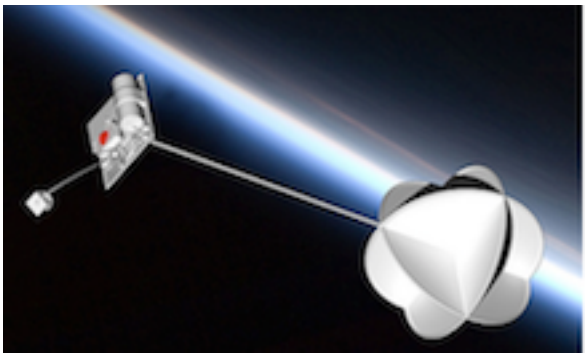
5 October, 2015 - Optical Communications and Sensor Demonstration (OCSD) Spacecraft Configuration. OCSD differs from other space-based laser communication systems because the laser is hard-mounted to the spacecraft body, and the orientation of the CubeSat controls the direction of the beam. This makes the laser system more compact than anything previously flown in space. ##

Virgin Galactic's 'Cosmic Girl' Is A Satellite Launching Mothership | Video

www.space.com/31294-**virgin-galactic-s-cosmic-girl-is-a-satellite-launching-mothership-video**.html

Tiny 'ThumbSats' Aim to Bring Space to All

28 October, 2015 - www.space.com/30943-**tiny-thumbsats-bring-space-all**.html



While CubeSats are inexpensive enough for universities and small companies to access, a company called **ThumbSat, Inc.** has a vision of even cheaper space exploration. As the name of the firm implies, a "ThumbSat" is controlled by a tiny circuit board and carries an experiment that is just 48 mm x 48 mm x 32 mm across at most and weighing around 25 grams (0.055lb). What's more, ThumbSat is willing to do more of the mission planning for you than a typical CubeSat, the company says. ##

Cubesat packed rail-Launched Super Strypi Rocket Fails in Debut

4 November, 2015 - www.space.com/31021-**rail-launched-super-strypi-rocket-cubesats-fails**.html

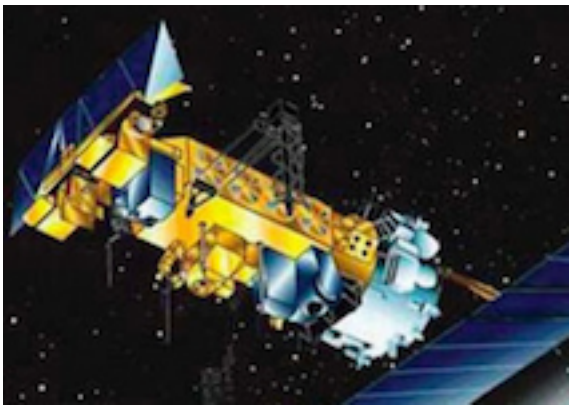
The U.S. Air Force's rail-launched Super Strypi rocket lifted off from Hawaii roared toward the sky and failed less than a minute into the long-awaited flight.

ORBITAL SPACE DEBRIS PROBLEM

NOAA Weather Satellite Breaks Up in Orbit

3 December, 2015 - www.space.com/31257-**weather-satellite-breaks-up-in-space**.html

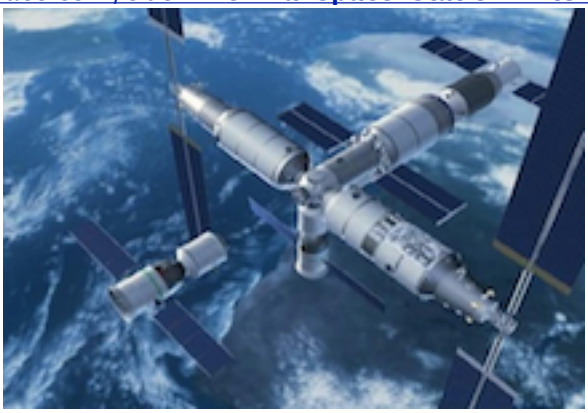
A U.S. National Oceanic and Atmospheric Administration satellite retired in 2014 has suffered an apparent breakup, the second time in less than a year that a polar-orbiting weather satellite has generated orbital debris.



INTERNATIONAL SPACE STATION(S)

China's Space Station Planners Put Out Welcome Mat

14 October, 2015 - www.space.com/30824-**china-space-station-international-cooperation**.html



An artist's concept of China's planned space station

China is soliciting interntional participation in its planned manned space station. Modules from other nations would attach to the 3-module core system, with visits by foreign crew-transport vehicles for short stays and the involvement of non-Chinese researchers in placing experiments on the complex.

Celebrating 15 Years of Human Space Exploration in Low-Earth Orbit

www.nasa.gov/press-release/**space-station-crew-celebrates-15-years-of-human-space-exploration-in-low-earth-orbit**

15 years continuous occupation of ISS since November 2, 2000.

Declassified: The NRO's Abandoned Plans for a Manned Spy Space Station

28 October, 2015 - www.space.com/30910-us-**military-spy-space-station-declassified**.html

The National Reconnaissance Office released Oct. 22 a trove of declassified records —including **this silent video** and **photos below** from the 1960s about a military human spaceflight program.

The Manned Orbiting Laboratory (MOL) would have sent military astronauts to a small station.



more pictures, control room, exterior

NASA Orders SpaceX Crew Mission to International Space Station

20 November, 2015 - www.spacedaily.com/**reports/prnewswire-space-news**.html

23 November, 2015 - www.space.com/31198-**nasa-spacex-astronauts-space-station**.html

NASA took a significant step toward expanding research opportunities aboard the International Spae Station with its first mission order from SpaceX to launch astronauts from U.S. soil. The Boeing Company of Houston received its first crew mission order in May.

"It is important to have at least two healthy and robust capabilities from U.S. companies to deliver crew and critical scientific experiments from American soil to the space station throughout its lifespan."

Determination of which company will fly its mission to the station first will be made at a later time. Commercial crew missions to the space station, on the Boeing CST-100 Starliner and SpaceX Crew Dragon spacecraft, will restore America's human spaceflight capabilities and increase the amount of time dedicated to scientific research aboard the orbiting laboratory. ##

Orbital ATK's Private Cygnus Supply Ship Arrives at Space Station

9 December, 2015 - www.space.com/31316-**private-cygnus-spaceship-space-station-arrival**.html

The Cygnus craft launched toward the space station on Sunday (Dec. 6) aboard an Atlas V rocket built by United Launch Alliance. The craft is carrying nearly 4 tons of food, supplies and experiment gear for the station's six-person crew. This was the first successful Cygnus launch since the loss of its last Cygnus vehicle and Antares rocket in October 2014. The Station has had to rely on shipments on Space-x and the Russians. ##

NASA Orders 2nd Boeing Crew Mission to International Space Station

www.nasa.gov/press-release/**nasa-orders-second-boeing-crew-mission-to-international-space-station**

18 December, 2015 - Once certified by NASA, the **Boeing CST-100 Starliner** and **SpaceX Crew Dragon** each will be capable of two crew launches to the station per year.

Above: This artist's concept shows Boeing's CST-100 Starliner spacecraft, currently under development for NASA's Commercial Crew Program, docking to the International Space Station.

Spacewalking Astronauts Rescue Stuck Space Station Railcar

21 December, 2015 - www.space.com/31429-spacewalking-astronauts-rescue-stuck-railcar.html

NASA astronauts Scott Kelly and Tim Kopra completed a spacewalk December 21, releasing a stuck railcar and moving it to a workstation, where it could be locked down. Here, Kopra works near the recently arrived Cygnus supply craft (top). ##

ADVANCED TECHNOLOGIES & ROBOTICS

Magnetic sail tech alternative to rocket-based space travel

www.spacedaily.com/reports/**Magnetic_Sail_Technology_Intriguing_Alternative_to_Rocket_Powered_Space_Travel**_999.html https://www.youtube.com/watch?v=EdJsUFpIIp0

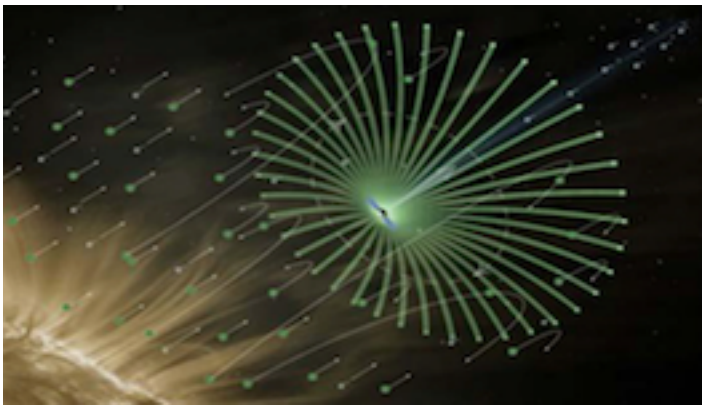
14 October, 2015 - Dark Sea Industries, an aerospace company focused on developing new propulsion technologies for space-related industries is currently conducting **a crowdfunding campaign on Indiegogo** to raise money to construct **several prototypes to test the theory behind using a superconducting coil, or solenoid, to create electromagnetic fields to propel spacecraft.**

The idea explores the possibilities of using electric or magnetic fields already in the space around the Sun (heliosphere) or Earth (magnetosphere) to power magnetic sails. #

'Electric Sails' Could Propel Superfast Spacecraft by 2025

9 November, 20115 - www.space.com/31063-**electric-sail-solar-wind-space-exploration**.html

Robotic spacecraft may ride the solar wind toward interstellar space at unprecedented speeds a decade or so from now.Researchers are developing an "electric sail" (e-sail) propulsion system that would harness the solar wind, the stream of protons, electrons and other charged particles that flows outward from the sun at more than 1.6 million km/hr (1 million mph).



##

'1st Hardware Store in Space': Commercial 3D Printer Launching in 2016

29 October, 2015 - www.space.com/30965-**made-in-space-3d-printer-lowes**.html

The home-improvement industry will soon get its first foothold in space. California-based startup **Made In Space** is partnering with home-improvement giant **Lowe's** to launch a commercial 3D printer to the International Space Station (ISS) early next year. ##

Humanoid Robot R5: Valkyrie 'Dances' In NASA Music Video

www.space.com/31270-**humanoid-robot-r5-valkyrie-dances-in-nasa-music-video**.html

Cygnus Spacecraft Hauling Science to ISS on Return-to-Flight Mission

2 December, 2015 - www.space.com/31261-**cygnus-cargo-spacecraft-science-experiments**.html

The previous Cygnus mission ended just seconds after launch on Oct. 28, 2014, when the spacecraft's Antares rocket exploded, apparently because of a problem with one of its first-stage AJ26xs engines.

The first launch of the private Cygnus cargo spacecraft since then has delivered a wealth of science equipment and experiments to the International Space Station.

6 December, 2015 - www.space.com/31267-**cygnus-spacecraft-return-to-flight-photos**.html
www.space.com/31278-**cygnus-spacecraft-launch-orbital-atk-return-to-flight**.html
www.nasa.gov/press-release/**nasa-cargo-launches-to-space-station-aboard-orbital-atk-resupply-mission**

MISSION TO PLANET EARTH

Daily Views of Earth Available on New NASA Website

19 Oct, 2015 www.nasa.gov/press-release/**daily-views-of-earth-available-on-new-nasa-website**
www.space.com/30864-**earth-one-full-day-from-one-million-miles-time-lapse-video**.html

NASA has launched a new website so the world can see images of the full, sunlit side of the Earth every day. The images are taken by a NASA camera one million miles away on the Deep Space Climate Observatory (DSCOVR), a partnership between NASA, the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Air Force.

Ingredients for Life Were Always Present on Earth, Comet Suggests

23 October, 2015 - www.space.com/30911-**comet-lovejoy-organic-molecules-earth-life**.html

The basic building blocks of life may have been present on Earth from the very beginning. Astronomers detected 21 different complex organic molecules streaming from **Comet Lovejoy** during its highly anticipated close approach to the Sun this past January. Many of these same carbon-containing compounds have also been spotted around newly forming sunlike stars.

New study: Antarctica isn't shrinking after all — it's getting larger

www.aol.com/article/2015/11/02/**nasa-says-antarctic-ice-may-be-growing-after-all**/21257391/

2 November, 2015 -n Antarctica is actually gaining ice mass thanks to snow and instead of driving sea level rise, may actually be slowing it down.

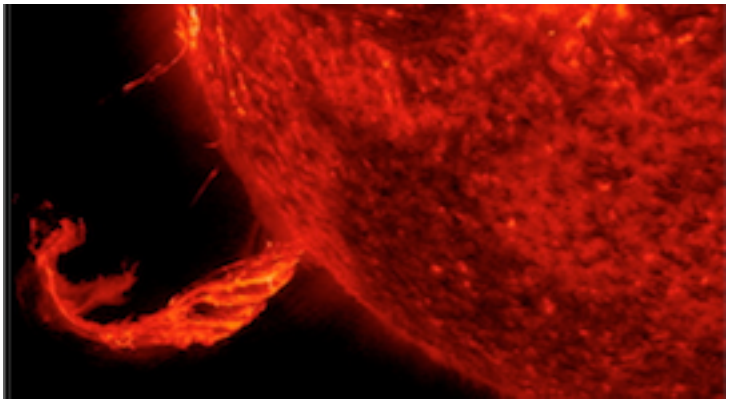
"Our main disagreement is for east Antarctica and the interior of west Antarctica — there, we see an ice gain that exceeds the losses in the other areas."

"The problem is sea levels are still rising — though where that water is coming from is still a mystery — and parts of Antarctica are still melting fasterthanever. So NASA wants a closer look to better understand exactly how all Antarctica's ice fits into the sea-level picture."

The upcoming **ICESat 2** mission will be able to track snowpack changes in Antarctica down to the thickness of a pencil. It's scheduled for launch in 2018. ##

The Active Sun: US Unveils Plan to Deal with Space Weather

2 November, 2015 - www.space.com/30986-**united-states-space-weather-plan**.html



On Octobef 29th, the White House released two documents that together lay out the nation's official plan for mitigating the negative impacts of solar flares and other types of "space weather," which have the potential to wreak havoc on power grids and other key infrastructure here on Earth.

The new "National Space Weather Strategy" outlines the basic framework the federal government will pursue to better understand, predict and recover from space-weather events,

High-energy solar flares aimed at Earth can affect the operation of orbiting satellites, and the most powerful emissions can even pose a risk to astronauts aboard the Intenational Space Station. ##

White House is preparing for Catastrophic Solar Flares

www.aol.com/article/2015/11/04/white-house-is-preparing-for-catastrophic-solar-flares-that-coul/21258627/

www.whitehouse.gov/sites/default/files/microsites/ostp/final_nationalspaceweatheractionplan_20151028.pdf

4 November, 2015 - The White House is developing a plan to protect American interests against an electromagnetic pulse caused by solar flares that has the potential to wipe out power around the world.

It's happened before. Back in 1859 the Earth was walloped with a huge amount of solar activity known as **the Carrington event**. The solar activity was so high that **the northern lights were spotted as far south as Cuba and Honolulu**, and telegraph operators reported seeing sparks leap from their devices.

In our much more high-tech world, the impact today would be far greater, with the potential to wipe out and shut down power grids, cell phone technology, GPS devices, and even the Internet. A National Academy of Sciences report from 2008 suggested **the cost of such an event could be $2.6 trillion**. ##

Ancient Cosmic Crashes May Have Altered Earth's Composition

5 November, 2015 - www.space.com/31030-**cosmic-crashes-change-earth-composition**.html

Earth formed by accretion - the gradual accumulation of bits of matter due to their mutual gravitational pull. Heat from the radioactivity of accretting meteorites and from the impacts of rocks constantly bombarding the newborn Earth caused the planet to melt enough for heavy materials to sink downward. This resulted in an iron-rich core, above which lay a rocky mantle and crust. ##

Earth's Absorption of CO2 May Tilt In Wrong Direction | Video

www.space.com/31108-**earth-s-absorption-of-co2-may-tilt-in-wrong-direction-video**.html

For at least the past 50 years, about half of all Earth's carbon dioxide emissions - human and natural - have been absorbed by the land and oceans. Scientists are trying to understand how much more CO2 this global carbon sink can take, before it spills over.

More

www.space.com/31107-**rural-biomass-burning-vs-megacity-industry-who-emits-more-co2**-5-day-time-lapse-video.html

Scientists are studying the heat trapping behavior of CO2 released by land-clearing and accidental forest fires vs. factories in large urban centers.

More

www.space.com/31105-**3-months-of-carbon-dioxide-measured-from-space-time-lapse-video**.html

NASA Orbiting Carbon Observatory 2, launched in July 2014, measures global atmospheric carbon dioxide. Data from May to August 2015

More

www.space.com/31104-**gaias-garden-one-year-of-earths-plant-growth-time-lapse-video**.html

Plant growth and decay on land and oceans over a 12-moth cycle can be seen in this 'average year' data set, compiled from many science imaging satellites

More

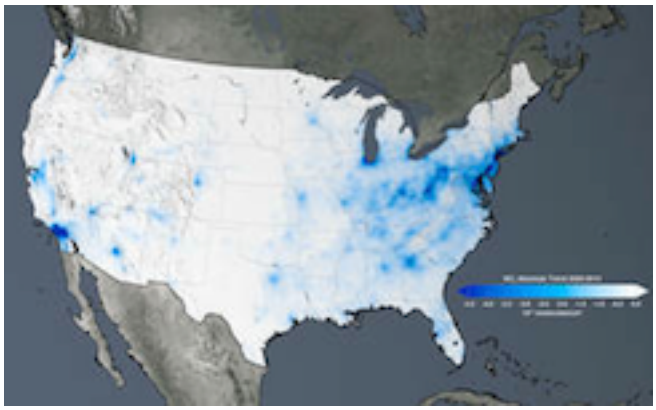
www.nasa.gov/press-release/**as-earth-warms-nasa-targets-other-half-of-carbon-climate-equation**

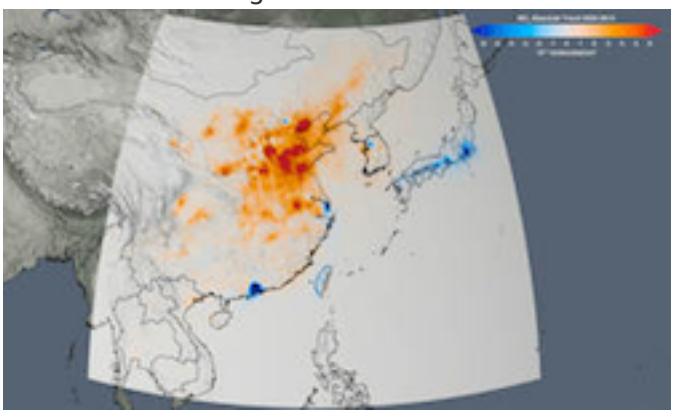
NASA and university scientists discuss new insights, tools and agency research into **key carbon and climate change questions**, as the agency ramps up its efforts to understand **how Earth's ocean, forest, and land ecosystems absorb nearly half of emitted carbon dioxide today**.

New NASA Satellite Maps Show Human Fingerprint on Global Air Quality

www.nasa.gov/press-release/**new-nasa-satellite-maps-show-human-fingerprint-on-global-air-quality**

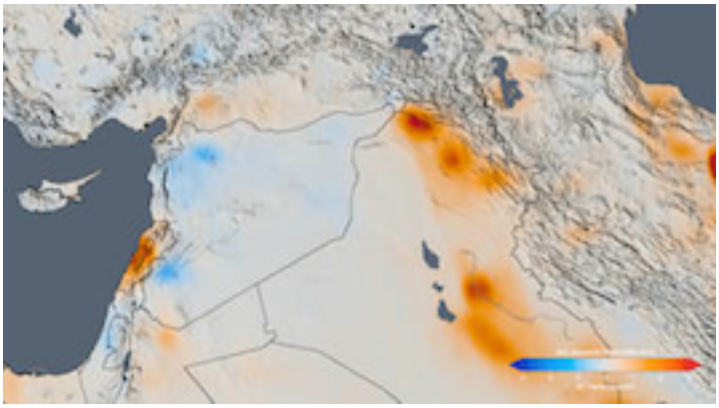
14 December, 2015 – Using new, high-resolution global satellite maps of air quality indicators, NASA scientists tracked air pollution trends over the last decade in various regions and 195 cities.





Left: The trend map of the United States shows the large decreases in nitrogen dioxide concentrations tied to environmental regulations from 2005 to 2014

Right: The East Asia trend map shows change in nitrogen dioxide concentrations related to a mix of economic growth and environmental controls across China, South Korea, Japan 2005 to 2014.



Above: The trend map of the Middle East shows the change in nitrogen dioxide concentrations from 2005 to 2014. The decreases in Syria are tied to the economic disruption caused by their civil war.

ADVANCES IN SOLAR & HYDROGEN POWER SYSTEMS

.'Hydricity' concept uses Solar Energy to produce power round-the-clock

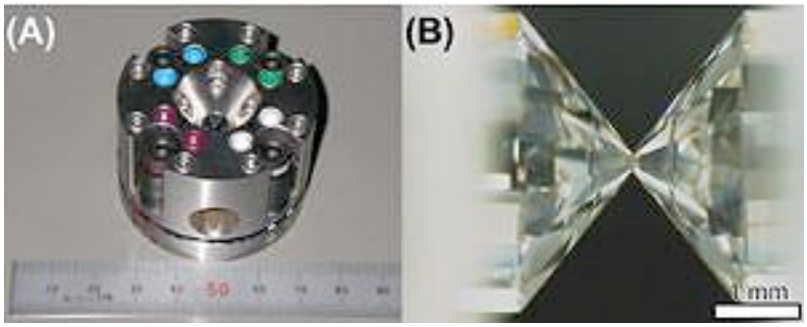
www.solardaily.com/reports/**Hydricity_concept_uses_solar_energy_to_produce_power_round_the_clock**_999.html

18 December, 2015 - **Hydricity** uses solar concentrators to focus sunlight, producing high temperatures and superheating water to operate a series of electricity-generating steam turbines & reactors to split water into hydrogen and oxygen. The hydrogen would be stored for use overnight to superheat water and run the steam turbines, or for other applications, producing zero greenhouse-gas emissions. ##

Creation of Jupiter's interior, a step towards room temp superconductivity

www.spacedaily.com/reports/**Creation_of_Jupiter_interior_a_step_towards_room_temperature_superconductivity**_999.html

21 December, 2015 - Hydrogen is the most abundant element in the universe, and a major component of stars such as the Sun and gas-giant planets such as Jupiter and Saturn. In recent years, hydrogen's behavior at high temperature and high pressure has been of interest not only for planetary science, but also for fields such as materials science for the purpose of achieving a hydrogen energy society.



A, B) can generate high-temperature and high-pressure condition such as earth interior within the laboratory by placing the sample between the diamonds for laser-heating at high pressures. Image courtesy Kenji Ohta.

Since hydrogen is both a highly diffusive and highly reactive element, it is difficult to maintain its stability in high-temperature, high-pressure equipment for use in experimentation, which has greatly impeded research on high temperature, high pressure hydrogen.

A research group of Osaka University and Tokyo Institute of Technology successfully developed technology which stabilizes hydrogen in a high-temperature, high-pressure environment without chemical reactions with surrounding matter. ##

NEAR SPACE & SPACE TOURISM

SpaceShipTwo Bounces Back to Rubber Fuel

20 October, 2015 - www.space.com/30850-**spaceshiptwo-back-rubber-fuel**.html

Virgin Galactic plans to use a rubber-like fuel when it resumes powered test flights of its SpaceShipTwo suborbital vehicle based on the results of an ongoing series of tests of the spacecraft's hybrid rocket motor, using a rubber-like fuel formally known as **hydroxyl-terminated polybutadiene** (HTPB).

Private Spaceflight Industry Aims to Shake Off a Rough Year

27 October, 2015 - www.space.com/30926-**private-spaceflight-accidents-recovery**.html
www.space.com/31165-**how-virgin-galactic-is-testing-new-spaceshiptwo-video**.html

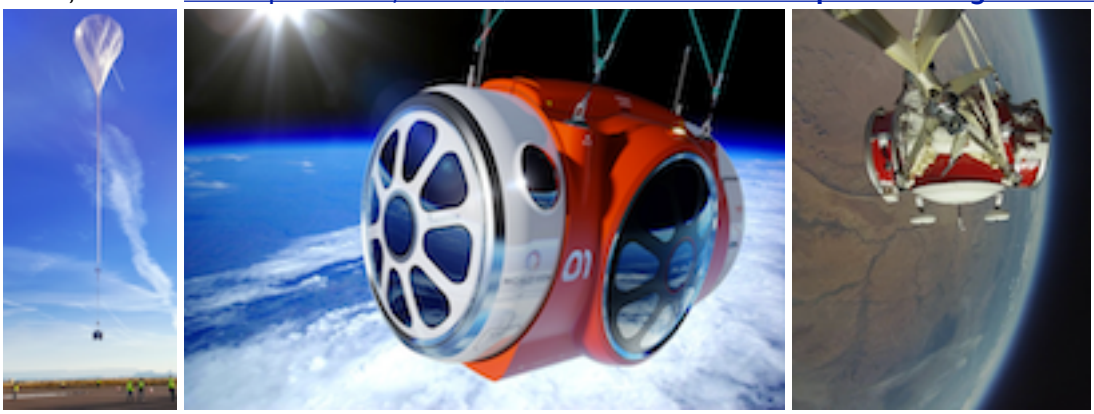
Virgin Galactic's 2nd **SpaceShipTwo** under construction in Mojave, California

Over the past 12 months, robotic resupply missions to the International Space Station (ISS) launched by both Orbital ATK and SpaceX failed, and Virgin Galactic's SpaceShipTwo broke apart during a test flight, killing the vehicle's co-pilot and seriously wounding its pilot.

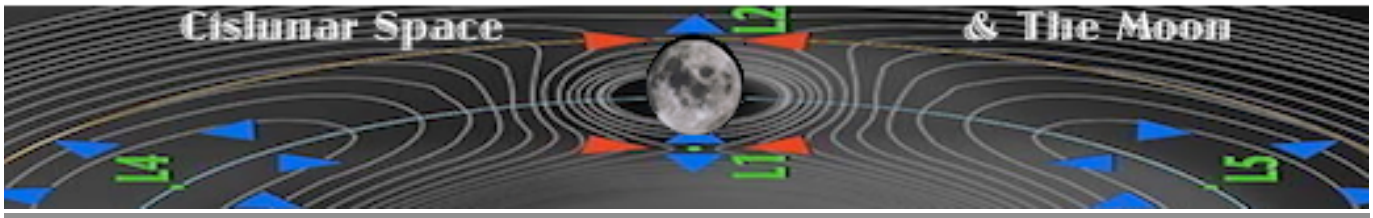
These accidents have slowed the progress of commercial spaceflight, but the industry is far from grounded. Orbital ATK and SpaceX plan to be flying again before the year is out, for example, and Virgin Galactic is nearly finished building SpaceShipTwo number two. ##

Watch Amazing World View Test Flight for Balloon-Based Space Tourism

20 October, 2015 - www.space.com/30950-**world-view-balloon-epic-test-flight-video**.html



Arizona-based World View Enterprises, which aims to loft paying customers to the stratosphere beneath a giant balloon, launched an uncrewed test flight October 26th.. The company sent a 10% scale version of its passenger capsule to an altitude of 30,624 m (100,475 ft) above the town of Page in northern Arizona. ##



THE MOON

We insist on capitalizing "Moon" when it refers to Earth's satellite. Read why:
http://www.moonsociety.org/info/capiltal-M-for-Moon.html

Explore the Moon (Virtually) with These Awesome Global Maps

23 Oct0ber, 2015 - http://www.space.com/30904-awesome-moon-maps-nasa-usgs.html

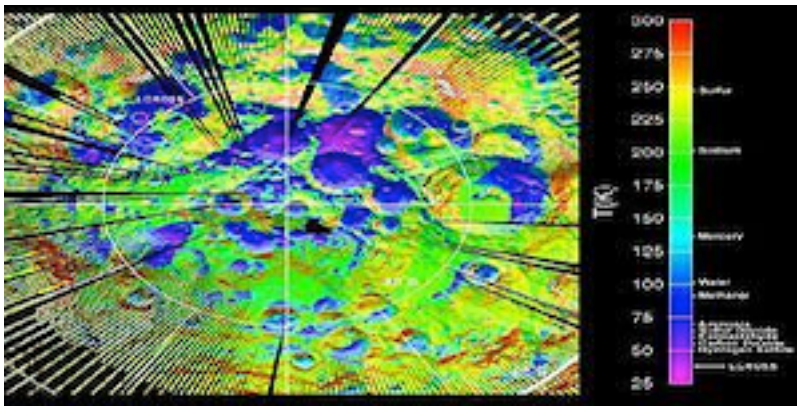
The US Geological Survey (USGS) recently posted online two Moon maps — a photo mosaic and a topographic map — that were constructed using images and dara captured by NASA's long-running Lunar Reconnaissance Orbiter (LRO) spacecraft. ##

LUNAR SCIENCE

Asteroids found to be the Moon's main 'water supply'

www.space-travel.com/reports/**Asteroids_found_to_be_the_moons_main_water_supply**_999.html

2 October, 2015 - Below is the temperature of the surface around the southern pole of the Moon

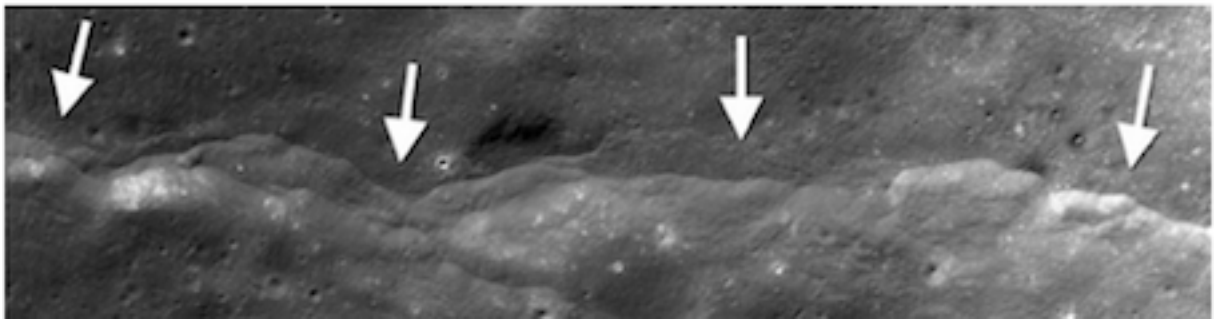


For a larger version of this image please go to www.eurekalert.org/multimedia/pub/100275.php .

Water reserves found on the Moon are the result of asteroids acting as "delivery vehicles" and **not of falling comets** as was previously thought. Using computer simulation, scientists have discovered that "**a large asteroid can deliver more water to the lunar surface than the cumulative fall of comets over a billion year period.**" ##

Earth's Gravitational Pull Cracks Open the Moon

12 October, 2015 - www.space.com/30795-**earth-gravitational-pull-cracks-moon**.html



Just as the Moon's gravitational pull causes seas and lakes to rise and fall as tides on Earth, the Earth exerts tidal forces on the Moon. Scientists have known this for a while, but now they've found that Earth's pull actually opens up faults on the Moon. ##

Mound near lunar south pole formed by unique volcanic process

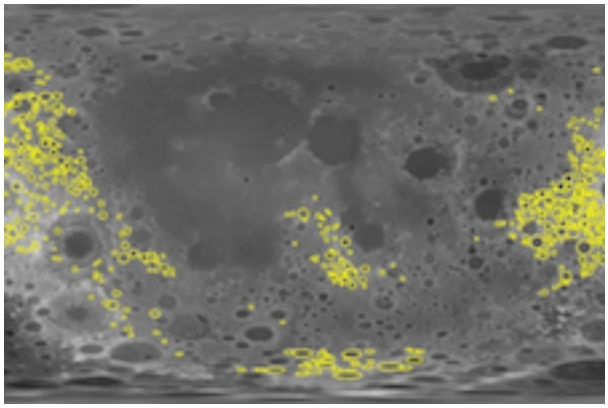
www.space-travel.com/reports/**Mound_near_lunar_south_pole_formed_by_unique_volcanic_process_**999.html

Mafic Mound, a strange feature near the Moon's south pole.

18 October, 2015 - A giant mound near the Moon's south pole appears to be a volcanic structure unlike any other found on the lunar surface. The formation, known as Mafic Mound, stands about 800 meters (260 ft) tall and 75 kilometers (47 miles) across, smack in the middle of a giant impact crater known as the South Pole-Aitken Basin. This new study suggests that the mound is the result of a unique kind of volcanic activity set in motion by the colossal impact that formed the basin. ##

Moon's Shattered Crust Could Shed Light on Earth Life's Origins

19 October, 2015 - www.space.com/30859-**moon-asteroid-impacts-earth-life-origins**.html



Researchers analyzed the gravity signatures of more than farside 1,200 craters (yellow)

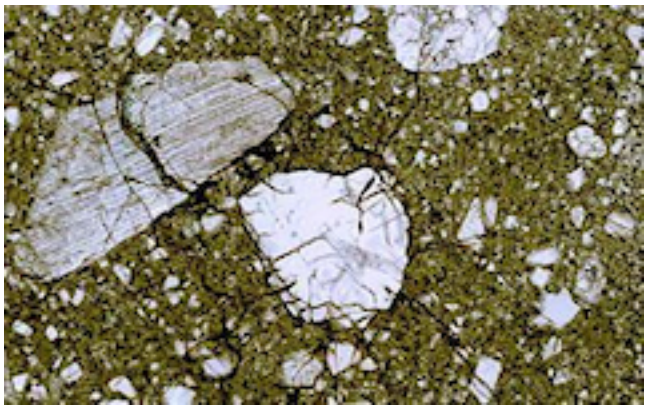
Some parts of the Moon were so heavily bombarded with small asteroids billions of years ago that the impacts completely shattered the upper crust there.

Similar impacts during this same era likely fractured Earth's surface in the same way, generating the types of underground environments that the planet's first life-forms may have exploited. ##

Study questions dates for cataclysms on early Moon, Earth

www.spacedaily.com/reports/**Study_questions_dates_for_cataclysms_on_early_moon_Earth**_999.html

20 October, 2015 - Phenomenally durable crystals called zircons are used to date some of the earliest and most dramatic cataclysms of the solar system. One is the super-duty collision that ejected material from Earth to form the moon roughly 50 million years after Earth formed. Another is the late heavy bombardment wave of impacts that may have created hellish surface conditions c. 4 billion years ago.



The deformed lunar zircon at center was brought from the Moon by Apollo astronauts. The fractures characteristic of meteorite impact are not seen in most lunar zircons, so the ages they record probably reflect heating by molten rock, not impact.

Both events are widely accepted but unproven, so geoscientists are eager for more details and better dates. Many of those dates come from zircons retrieved from the Moon during NASA's Apollo voyages in the 1970s.

A study of zircons from a gigantic meteorite impact in South Africa, now online in the journal Geology, casts doubt on the methods used to date lunar impacts. The critical problem is the fact that lunar zircons are "ex situ," meaning removed from the rock in which they formed, which deprives geoscientists of corroborating evidence of impact. ##

Europe-Russia Lunar mission will make them friends again

www.space-travel.com/reports/**Europe_Russia_Lunar_mission_will_make_them_friends_again**_999.html

21 October, 2015 - The European Space Agency (ESA) and its Russian counterpart, Roscosmos, plan to launch a probe to the Moon's southern pole to look for water and the raw materials necessary for making fuel and oxygen. The mission, **Luna 27**, which is set for launch in 2020, is the first step towards the establishment of a permanent base on the Moon.

Russian Moon mission would need 4 Angara-A5V launches

www.space-travel.com/reports/**Early_Stage_of_Russian_Moon_Mission_to_Require_4_Angara_A5V_Rocket_Launches**_999.html

30 October, 2015 - For Russian cosmonauts to fly to the Moon will require four launches of Angara-?5V heavy-class carrier rockets during the initial stage of the mission. A manned lunar landing by Russian cosmonauts is planned for 2029 with four launches, while a maiden flight of a new super-heavy spacecraft made of composites specifically for Moon missions is scheduled for 2021.##

Yutu, China's first Moon rover sets record for longest stay

www.spacedaily.com/reports/**Chinas_first_moon_rover_sets_record_for_longest_stay**_999.html

Photo taken by the landform camera on the Chang'e-3 moon lander on Dec. 22, 2013 shows the Yutu moon rover during Chang'e-3 lunar probe mission's first lunar day circle. Chang'e-3, with the country's first moon rover onboard, landed on the moon on Dec. 14, 2013, marking the first time that China has sent a spacecraft to soft land on the surface of an extraterrestrial body.

1 November, 2015 - Yutu, has been operating on the Moon for almost two years, setting the record for the longest active stay by a rover, staying active longer than the Soviet Union's 1970 moon rover **Lunokhod 1**, which spent 11 months on the Moon before shutting down. ##

Newfound Moon Craters Point to Asteroid Puzzle

3 November, 2015 - www.space.co bm/31003-**moon-asteroid-impacts-mystery**.html

Newfound lunar craters suggest that asteroids that smashed into the Moon long ago were ver different from the ones now in the asteroid belts. Swarms of asteroids and comets pummeled Earth, the Moon and the other worlds of the inner solar system during an era known as the Late Heavy Bombardment about 4.1 to 3.8 billion years ago.

Many lunar basins are readily apparent to the naked eye, but their exact number, sizes and origins are unclear as their details are often concealed by the destructive effects of subsequent impacts and volcanic eruptions.

NASA's Gravity Recovery and Interior Laboratory (GRAIL) mission's two spacecraft, Ebb and Flowt, were in the same orbit around the Moon. Tiny changes in the distance between them caused by the gravitational pull of clusters of rock have allowed researchers to probe the Moon's structure and composition in unprecedented detail.

Researchers confirmed 27 craters shaped like concentric rings, 160 km (100 mi) or more wide, a structure unique to impact basins, and also identified 24 more structures that might be such craters, including three new to science. ##

Why Moon rocks contain fewer volatiles than Earth's

www.space-travel.com/reports/**SwRI_scientists_explain_why_moon_rocks_contain_fewer_volatiles_than_Earths**_999.html

10 November, 2015 - Scientists at Southwest Research Institute combined dynamical, thermal, and chemical Moon formation models to explain key differences between the composition of lunar rocks and the Earth's. The Moon's lack of easily vaporized elements provides evidence about how the Earth-Moon system formed 4.5 billion years ago. ##

Earth Stole Water and More from Young Moon

13 November, 2015 - www.space.com/31115-**earth-stole-moon-water**.html

The idea for decades has been that after the impact that formed Earth and the Moon, the vaporized volatiles escaped, and that's why the Moon lacks them.

New research suggests that after the impact, Earth may have snatched up easily vaporized material (volatiles) including water and other molecules. As the newly formed moon moved away, it may have spurned the remaining material available, casting it back toward Earth. ##

Explaining the Moon's Mysterious Tilt

25 November, 2015 - www.space.com/31219-**moon-mysterious-tilt-solved.**html

The Moon's current orbit is tilted about 5 degrees with respect to Earth. Previous research suggested this inclination should be 10 times smaller, half a degree. This is a long-standing mystery known as the lunar inclination problem. Current theory is that the Moon was formed of debris blasted off the proto-Earth by a collision of a "Mars-sized" body dubbed "Theia." Theia may have hit at an inclination that is now mirrored in the Moon's inclination. ##

LADEE Mission Shows Force of Meteoroid Strikes on Lunar Exosphere

www.space-travel.com/reports/**LADEE_Mission_Shows_Force_of_Meteoroid_Strikes_on_Lunar_Exosphere**_999.html

21 December, 2015 - NASA scientists have released new findings about the Moon's tenuous exosphere - the thin layer of gas surrounding the Moon that is one 25-trillionth the density of Earth's atmosphere. The data reveal, for the first time, that meteoroid strikes cause a predictable increase in the abundance of two key elements - **sodium** and **potassium** - within the lunar exosphere. ##

Chinese rover analyzes Moon rocks: First new 'ground truth' in 40 years

www.spacedaily.com/reports/**Chinese_rover_analyzes_moon_rocks_First_new_ground_truth_in_40_years**_999.html

24, December, 2015 - In 2013, Chang'e-3, an unmanned lunar mission, touched down on the northern part of the Imbrium basin. on a smooth flood basalt plain next to a relatively fresh impact crater (now officially named the Zi Wei crater) that had conveniently excavated bedrock from below the regolith for the Yutu rover to study. Since the Apollo program ended, American lunar exploration has been conducted mainly from orbit. But orbital sensors primarily detect the regolith (the ground-up surface layer of fragmented rock) that blankets the Moon, and the regolith is typically mixed and difficult to interpret.

Because Chang'e-3 landed on a comparatively young lava flow, **the regolith layer was thin and not mixed with debris from elsewhere. Thus it closely resembled the composition of the underlying volcanic bedrock.** This characteristic made the landing site an ideal location to compare in situ analysis with compositional information detected by orbiting satellites.

The **basalts at the Chang'e-3 landing site** also turned out to be **unlike any returned by the Apollo and Luna sample return missions**.##

LUNAR RESOURCES

EUROPE'S MOON - A Next Destination?

21 December, 2015 - www.leonarddavid.com/**europes-moon-a-next-destination/**

There is increasing interest in Europe to prioritize the Moon as humankind's next deep space destination evident given an international symposium held December 15-16 on

"Moon 2020-2030 – A New Era of Coordinated Human and Robotic Exploration,"
staged at the European Space Agency's (ESA) ESTEC in Noordwijk, The Netherlands

A strong recommendation that will be coming out of the meeting is that **real analog studies** will be necessary to understand how to do operations on the Moon.
"Not analog operations at a Moon-like site which can be hugely expensive, just for travel, but **analog operations where geologists use a real rover robot, perhaps just in a rockyard, with vision, dexterity/haptics and low latency control to do real-time field geology**,"

ESA, the European Space Agency, is exploring the promise of 3**D printing to enable construction of lunar habitats**.

"**We keep talking about lunar resources, but we still need to demonstrate they can be used**…they are, in fact, reserves. So **ground truth verification** of deposit size, composition, form, and homogeneity requires **a coordinated prospecting program**. A successful program would then clearly demonstrate that **lunar resources can enable solar system exploration**,

"**NASA appears to be sidelined in this endeavor**, a product of current NASA space policy,"

GOOGLE LUNAR X-PRIZE

Moon Express signs historic launch agreement for private Moon mission

www.spacedaily.com/reports/prnewswire-space-news.html?rkey=20151001SF17717&filter=1639
1 October, 2015. - Company contracts Rocket Lab on September 30 for three launches starting in 2017, the first Google Lunar X-Prize contendor to secure a launch contract.
www.space-travel.com/reports/**Space_startup_confirms_plans_for_robotic_moon_landings**_999.html
2 October, 2015 - California-based space exploration startup **Moon Express** has signed a deal with Rocket Lab to commence a series of lunar launches starting in 2017.


"disclaimer: image is for illustration purposes only"

CEO Bob Richards announced the partnership between his company, MoonEx, and the lab. The contract marks the beginning stages of **three consecutive robotic lunar landings** set to take place two years from now. The goal: win the $30 million Google Lunar X Prize for first private company to do so. "Landing on the moon the first time would be fantastic, but we want to have some backup plans and to be able to try it again and then try it again." ##

XPRIZE verifies Moon Express launch contract

www.space-travel.com/reports/**XPRIZE_Verifies_Moon_Express_Launch_Contract_Kicking_Off_New_Space_Race**_999.html
10 December, 2015 - Moon Express has received official verification of their launch contract from XPRIZE as part of the $30M Google Lunar XPRIZE, a global competition for privately funded teams to land an unmanned spacecraft on the surface of the moon by December 31, 2017.

Moon Express will use a Rocket Lab Electron rocket combined with the company's "MX-1E" micro-lander as part of a 2017 mission.

Moonspike Rocketship Launches on Kickstarter Journey to the Moon

13 October, 2015 - www.spacedaily.com/reports/prnewswire-space-news.html
www.kickstarter.com/projects/moonspike/**moonspike-the-worlds-first-crowdfunded-moon-rocket**

Moonspike is a private project to design and construct a fully-fledged three-stage 22 ton, liquid-fueled Moon rocket - similar in design to the Saturn V rocket that took Neil Armstrong to the Moon in 1969. The project has launched a Kickstarter campaign to build an actual Moon rocket.

The fundraising campaign has gathered $100,000 of a $1 million goal from 770 backers in its first few days online. ##

Moonspike Private Moon Venture Regroups After Failed Crowdfunding Bid

10 November, 2015 - www.space.com/31041-**moonspike-crowdfunding-moon-venture-fails**.html

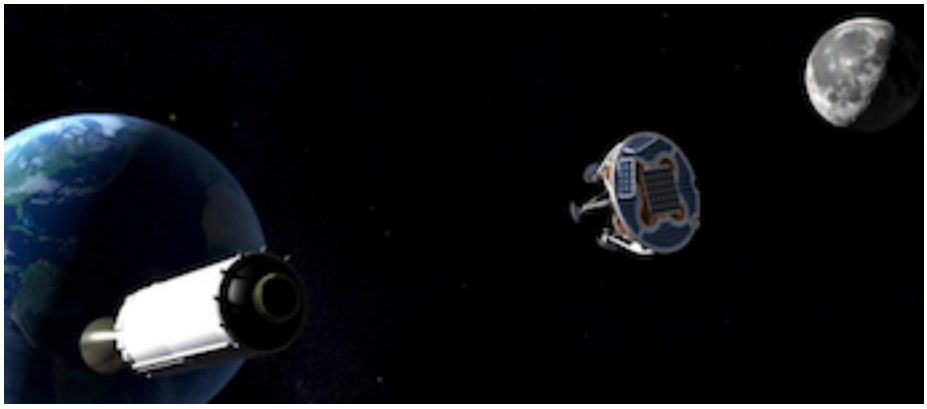
Moonspike plans to develop both a spacecraft to crash-land on the Moon as well as a rocket to send it there.

A European venture to send a small spacecraft to the Moon is reconsidering its plans after an online fundraising effort fell fall short of its goal. A month-long fundraising campaign on the crowdfunding website Kickstarter Oct. 1, seeking to raise at least 600,000 pounds ($925,000) to start work on key spacecraft and launch vehicle subsystems. However, the “all of nothing” campaign ended November 1 with less tan 79,000 UK pounds ($122,000) raised so receied nothing.

Moonspike is now brainstorming a “Plan B.

Will Private Moon Race's First Contract Spur Snowball Effect?

4 November, 2015 - www.space.com/31023-**private-moon-race-launch-contracts**.html
www.**spaceil**.com/mission/ - http://lunar.xprize.org/teams/team-spaceil



Space-X launches SpaceIL’s lunar rover to the Moon

Last month, Israel-based **SpaceIL** announced it had signed a deal to launch its lander to the Moon aboard a **SpaceX Falcon 9** rocket in the **second half of 2017**, becoming the first entrant in the Google Lunar X Prize (GLXP) competition to secure a "verified" launch contract. ##

MOON PROGRAM HISTORY

Moon Memories: Look through Thousands of Apollo Photos on Flickr

8 October, 2015 – www.space.com/30791-**nasa-apollo-moon-photos-online**.html

A huge new **online gallery** gives people around the world an up-close look at NASA's iconic **Apollo moon missions of the late 1960s and early 1970s**.

More than 8,400 unprocessed scans have now been uploaded into the online **Project Apollo Archive**. The entire gallery — with each picture organized by the magazine or film on which it was shot — is available on the photo-sharing service Flickr. ##

Long-Lost Lander: Researchers Hunting for Soviet Moon Probe Luna 9

30 November, 2015 – www.space.com/31213-**luna-9-soviet-moon-probe-search**.html

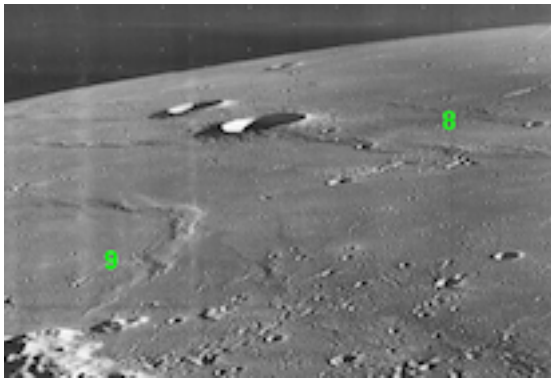


Photo at right, courtesy of Wikipedia: Oblique view of Planitia Descensus showing crash site of Luna 8 and the landing point of Luna 9 (Lunar Orbiter 3 image)

https://en.wikipedia.org/wiki/Luna_9 xs

The former Soviet Union's Luna 9 lander soft-landed on the Moon on Feb. 3, 1966, and shortly thereafter beamed home the first images taken from the lunar surface. When pieced together, those pictures offered a panoramic view of the Moon's bleak terrain and the horizon less than a mile away.

Now, nearly a half-century later, researchers are using NASA's sharp-eyed Lunar Reconnaissance Orbiter (LRO) in an attempt to locate the final resting place of Luna 9, which is less than 0.6 m (2 ft) wide and weighed about 100 kg (220 lbs) back on Earth. ##

RETURN OF HUMANS TO THE MOON

All-female Russian crew starts Moon mission test

www.space-travel.com/reports/**All-female_Russian_crew_starts_Moon_mission_test**_999.html

The women stayed in the same facility built in Moscow for the Mars 500 (days) eexperiment.

28 October, 2015 - Six Russian women on clambered into a mock spaceship to begin a unique experiment testing how an all-female crew would interact on a trip to the Moon and back. For eight days, the female volunteers will live inside a wood-panelled suite of rooms at Moscow's Institute of Biomedical Problems,[see photos below] renowned for its wacky research into the psychological and physical effects of space travel. (The institute in 2010 locked six male international volunteers in an isolation experiment lasting 520 days, to simulate a flight to Mars and back.}

DEVELOPING THE MOON

Russian scientists hope to get rocket fuel, water, oxygen from Lunar ice

www.space-travel.com/reports/**Russian_scientist_hope_to_get_rocket_fuel_water_oxygen_from_Lunar_ice_999**

28 September, 2015 - A processing factory to derive hydrogen rocket fuel, water and oxygen from lunar ice might start as early as 2035. After landing another lunar robot during 2020-2021 Russia will try to bring back a piece of lunar ice to the Earth by 2025. Following a thorough study, a group of Russian astronauts will fly to the Moon by the beginning of the 2030s. Then, within the next 5-10 years, a processing plant for rocket fuel, water and oxygen could be set up. ##

Pres. Obama Signs Law Allowing Moon Express Lunar Mining Rights

25 November, 2015 - www.spacedaily.com/reports/prnewswire-space-news.html

http://www.**moonexpress**.com

This legislstion, now law as Title IV of the "**U.S. Commercial Space Launch Competitiveness Act**" recognizes and promotes the rights of Moon Express to explore, harvest and own resources from the Moon. This makes the United States the first nation to **explicitly recognize private sector mining rights for water and minerals obtained from the Moon**. ##

A Contrary Opinion - Who owns space? US asteroid-mining act is dangerous and potentially illegal

www.spacedaily.com/reports/**Who_owns_space_US_asteroid_mining_act_is_dangerous_and_potentially_illegal_999.html**

27 November, 2015 - [**Editor:** This is a highly charged debate between

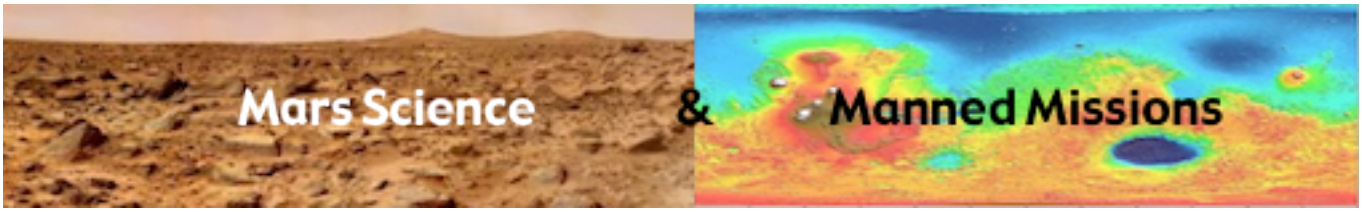
- those who think that ownership and development of resources on the Moon, on other planets and on their moons could pollute the heavens with "the scourge of humanity,"
- those who feel these places are "the natural heritage of humanity", the crown of evolution in our solar system.

It is a battle between people who think that humanity is a virus (just look at how we are wrecking Mother Earth!) And those who think that intelligent beings are the crown of universe.

Obviously, as on Earth, the same battle takes place between climate change deniers and those who realize that we need to save our environment from ourselves so that our children and our childrens' children can continue to enjoy this beautiful world as a heritage they have a right to inherit..

The solar system is obviously "ours" by default. But at the same time, we are going through **a cultural and ethical adolescence**. Let us hope that in time, we will have both preserved the awesome beauty of Earth and of our sister planets and moons, and at the same time bring these places to the honorable position of becoming what they could not have become on their own: worlds populated by humankind. - PK

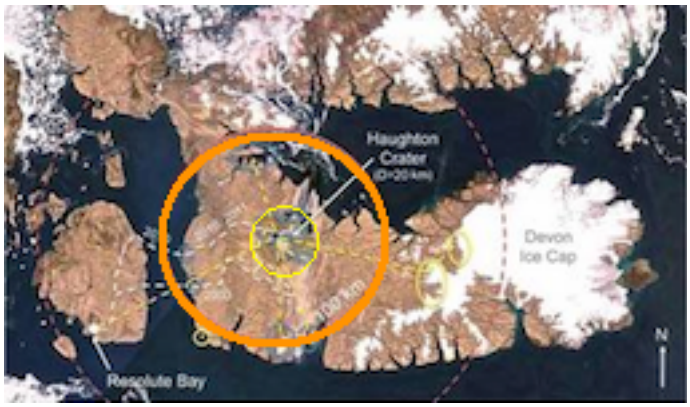
"



MARS ANALOG ACTIVITIES

Mars on Earth: Canadian Arctic Serves as Red Planet Training Ground

8 December, 2015 - www.space.com/31312-**mock-mars-mission-devon-island**.html



Left: Haughton Mars Project - **Right:** Mars Society's Flashline Mars Arctic Research Station

Devon Island, the largest uninhabited island on Earth, is home to the Haughton-Mars Project (HMP), an international, multidisciplinary field-research venture that aims to help lay the foundation for crewed missions to Mars. (The Mars Society's Mars Arctic Research Station is a kilometer away.) Both sites are within the **Haughton Crater**, roughly 20 km (12 mi) in diameter and some 23 million years old.

HMP started in 1997 and has been hosting NASA-supported research each year since then. The rocky, barren terrain of Devon Island offers many challenges, from remoteness and isolation to extreme temperatures and lack of infrastructure.

Starting its 20th year, HMP is now the longest NASA-funded research project on Earth,

Editor: actually, the Antarctic "Dry Valleys" offer a much closer temperature range, but it is much more costly to send scientists and volunteer crews down there.

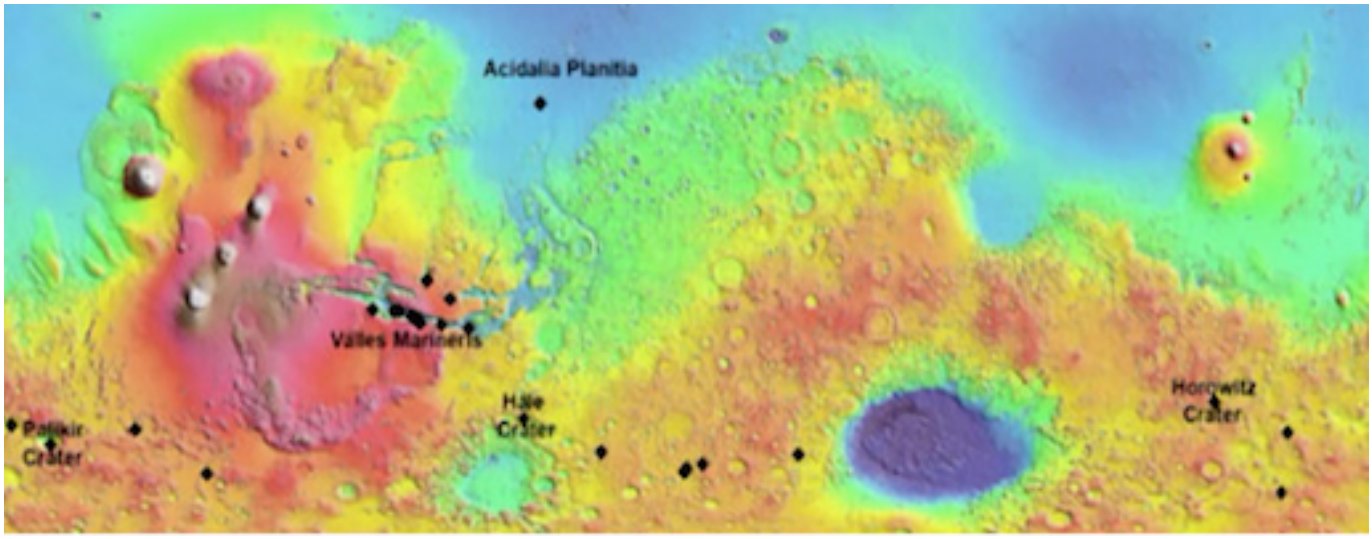
Wet Mars? Warm Mars? Dry Mars? Cold Mars?

"The idea of a warm ground under a cold-climate Mars is gaining acceptance, Impacts were dumping heat into the ground. Volcanism was also more active on a young Mars. Those two processes were injecting water vapor into a frigid atmosphere. The water vapor would then condense out onto the surface. There were transient ice covers here and there on Mars. Because the ground was warm, not the climate, these ice covers were melting from underneath, creating valley networks." - Pascal Lee

MARS SCIENCE

Indications of briny water & percolates found all over Mars

www.space.com/30680-**liquid-water-on-mars-found-at-last**-infographic.html



Black diamonds indicate dark briny streaks of hydrated perchlorate

28 September, 2016 – Measirements from Earth of ratios of regular water (H20) and heavy water (HD0) indicate Mars has lost enough regular water to once have covered 20% of Mars' surface – probably **Hellas Planiti**a (darkest blue) and the darkest areas in the Northern hemisphere. ##

Editor: How long have those "seas" been dry? Did these seas last long enough for life to rise beyond one-cellular forms? Will any of these primitive life forms have evolved to adapt to the slow "dessication" of Mars? Woule a program to slowly restore a heavier atmosphere and surface seas destroy them or let them evolve back to their ancient prime? Should we leave them alone or help them recover and flourish "in a world now being "colonized" by humans? If the present stage of evolution leads to their extinction, wouldn't our intervention be the moral thing to do?

Ancient Mars Had Long-Lasting Lakes, Boosting Chances for Life

8 October, 2015 – www.space.com/30778-**ancient-mars-lakes-curiosity-rover**.html
www.marsdaily.com/reports/**Curiosity_Rover_Team_Confirms_Ancient_Lakes_on_Mars**_999.html

A series of freshwater lakes within Mars' 154 km-wide (96-mi) Gale Crater likely persisted for hundreds or thousands of years at a time, and perhaps even longer.Even if the lake goes away, there will still be a groundwater table, and you now have a habitat which is perpetually wet that would allow microbes to be sustained.

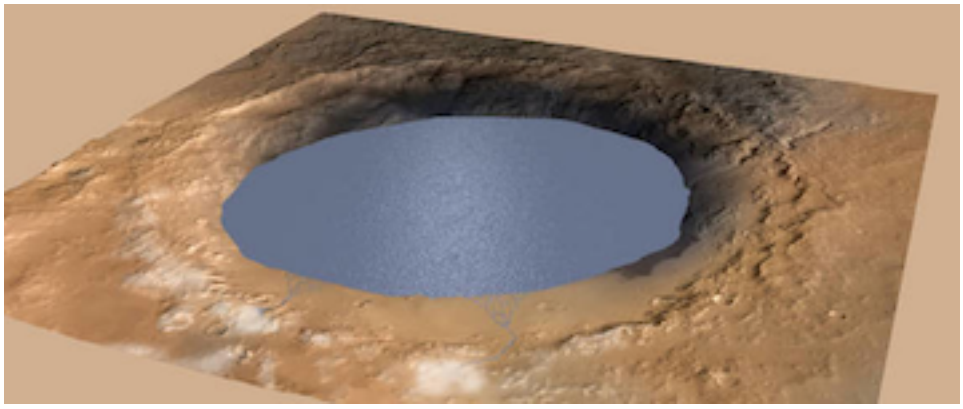
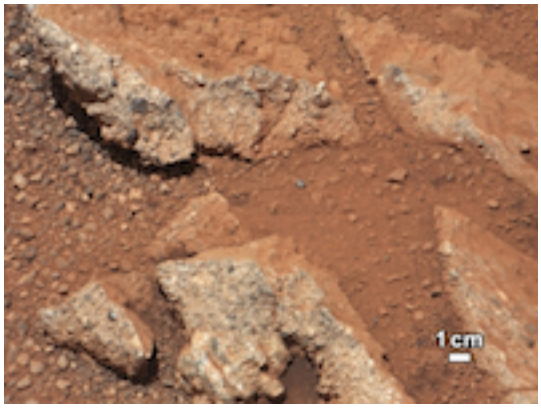


Illustration depicting a lake of fresh water partially filling Mars' Gale Crater.

Pebbles on Mars Shaped by Ancient Rivers Dozens of Miles Long

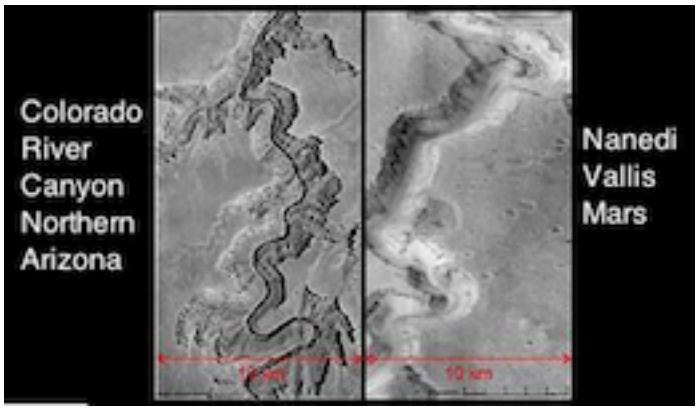
13 October, 2015 - www.space.com/30815-**mars-pebbles-ancient-rivers-curiosity-rover**.html



Researchers have used the shape of rounded Martian pebbles to extrapolate how far they must have traveled down an ancient riverbed on the Red Planet. The analysis suggests they moved approximately 50 kilometers (30 miles), indicating that Mars once had an extensive river system. ##

Climate models used to explain formation of Mars valley networks

www.marsdaily.com/reports/**Climate_models_used_to_explain_formation_of_Mars_valley_networks_999**.html



The Colorado River canyon, just above Grand Canyon (left), and Nanedi Vallis on Mars (right) pictured at the same scale shows how both canyons were formed by rivers that appear to have been approximately the same width. The river channel on Earth looks darker because it is filled with water, whereas Nanedi Vallis has been dry for billions of years.

Larger version of image: www.eurekalert.org/multimedia/pub/101079.php

14 October, 2015 - The extensive valley networks on the surface of Mars were probably created by running water billions of years ago, but the source of that water is unknown. Now, a team of researchers is using climate models to predict how greenhouse warming could be the source of the water. "Everyone is looking for life on Mars, and if Mars was habitable early on as indicated by flowing water, then the chances of there being some sort of life there now goes up." ##

MARS ANALOG EXERCISES

Mars Exploration Tech Showcased at NASA Innovation Expo

23 October, 2015 - http://www.space.com/30905-**nasa-innovation-expo-space-exploration**.html

For the first time ever, NASA invited the public to attend its Innovation Expo, traditionally employees-only event showcasing the work of agency engineers and scientists. This year's expo at the Kennedy Space Center Visitor Complex Oct. 16-17, tries to teach people how NASA aims to get boots on Mars by the end of the 2030s.

MARS MISSIONS

Listening for Alien Life: Could New Tech Detect Microbe Movements?

1 October, 2015 - www.space.com/30709-**space-noise-sensor-alien-life**.html

Spacecraft may one day be able to detect alien life by listening to the sounds microbes make.

Scientists are testing a new microphone technology called the remote acoustic sensor (RAS), which is capable of capturing sounds within extreme and often inaccessible aerospace environments.

A miniaturized version of the device could theoretically make its way to **Mars** or to Jupiter's ocean-harboring moon, **Europa,**

NASA Eyes Sample-Return Capability for Post-2020 Mars Orbiter

9 October, 2015 - www.space.com/30789-**nasa-sample-return-capability-mars-orbiter**.html

A Mars orbiter NASA plans to launch in the 2020s could carry the mechanisms needed to collect and store sealed Martian surface samples for a return trip to Earth. The orbiter would be NASA's next strategic mission custom-ordered by the agency and not selected through a competition that includes proposed missions to other places — after the Mars 2020 rover, scheduled to launch that year to cache surface samples and leave them on the ground for later retrieval. ##

Mars Water Discovery Sparks Exploration Debate

16 October, 2015 - www.space.com/30840-**mars-water-life-search-debate**.html

The revelation that dark streaks flowing downhill on Mars are signs of present-day liquid water has sparked debate on how best to investigate the Red Planet features. Called Recurring Slope Lineae (RSL), these streaks, laden with salts, are caused by liquis water flowing down steep slopes during warm seasons and fade when the weather is cooler.

The new findings may well bolster the odds that life exists today on Mars. Moreover, RSL might be a draw for future human explorers, as those sites could lead to underground aquifers on the planet.

These RSL areas are intriguing places to look for signs of present or extinct Mars life, but how do we explore further without risk of contaminating any surviving life torms?

China aims to go deeper into space, to Mars and Beyond

16 October, 2015 - www.spacedaily.com/reports/**China_aims_to_go_deeper_into_space**_999.html

As China's exploration of the Moon progresses, its space experts have begun considering going deeper into the solar system - **to Mars, asteroids and Jupiter - and a manned deep-space mission.**

China needs to tackle key problems: **how to go into deep space at higher speeds; generating energy and power**; and **developing space robots** to work in the complicated space environment.

Chinese scientists suggest landing a probe on the Moon's farside, an unprecedented feat. Although not officially announced, experts have begun to prepare the technologies needed. ##

The Martian Astrobiologist

21 October, 2015 - www.marsdaily.com/reports/**The_Martian_Astrobiologist**_999.html

With the Viking landers in the 1970s, Mars became the target of NASA's first dedicated mission to search for life in our solar system. The desire to send teams of researchers to visit scientific sites on Mars has been a driving force for space exploration.

On September 28th, 2015, NASA announced evidence that liquid water does exist on Mars today. Liquid water is one of the key ingredients for life as we know it, and its presence on Mars raises hopes that we may soon discover the first known living organisms native to a planet other than Earth. ##

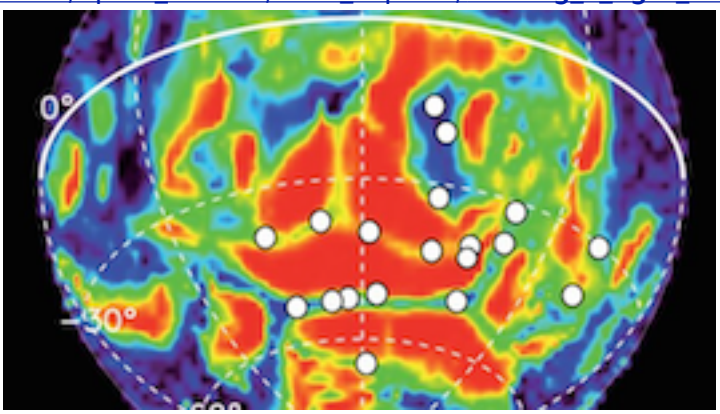
Landing site recommended for ExoMars 2018

22 Oct, 2015 - www.marsdaily.com/reports/**Landing_site_recommended_for_ExoMars_2018**_999.html

Visualisation tool depicting the location of four candidate landing sites (red markers) for **ExoMars 2018**. **Oxia Planum** has been recommended as the primary candidate for the landing site of the ExoMars 2018 mission, comprising a rover and surface platform. A joint endeavour between ESA and Russia's Roscosmos, Launch is planned for May 2018, with touchdown on Mars in January 2019. ##

Gorgeous Auroras Could Light Up Entire Martian Sky

5 November, 2015 - www.space.com/31043-**mars-auroras-nasa-maven-mission**.html
www.esa.int/Our_Activities/Space_Science/Mars_Express/**Shining_a_light_on_the_aurora_of_Mars**



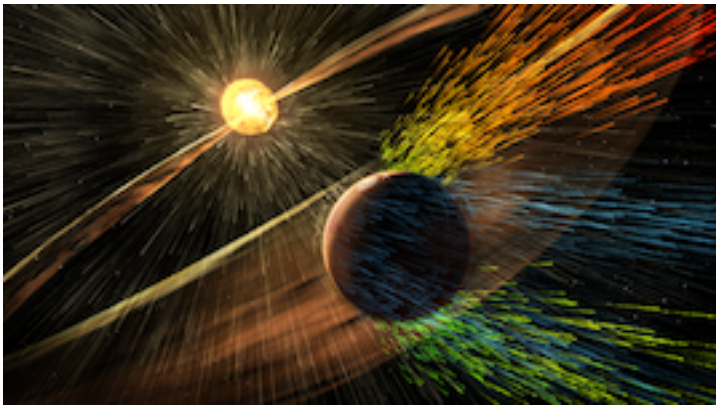
The first astronauts to set foot on Mars may be in for a spectacular sight — the entire night sky filled with glowing auroras. The MAVEN orbiter has discovered a new kind of aurora was observed in a part of the atmosphere that is above regions that don't have a magnetic field at all.

MAVEN detected these auroras using an instrument that observes ultraviolet light, which our eyes cannot detect. But modeling work suggests that the phenomena may also be visible to the naked eye. Bright enough displays of this kind could possibly shine in **green, red or blue** light.

Mars' lack of a global magnetic field - bad news for protection against harsh radiation - means solar particles can make an impact across the entire sky. ##

NASA Mission Reveals Speed of Solar Wind Stripping Martian Atmosphere

www.nasa.gov/press-release/**nasa-mission-reveals-speed-of-solar-wind-stripping-martian-atmosphere** - www.space.com/31031-**mars-atmosphere-discovery-nasa-maven**.html



5 November, 2015 - NASA's **M**ars **A**tmosphere and **V**olatile **E**volutio**N** (MAVEN) mission has identified the process that appears to have played a key role in the transition of the Martian climate from an early, warm and wet environment that might have supported surface life to the cold, arid planet Mars is today.

Dust Devils detected by seismometer could guide Mars mission

www.marsdaily.com/reports/**Dust_devils_detected_by_seismometer_could_guide_Mars_mission**_999.html

http://news.discovery.com/space/**the-dust-devils-of-mars-could-pack-a-seismic-punch**-151111.htm

10 November, 2015 - With an eye to learning more about Martian dust devils, in 2005 researchers chased a large dust devil near Eloy, Arizona. Buried in the shallow soft mud of a dry California lake bed, a seismometer was able to detect the tiny tilts of the ground as it was pulled up by passing dust devils.

Left: With In 2005 researchers chased a large dust devil near Eloy, Arizona.

Right: 11 November, 2015 - A large dust devil towers over Mars' surface on the plain of Amazonis Planitia. [High-Resolution Imaging Science Experiment (HiRISE) camera observation in 2012]. The shadow indicates this dust plume reached a height of 12 miles although it was only 140 yards in diameter.

Dust Devil 'Swarm' Races Across Martian Plain

www.space.com/31402-**dust-devil-swarm-spied-rumbling-across-martian-plain**.html

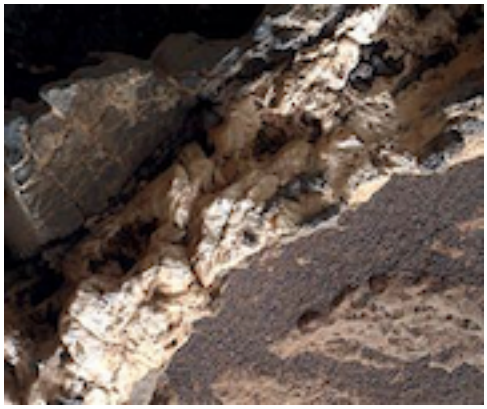
17 December, 2015 - Mars is a windy planet where active aeolian processes shape the landscape continuously. Active dune fields are evidence of the large-scale transport of fine Mars sand whereas dust devils (like miniature tornadoes) show us the small scale and short-lived atmospheric processes that can sculpt dark tracks into the surface. We have an armada of satellites in orbit around Mars and these atmospheric phenomena can be recorded and tracked. ##

Upgrade Helps NASA Study Mineral Veins on Mars

www.marsdaily.com/reports/**Upgrade_Helps_NASA_Study_Mineral_Veins_on_Mars**_999.html

15 November, 2015 - Scientists now have a better understanding about a site with the most chemically diverse mineral veins that The Curiosity rover has examined, thanks in part to a valuable new resource used in analyzing data from the rover of bright and dark mineral veins in March 2015 the "Garden City," site where some veins protrude as high as 3 cm above the eroding bedrock in which they formed.

The unusually diverse chemistry at Garden City includes calcium sulfate in some veins and magnesium sulfate in others. Additional veins were found to be rich in fluorine or varying levels of iron.



This view from the Mars Hand Lens Imager (MAHLI) shows a combination of dark and light material within a mineral vein at a site called "Garden City" on lower Mount Sharp.

NASA Chief Boldan: Private Companies will help NASA get to Mars

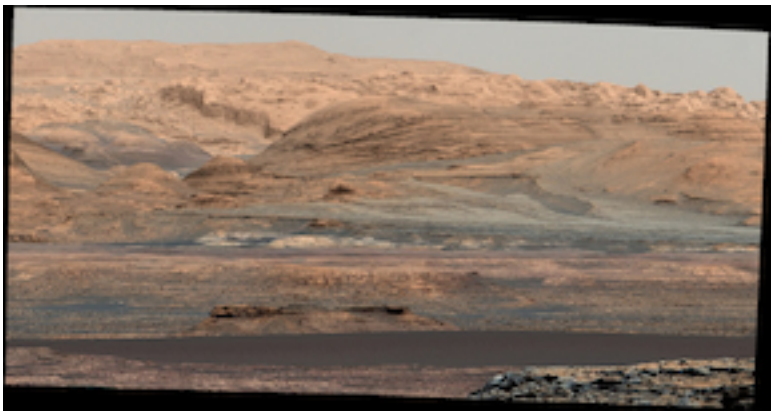
18 November, 2015 - www.space.com/31157-**nasa-private-spaceflight-space-cooperation**.html
18 November, 2015 - www.space.com/31147-**house-passes-commercial-space-bill**.html

NASA Administrator Charles Bolden believes work needs to be done by commercial companies to take up the responsibility of supporting science and human astronauts in low-Earth orbit and beyond, “NASA is not the only customer." This could potentially include **maintaining the American side of the International Space Station**,a one of a kind microgravity laboratory and testing ground for human trips into deep space. The work of private companies will not stop there. It will likely be commercial companies and international partners who assume a lead role in taking humans back to the surface of the Moon (leaving NASA to focus on getting humans to Mars.

House’spassage of H.R. 2262, with language **granting rights to resources extracted from asteroids and other celestial bodies**, clears the way for signing it into law by President Obama. ##

Curiosity Rover Headed to Dark Sand Dunes on Mars

18 November, 2015 - www.space.com/31151-**mars-rover-curiosity-dark-sand-dunes**.html
www.marsdaily.com/reports/Curiosity_**Mars_Rover_Heads_Toward_Active_Dunes**_999.html

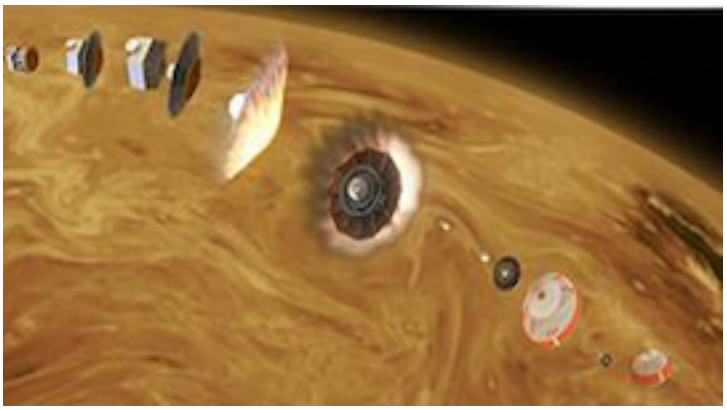


The dark band in the lower portion of this Martian scene is part of the " Bagnold Dunes" dune field lining the northwestern edge of Mount Sharp.

NASA's Curiosity rover will soon get history's first up-close look at the substantial Martian dark Bagnold Sand Dunes, in the northwestern foothills of the towering Mount Sharp. Curiosity will study one dune that's as wide as a football field and as tall as a two-story building. And they're active; observations by Mars orbiters show that some of the dunes are moving by as much as 1 meter (3+ ft) per year. ##

NASA completes heat shield tests for future Mars exploration vehicles

www.marsdaily.com/reports/**NASA_completes_heat_shield_testing_for_future_Mars_exploration_vehicles**_999.html



19 November, 2015 = As NASA missions to Mars progress with science and complex human exploration missions, spacecraft will require larger heat shields to protect against the extreme heat of entering a planet's atmosphere and decelerating at a safe altitude in the thin Martian atmosphere.

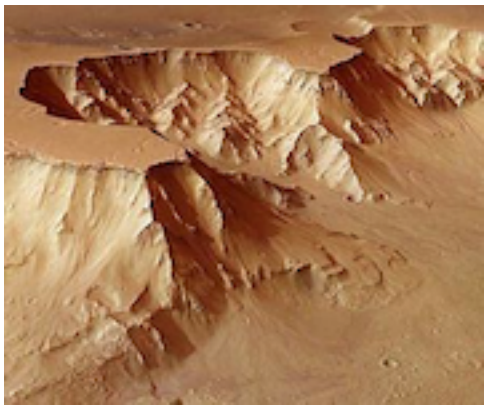
NASA's Adaptive Deployable Entry and Placement Technology (ADEPT) is one solution. ADEPT is **a mechanically-deployable heat shield concept using carbon fabric: a flexible heat shield that expands to "open" like an umbrella.**

Recently, Ames' engineers successfully completed heating simulation testing of an ADEPT model under conditions akin to entering the Martian atmosphere.

Surface temperatures on the test article reached 3,100 degrees Fahrenheit. The bluish-hue streaks, streaming away from the test article, are due to the decomposition of the resin-infused protective layers that prevent degradation of the stitched fabric joints. ##

Witness to a wet early Mars

20 November, 2015 - www.marsdaily.com/reports/**A_witness_to_a_wet_early_Mars**_999.html



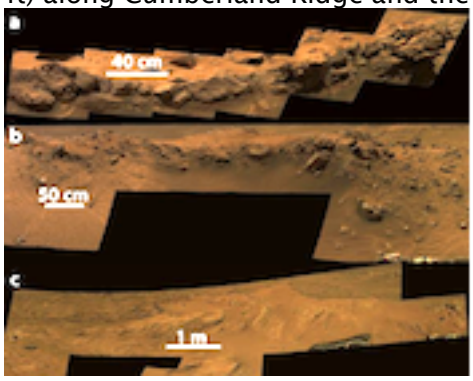
Close-up of features in Ganges Chasma, near Aurorae Chaos. The valley walls show evidence for slumping and landslides. Material closest to the valley floor shows a stepped morphology, which could reflect different water or ice levels over time. Small channels are observed on the cliff tops. ##

Acid Fog on Mars Likely Took a Bite Out of Its Rocks

24 November, 2015 - www.space.com/31187-**acid-fog-on-mars**.html

On Mars' surface, three Cumberland Ridge outcrops: a) Larry's Lookout, b) Jibsheet and c) Methuselah. Their progressively different terrain and levels of iron oxidation suggest they were affected by acidic fog.

Scientists concentrated on data that the Spirit rover gathered from exposed bedrock at Columbia Hills of Gusev Crater near the equator of Mars. Spirit analyzed a dozen locations on four outcrops of rocks spanning about 200 m (650 ft) along Cumberland Ridge and the Husband Hill summit.



Although Spirit's chemical scanner found the chemical composition of these rocks was similar, they looked different to all the rover's other instruments. The degree to which the rocks had either an orderly crystalline structure or a disorderly amorphous structure varied greatly over a distance of only about 30 m (100 ft) in Cumberland Ridge, or about a third the size of a football field.

These rocks also varied when it came to the sizes of the knobby bumps on them, as well as how much the iron in the rocks was oxidized. These variations in structure, bumps and iron may all stem from acid fog, the result of volcanic eruptions billions of years ago, probably before there was multicellular life on Earth. The rocks were exposed to acidic water vapor from volcanic eruptionssimilar to the caustic volcanic smog, or "vog," spewed from the eruptions of Kilauea in Hawaii. ##

Tracking down the 'missing' carbon from the Martian atmosphere

www.marsdaily.com/reports/**Tracking_down_the_missing_carbon_from_the_Martian_atmosphere**_999.html

Graphic of what has happened to Mars Atmosphere: www.eurekalert.org/multimedia/pub/104069.php

25 November, 2015 - Mars is blanketed by a thin, mostly carbon dioxide atmosphere--one that is far too thin to prevent large amounts of water on the surface of the planet from subliming or evaporating. But many researchers have suggested that the planet was once shrouded in an atmosphere many times thicker than Earth's. For decades that left the question, "Where did all the carbon go?" - read on! ##

Search for 'Missing' Carbon on Mars Cancelled

26 November, 2015 = http://www.space.com/31215-**mars-missing-carbon-mystery**.html

Mars' carbon-rich atmosphere was once thick enough to raise the planet's surface temperature and allow entire oceans of water to form — a drastic change from the cold desert it is today. This metamorphosis had put scientists on the hunt for a left-over "carbon reservoir" in Mars' dirt and soil.

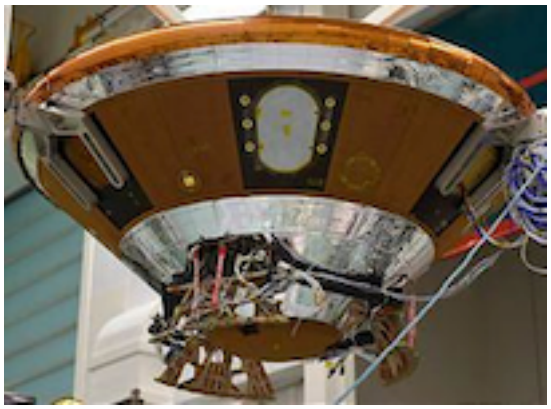
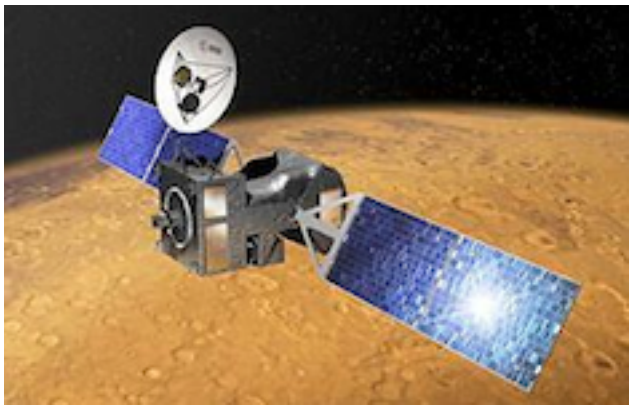
But new research has concluded that "a large 'missing' carbon reservoir is unnecessary" to explain the planet's watery past, and that the Martian air wasn't exceptionally dense billions of years ago. ##

ExoMars prepares to leave Europe for launch site
ExoMars has historical, practical significance for Russia, Europe

www.marsdaily.com/reports/**ExoMars_prepares_to_leave_Europe_for_launch_site**_999.html

www.marsdaily.com/reports/**ExoMars_has_historical_practical_significance_for_Russia_Europe**_999.html

27 November, 2015 - The **two ExoMars spacecraft** of the 2016 mission are being prepared for shipping to the Baikonur Cosmodrome in Kazakhstan ahead of their launch in March.

L:   R:

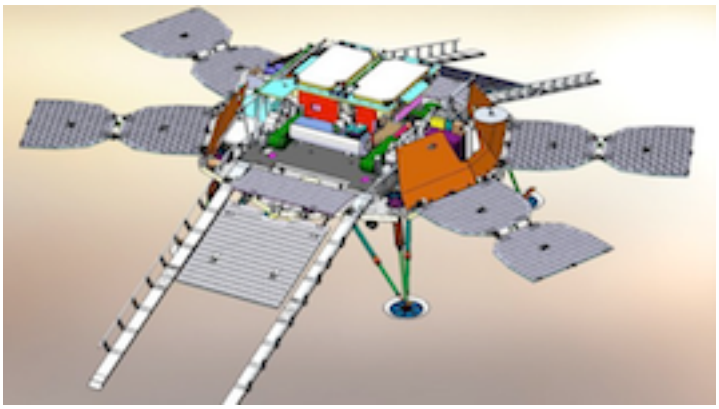
L:**Schiaparelli**, also known as the **ExoMars Entry, descent and landing Demonstrator Module** being installed at the top of the Trace Gas Orbiter, at Thales Alenia Space, Cannes, France, 25 November 2015
R: ExoMars in orbit around Mars

A joint endeavour with Russia's Roscosmos space agency, ExoMars comprises two missions. **The Trace Gas Orbiter (TGO)** and **Schiaparelli make up the 2016 mission, while the 2018 mission will combine a rover and a surface science platform**. Both launched on Russian rockets from Baikonur.

European Payload Selected for EXO-Mars 2018 Surface Platform

www.esa.int/Our_Activities/Space_Science/**European payload selected for ExoMars 2018 surface platform**

28 November, 2015 - Two European instruments and four European contributions on two Russian instruments have been selected for the Russian-led science platform that will land on Mars as part of the ESA-Roscosmos ExoMars 2018 mission.



The first of the two ExoMars mission, in final preparation for launch next March, consists of the Trace Gas Orbiter, which will investigate the possible biological or geological origins of important trace gases in the martian atmosphere, and Schiaparelli, an entry, descent and landing demonstrator module that will test key landing technologies and provide atmospheric and environmental data important for ESA's contributions to subsequent missions to Mars.

The second ExoMars mission, planned for launch in May 2018, comprises a European-led rover that will be the first to combine driving across the Martian surface with drilling two metres below the surface, and a stationary surface science platform. ##

NASA's New 'Star Trek' Tech Is Designed to Detect Alien Life on Mars

28 November, 2015 - www.space.com/31225-**nasa-star-trek-tech-life-search**.html

New NASA technology straight out of "Star Trek" could help scientists detect life on other worlds. The "**chemical laptop**" is a miniature, portable laboratory that resembles the TV show's famous **tricorder** scanning device, designed to make data collection easier and faster than ever before.

Currently in development at the Jet Propulsion Laboratory (JPL) is a chemical analyzer made to detect both amino acids and fatty acids, often called "the building blocks of life," in samples from extraterrestrial terrain. Finding both could indicate that life is now, or once was present. ##

Study finds evidence for more recent clay formation on Mars

www.marsdaily.com/reports/Study_finds_**evidence_for_more_recent_clay_formation_on_Mars**_999.html

15 December, 2015 - Recent orbital and rover missions to Mars have turned up ample evidence of clays and other hydrated minerals formed when rocks are altered by the presence of water. Most of that alteration is thought to have happened during the earliest part of Martian history, more than 3.7 billion years ago. But a new study shows that later alteration - within the last 2 billion years or so - may be more common than many scientists had thought.

Clays also tend to be found in and around large impact craters, where material from deep below the surface has been excavated. ##

Rocks Rich in Silica Present Puzzles for Mars Rover Team

www.marsdaily.com/reports/**Rocks_Rich_in_Silica_Present_Puzzles_for_Mars_Rover_Team**_999.html

18 December, 2015 - An unexpected clue often delivers more questions than answers. In this case, the scene is a mountain on Mars. The clue: the chemical compound silica. Lots of silica. NASA's mobile laboratory, Curiosity, has found much higher concentrations of silica at some sites it has investigated in the past seven months than anywhere else it has visited since landing on Mars 40 months ago.

Silica is up 90% of the composition of some of the rocks. It is a rock-forming chemical combining the elements silicon and oxygen, commonly seen on Earth as quartz, and in many other minerals.

This May 22, 2015, view from the Mast Camera (Mastcam) in NASA's Curiosity Mars rover shows the "Marias Pass" area where a lower and older geological unit of mudstone -- the pale zone in the center of the image -- lies in contact with an overlying geological unit of sandstone.

These high-silica compositions are a puzzle. You can boost the concentration of silica either by leaching away other ingredients while leaving the silica behind, or by bringing in silica from somewhere else. Either of those processes involve water. If we can determine which happened, we'll learn more about other conditions in those ancient wet environments. ##

Martian gullies likely contain 'no water': study

21 Dec, 2015 - www.marsdaily.com/reports/**Martian_gullies_likely_contain_no_water_study**_999.html

Months after scientists announced "the strongest evidence yet" of liquid water on Mars, a study Monday said there was none at least in the valleys carved into numerous Red Planet slopes.

When first discovered, these gullies were interpreted as runoff from melting water ice or groundwater leaks that occurred hundreds of thousands of years ago. Then it was discovered that gully formation was ongoing, in spite of Mars being too cold for liquid water to exist.

Computer simulations show that **thawed and trapped CO2 gas** building up beneath the surface ice layer would eventually break through the soil and trigger flows of gas and debris.

No similar processes are known to occur on Earth. ##

Mars Mission Team Tackles Vacuum Leak on Key Science Instrument

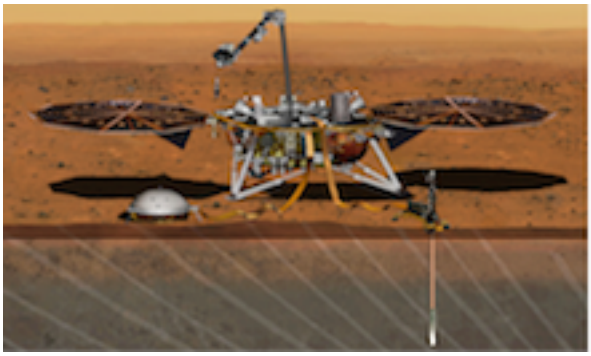
www.marsdaily.com/reports/**Mars_Mission_Team_Addressing_Vacuum_Leak_on_Key_Science_Instrument**_999.html

7 December, 2015 - A key science instrument that will be carried aboard NASA's Interior Exploration Using Seismic Investigations, Geodesy and Heat Transport (**InSight**) spacecraft being prepared for launch in March 2016 is experiencing a leak in the vacuum container carrying its main sensors. The sensors are part of an instrument called the Seismic Experiment for Interior Structure (SEIS), which is provided by the French Space Agency (CNES). ##

InSight Mars Lander Won't Launch in 2016, Leaky Instrument to Blame

22 December, 2015 - www.space.com/31448-**nasa-mars-lander-insight-launch-delay**.html

24 December, 2015 - www.space.com/31451-**nasa-insight-mars-lander-delay-effects**.html



NASA has called off the planned March 2016 launch of a Mars lander, saying one of the spacecraft's key instruments cannot be fixed in time for liftoff. Because Mars and Earth align favorably just once every 26 months, the InSight lander now must wait until mid-2018 to begin its mission to characterize Mars' interior in unprecedented detail. ##

MARS' MOONLETS: PHOBOS & DEIMOS

Mars May Become a Ringed Planet Millions of years from now

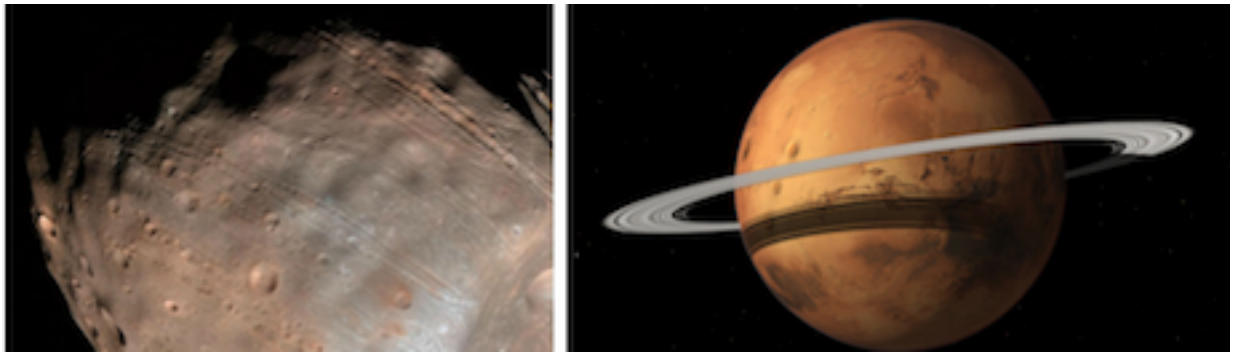
17 November 2015 - www.digitaltrends.com/cool-tech/**mars-moon-phobos-is-breaking-apart**/

23 November, 2015 - www.space.com/31195-**mars-may-get-rings-like-saturn**.html

www.marsdaily.com/reports/**Mars_to_lose_its_largest_moon_Phobos_but_gain_a_ring**_999.html

www.digitaltrends.com/cool-tech/**phobos-rings-around-mars**/

Mars' larger, inner moon, Phobos, is only about 22 km (14 mi) wide, and orbits the Red Planet rapidly, rising and setting twice each Martian day. It is slowly moving lower — drawing closer to Mars by **2 meters** (6.5 ft **every century** — which may result in a dramatic crash into the Martian surface **within 30 to 50 million years.**



L: Parallel groves show that Phbos is slowly getting pulled closer and closer to Mars by tidalforces.
R: Millions of years from now it may disintegrate and end up forming a ring around Mars

HUMANS TO MARS

NASA Releases Plan Outlining Next Steps in the Journey to Mars

www.nasa.gov/press-release/**nasa-releases-plan-outlining-next-steps-in-the-journey-to-mars**
www.space.com/30788-**nasa-astronauts-on-mars-plan**.html
www.marsdaily.com/reports/**NASA_outlines_obstacles_to_putting_a_human_on_Mars**_999.html

8 October, 2015 - NASA has released a detailed outline of that plan in its report, "NASA's Journey to Mars: Pioneering Next Steps in Space Exploration." The plan is online at: http://go.nasa.gov/1VHDXxg

The journey to Mars crosses three thresholds, each with increasing challenges.

- **Earth Reliant** exploration is focused on research aboard the International Space Station.
- In the **Proving Ground**, NASA will learn to conduct complex operations in a deep space environment that allows crews to return to Earth in a matter of days. Primarily operating in cislunar space.
- **Earth Independent** activities build on what we learn on the space station and in deep space to enable human missions to the Mars vicinity, possibly to low-Mars orbit or one of the Martian moons, and eventually the Martian surface ##

NASA Challenge Seeks Ways to Use Mars' Natural Resources for Astronauts

www.marsdaily.com/reports/**NASA_Challenge_Seeks_Ways_to_Use_Mars_Natural_Resources_for_Astronauts**_999.html

9 October, 2015 - Living off the land is different when the land is 140 million miles away, so NASA is looking for innovative ideas to useMartian resources to help establish a human presence on Mars.

The In Situ (on location) Resource Utilization Challenge offers the public an opportunity to submit designs for structures on Mars that would use existing material.

$10,000 to 1st-place winner, with **$2,500** each for two 2nd-place submissions. ##

The Human Journey to Mars: Bridging the Technology Gap

www.marsdaily.com/reports/**The_Journey_to_Mars_Bridging_the_Technology_Gap**_999.html

14 October, 2015 - As the new movie "**The Martian**" demonstrates, there's an amazing list of technologies required to safely send human beings to Mars and bring them home again. NASA's Marshall Space Flight Center in Huntsville, Alabama, oversees a host of key technology development efforts at NASA and partner facilities around the country, each dedicated to advancing and maturing technologies critical to exploration of Mars and other solar-system destinations. ##

To save on weight, a detour to the Moon is the best route to Mars

www.marsdaily.com/reports/**To_save_on_weight_a_detour_to_the_moon_is_the_best_route_to_Mars_**999.html

15 October, 2015 - Launching humans to Mars may not require a full tank of gas: A new MIT study suggests that a Mars mission may lighten its launch load considerably by refueling in orbit above the Moon. Previous studies suggest that lunar soil and water ice in craters near the Moon's poles may be mined and converted to fuel, assuming such technologies are established in time for a mission to Mars.

'The Martian' Might Be the Most Realistic Space Movie Ever Made

15 October, 2015 - www.space.com/30831-**the-martian-most-realistic-space-movie-ever**.html

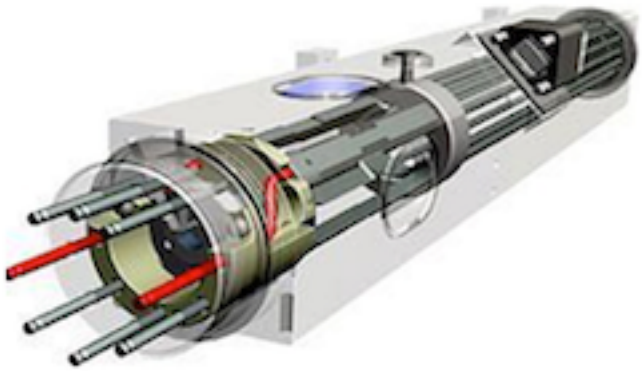
"The Martian," a science fiction film based on the novel by Andy Weir, might be the most realistic space exploration movie ever made. A science-fiction film's "accuracy" or "realism" shouldn't hinge only on the science and technology, but also on the presentation of scientists and their culture.

With that in mind, "The Martian" might be the most realistic (but fictional) space movie of all time. The movie captures the culture of science — the way scientists talk, the way they interact, their motivations and their response to extreme failure.

The Journey to Mars: Bridging the Technology Gap

www.marsdaily.com/reports/The_Journey_to_Mars_Bridging_the_Technology_Gap_999.html

15 October, 2015 - As the new movie "The Martian" demonstrates, there's an amazing list of technologies required to safely send human beings to the Red Planet and bring them home again. From groundbreaking deep-space navigational tools to revolutionary propulsion systems and vehicle braking and planetary descent technologies, Below: Artist's rendering of the Deep Space Atomic Clock



Marshall Space Flight Center in Huntsville, Alabama and its TDM partners,under the leadership of NASA's Space Technology Mission Directorate in Washington, are pursuing high-value technology projects with to transform how we deliver robotic and human explorers to Earth's nearest planetary neighbor. ##

You too can learn to farm on Mars

21 October, 2015 - www.marsdaily.com/reports/**You_too_can_learn_to_farm_on_Mars**_999.html

Scientists at Washington State University and the University of Idaho are helping students figure out how to farm on Mars. They have teamed up to explore the challenge.

"You are selected to be part of a mining colony of 100 people located on Mars. Before you head to Mars, however, you need to figure out how to feed yourself and your colleagues once you are there."

One particular challenge is that we have little idea of what Martian soil is actually like, he said. Probes have detected little carbon, the central element to life as we know it, and nitrogen, which is needed to make protein. Water is also likely to react with peroxides in the soil, bubbling off as gas. ##

Bad News for Terraforming: Mars' Atmosphere Is Lost in Space

6 November, 2015 - www.space.com/31044-**mars-terraforming-nasa-maven-mission**.html

The hopes of turning Mars into a more Earth-like planet have just taken a hit. One potential way to change the frigid Red Planet's climate to make it more suitable for human colonizations involves freeing lots of heat-trapping carbon dioxide from the Martian crust back into the atmosphere.

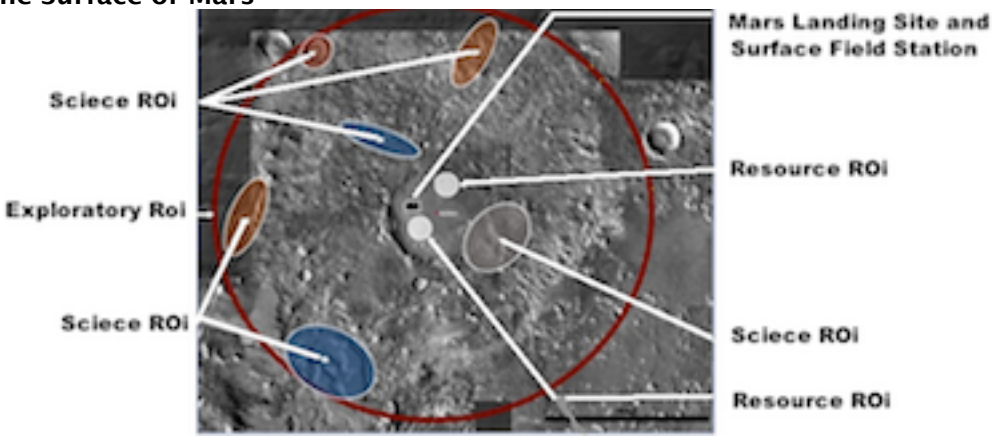
But MAVEN results announced November 6, show that the planet's CO2 went up rather than down: Shortly after Mars' global magnetic field shut down about 4.2 billion years ago, the solar wind and powerful sun explosions stripped away most of the planet's atmosphere.

The new MAVEN discoveries suggest that making the Red Planet comfortable for human habitation — always viewed as a tall order — may be even tougher than previously thought. ##

Where (in what kind of place) will the 1st Astronauts on Mars Land?

17 November, 2015 - www.space.com/31143-**manned-mars-landing-sites-workshop**.html

NASA is pressing forward on identifying possible landing zones for the first human expeditionary crews on Mars. About 175 people from around the world came to Houston for the event, with another 280 connected via the Internet at the **first Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars**



Exploration Zone Layout Considerations

Participants reasoned that the ideal Red Planet crewed sites should be of high scientific value — allowing pioneers to **search for signs of Mars life** and investigate other intriguing questions — and also possess **enough resources to help sustain expeditionary crews**, ##

Elon Musk "SpaceX Rocket Landing Is a Giant Leap Toward a City on Mars"

22 December, 2015 - www.space.com/31445-**spacex-rocket-landing-mars-colony-elon-musk**.html

SpaceX, successfully landed the first stage of its Falcon 9 rocket at Florida's Cape Canaveral Air Force Station during an orbital launch Dec. 21st. The historic accomplishment brings SpaceX a big step closer to developing fully and rapidly reusable rockets — technology vital to the colonization of Mars.

University researchers test prototype Mars spacesuits at Kennedy

www.marsdaily.com/reports/**University_researchers_test_prototype_spacesuits_at_Kennedy**_999.html

A U. North Dakota graduate adjusts the sleeves on the NDX-1 spacesuit while the neck ring is adjusted.
21 December, 2015 - The spacesuits astronauts will wear while exploring the surface of Mars will protect the person inside, supply air and water, and be flexible enough that astronauts can dig samples and do the other tasks required. A spacesuit which is really a miniaturized spacecraft, and it has to be built in a way that is mobile, fairly comfortable and lets you work. It's really much more of a machine.

FLIGHT ON MARS (of relevance to)

Solar Impulse 2 ready to fly again by April 20

www.solardaily.com/reports/**Solar_Impulse_2_ready_to_fly_again_by_April_20_spokeswoman**_999.html

23 Decmber, 2015 - The sun-powered plane **Solar Impulse 2**, grounded in Hawaii since the summer for repairs, will be ready to fly again by April 20, 2016. It took off from the United Arab Emirates (UAE) on March 9, powered by 17,000 solar cells to promote renewable energy by a round-the-world flight. It had completed nearly half of an unprecedented round-the-world journey without using a drop of fuel before battery pack damage during a gruelling 5-day leg forced its grounding. ##

ASTEROIDS & ASTEROID RESOURCES

Asteroid's rolling stones were once powered by the Sun

http://news.sciencemag.org/space/2015/10/**asteroid-s-rolling-stones-were-once-powered-sun**
https://en.wikipedia.org/wiki/**25143_Itokawa**

9 October, 2015 – **25143 Itokawa** is the first asteroid to be the target of a sample return mission, by Japan's probe Hayabusa,and the smallest asteroid photographed by a spacecraft. On sthe surface are hundreds of large, rounded boulders. But how did they get so round? Gravity barely exists on Itokawa, so surface collisions strong enough to shape the boulders couldn't have taken place.

New research suggests **another culprit: the Sun**. By studying the forces required to round off the sharp edges of rocks, a model that predicts maximum collision speeds needed for boulder-surfacing, a relatively low speed— 6-7 meters per second. The process must have taken over thousands, even hundreds of thousands of years before the asteroid was formed, when a gravitationally stable cloud of debris spun in the disk of material that would go on to build the solar system. As sunlight bounced off the orbiting boulders, photons provided a tiny push. As they radiated back outward as heat, they triggered a recoil effect adding a gentle spin. Over time, these slowly spinning boulders bumped into each other with enough force to wear their edges into smooth surfaces. As these collisions would have occurred in the early solar system, they could also have affected the process that built the planets. ##

Asteroids one of two leading destinations for low-cost NASA missions

http://news.sciencemag.org/space/2015/09/mission-bizarre-metal-asteroid-among-winners-nasa-discovery-competition?utm_campaign=email-news-weekly

30 September, 2015 -Today, NASA winnowed down the contenders for the agency's next low-cost planetary science mission. Five finalists were announced from among 27 proposals in Discovery, a competitive mission l with a $500 million cost cap, and two of them are missions to Venus, **not visited by a NASA prove since 1994**. The other 3 finalists would study asteroids.

- **Psyche** – to **explore an asteroid that could be made up almost entirely of iron and nickel**;
- **Lucy** would tour five Trojan asteroids, followoing the orbit of Jupiter ahead or behind it;
- **NEOCam** (Near Earth Object Camera), which aims to discover 10 times more near-Earth objects than have been discovered to date; and
- **VERITAS** (Venus Emissivity, Radio Science, InSAR Topography and Spectroscopy) a **mission to map Venus' surface with radar**;
- **DAVINCI** (Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging), which would study the **chemical composition of Venus' atmosphere** during a 63-minute descent.

Editor: We're rooting for Venus! And for Veritas over Davinci

New U.S. Space Mining Legislation Is 'History in the Making'

20 Novmber, 2015 - www.space.com/31177-**space-mining-commercial-spaceflight-congress**.html

Space mining just got a big boost.

The U.S. Congress' passage of a bill that **allows American companies to own and sell materials they extract from the Moon, asteroids or other celestial bodies** should help spur the development of off-Earth mining, representatives of the nascent industry say. It sets up a firm foundation for the next phase of space business, to mine water and metals from near-Earth asteroids

Boldan: Private Companies granted rights to Asteroid Resources

18 November, 2015 - www.space.com/31147-**house-passes-commercial-space-bill**.html

House'spassage of H.R. 2262, with language **granting rights to resources extracted from asteroids and other celestial bodies**, clears the way for signing it into law by President Obama. ##

Instrument Delivered for NASA's 2016 Asteroid Sample Return Mission

www.spacedaily.com/reports/prnewswire-space-news.html?rkey=20151217DC84363&filter=1639

https://en.wikipedia.org/wiki/101955_**Bennu**

17 December, 2015 - A sophisticated laser-based mapping instrument has arrived at Lockheed Martin Space Systems in Denver for integration onto NASA's Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer (OSIRIS-REx) spacecraft.

The **OSIRIS-REx Laser Altimeter** (**OLA**), contributed by the Canadian Space Agency (CSA), will **create 3-D maps of asteroid Bennu** to help the mission team **select a sample collection site**.

Bennu is listed 3rd highest Earth impactor listed on the Sentry Risk Table, with a mean diameter of about 492 m (1,614 ft; 0.306 mi) and has been observed extensively with the **Arecibo Observatory Planetary Radar** and the Goldstone Deep Space Network. ##

CERES

Dawn Probe Heads to Superclose Orbit of Dwarf Planet Ceres

October 29, 2015 - www.space.com/30960-**dawn-spacecraft-ceres-final-orbi**t.html

NASA's Dawn spacecraft has begun the long journey to its final orbit around the dwarf planet Ceres. On October 23, it began spiraling down **to an orbit that lies just 375 km (230 m) from Ceres surface**. The probe should begin collecting data and capturing photos from the new orbit in mid-December. It will record spectra of neutrons, gamma-rays, and visible and infrared light; measure the distribution of mass inside Ceres; and take pictures" from this orbit. ##

Mystery Solved? Ceres' Bright Spots Likely Made of Salt

9 December, 2015 - www.space.com/31323-**dwarf-planet-ceres-bright-spots-likely-salt**.html

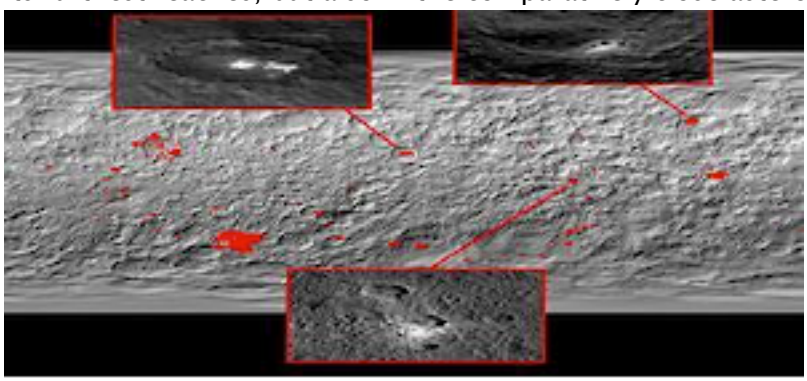
Observations by the Dawn spacecraft, orbiting Cerew since March, suggest that its many bright spots could be made primarily of hydrated magnesium sulfates (on Earth, sold as Epsom salt)

Dwarf planet Ceres: water vapor in Occator crater

www.spacedaily.com/reports/**Dwarf_planet_Ceres_water_vapor_in_Occator_crater**_999.html

24 December, 2015 - When the Sun shines into the Occator crater on the surface of the dwarf planet Ceres, a kind of thin haze appears above its brightest spot, indicating that frozen water may exist near the surface . The bright spots likely contain magnesium sulphates, a class of mineral salts.

Many of the other bright areas on Ceres' surface most likely by now consist solely of dried mineral salts. The new results show that since the birth of the Solar System frozen water has been able to survive not only in its furthest reaches, but also in the comparatively close asteroid belt.



Mosaic of the surface: Most of the 130 bright spots (shown in red here) on the dwarf planet Ceres are associated with craters, as this image shows. Three zooms provide a closer look at these regions. Top left: A kind of haze appears above the Occator crater when the Sun shines in. Therefore, this could indicate that the crater contains frozen water beneath the surface. Top right: The Oxo crater is the second brightest structure on Ceres. A kind of haze can be found there as well. Bottom: A typical crater without water. The brightness originates from mineral salts which could have dried up over time.

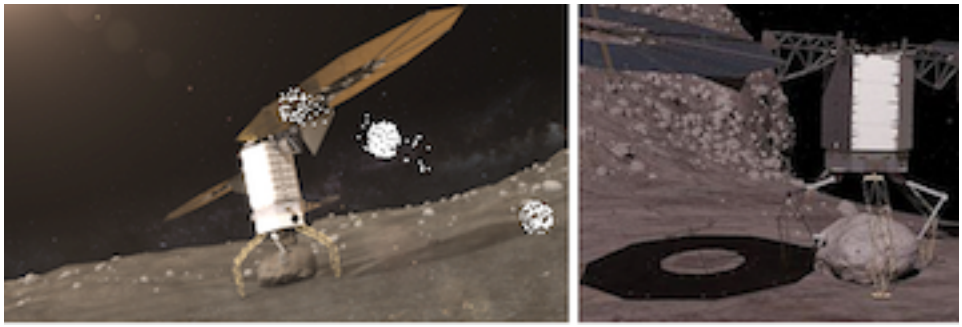
ASTEROID THREATS

NASA Calls for Ideas on Asteroid Redeployment Mission Spacecraft Development

www.nasa.gov/press-release/**nasa-calls-for-american-industry-ideas-on-arm-spacecraft-development**

www.spacedaily.com/reports/NASA_Calls_for_American_Industry_Ideas_on_ARM_Spacecraft_Development_999.html

22 October, 2015 - Jet Propulsion Laboratory (JPL) in Pasadena, California, has issued a call to American industry for innovative ideas on how NASA could obtain **a core advanced solar electric propulsion-based spacecraft to support the Asteroid Redirect Robotic Mission (ARRM)**.



The robotics capture system planned aboard the pioneering vehicle will be capable of acquiring a 20-ton (or larger) boulder of up to about 6 m (19 ft) in width from an asteroid's surface and then returning it to an astronaut-accessible orbit near the Moon.

This mission will use a number of important technologies to prepare for an early human exploration mission in deep space -- specifically, the area around the Moon known as **cislunar space**. The robotic mission also will provide the first large-scale asteroid samples on which to conduct research and analysis for better understanding of the composition and nature of these primordial planetary bodies, leading to future use of in-situ resources from asteroids. ##

Mass Extinctions tied to Comet Stikes Every 26 million years or so

3 November, 2015 - www.space.com/31001-**earth-mass-extinctions-comet-strikes**.html

Over the past 260 million years, cratering rates on Earth have peaked every 26 million years or so, in tune with a previously noted cycle of mass-extinction events, researchers found. Furthermore, five of the six largest impact craters known from the last quarter-billion years — including the 112-mile-wide (180 kilometers) crater associated with the demise of the dinosaurs 65 million years ago — were gouged out at roughly the same time that a mass extinction occurred.

[Ed. On this schedule, the next such event will be in 13 million years.]

COMETS

Take a Trip to Comet 67P in Awesome Video from the Philae Lander

www.space.com/30837-**philae-comet-landing-descent-video**.html

Ingredients for Life Were Always Present on Earth, Comet Suggests

23 October, 2015 - www.space.com/30911-**comet-lovejoy-organic-molecules-earth-life**.html

The basic building blocks of life may have been present on Earth from the very beginning. Astronomers detected 21 different complex organic molecules streaming from **Comet Lovejoy** during its highly anticipated close approach to the Sun this past January. Many of these same carbon-containing compounds have also been spotted around newly forming sunlike stars.

Modern Mystery: Ancient Comet Is Spewing Oxygen

28 October, 2015 - www.space.com/30961-**modern-mystery-ancient-comet-spewing-oxygen**.html

www.esa.int/Our_Activities/Space_Science/Rosetta/**First_detection_of_molecular_oxygen_at_a_comet**

The Rosetta spacecraft has detected molecular oxygen in the gas streaming off comet 67P/Churyumov-Gerasimenko, a curious finding that has scientists rethinking the ingredients that were present in the early solar system. Molecular oxygen is extremely reactive with hydrogen, which was swirling in abundance as the sun and planets were created. Current solar system models suggest the molecular oxygen should have disappeared by the time 67P was formed, about 4.6 billion years ago.

Philae Lander's Bouncy Comet Landing Reconstructed In New Animation

www.space.com/31099-**philae-s-landers-bouncy-comet-landing-reconstructed-in-new-animation**.html

Comet's Death Dive into the Sun captured by Spacecraft Video

www.space.com/31321-**comet-s-death-dive-into-sun-captured-by-spacecraft-video**.html

Centaurs - Earth-Smashing Space Rocks Undercounted

24 December, 2015 - www.space.com/31455-**earth-smashing-space-rocks-undercounted**.html

www.universityherald.com/articles/27275/20151223/**centaur-comets-threaten-earth-by-breaking-apart-creating-smaller-pieces**.htm

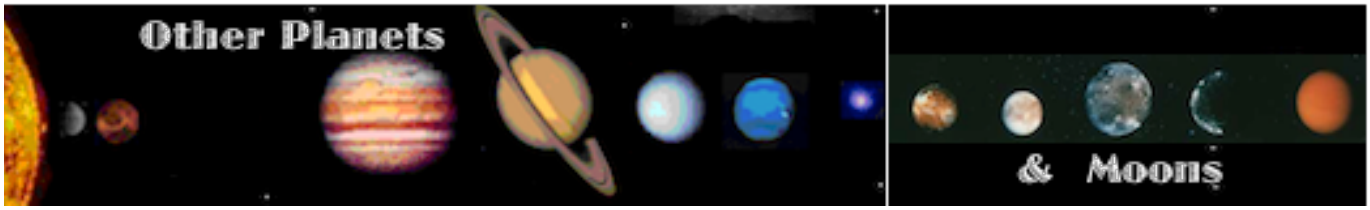
www.spacedaily.com/reports/**Giant_comets_may_threaten_Earth_astronomers**_999.html

https://en.wikipedia.org/wiki/**Centaur_(minor_planet)**

Most studies of potential Earth-smashers focus on objects in the asteroid belt roughly between Mars, Earth's outside neighbour, and Jupiter on its other flank, said the researchers.

But they noted that **the discovery in the last two decades of hundreds of giant comets dubbed centaurs, albeit with much larger orbits, requires expanding the list of potential hazards.**

These balls of ice and dust, typically 50-100 km (31-62 mi) wide, have unstable, elliptical orbits that start way beyond Neptune. Their paths cross those of the giant planets Jupiter, Saturn, Uranus and Neptune, whose gravity fields occasionally deflect a comet towards Earth -- **once about every 40,000-100,000 years**. ##



MERCURY

BepiColumbo, Europe's first mission to Mercury. To launch in 2017

12 October, 2015 – www.esa.int/spaceinimages/Images/2015/10/**BepiColombo_in_the_spotlight**

BepiColombo, Europe's first mission to study Mercury, is a joint mission with Japan. Two spacecraft – the **Mercury Planetary Orbiter** and the **Mercury Magnetospheric Orbiter** – will fly in two different orbits around the planet to study it from complementary perspectives.

Set to **arrive at Mercury in 2024**, BepiColombo will investigate **properties of Mercury that are still mysterious**, such as its **high density**, the fact that it is the only planet with a **magnetic field** similar to Earth's, the much **higher than expected amount of volatile elements** detected by NASA's Messenger probe and the nature of **water ice that may exist in the permanently shadowed areas at the poles**.

VENUS

Venus is one of two leading destinations for low-cost NASA missions

http://news.sciencemag.org/space/2015/09/mission-bizarre-metal-asteroid-among-winners-nasa-discovery-competition?utm_campaign=email-news-weekly

30 September, 2015 – Venus is back on NASA's agenda. NASA has winnowed down the contenders for the agency's next low-cost planetary science mission. Five finalists were announced from among 27 proposals in Discovery, a competitive mission with a $500 million cost cap. Two of them are missions to Venus, **not visited by a NASA prove since 1994**. The other 3 finalists would study asteroids.

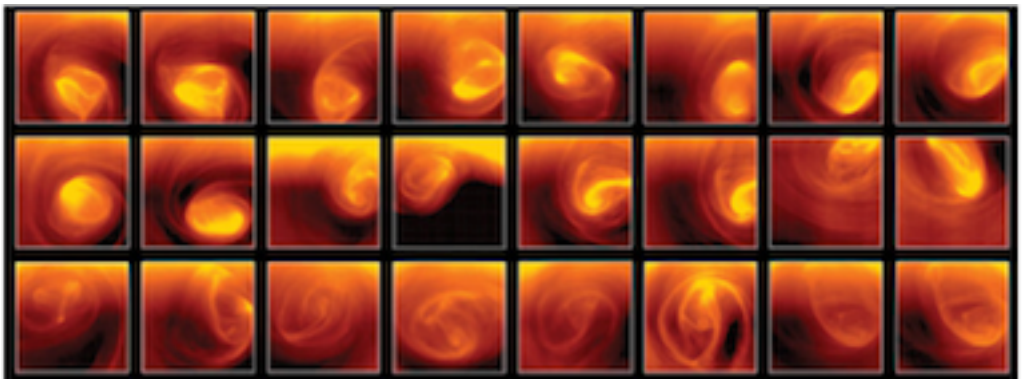
The five finalists are:

- VERITAS (Venus Emissivity, Radio Science, InSAR Topography and Spectroscopy) a **mission to map Venus' surface with radar**;
- **DAVINCI** (Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging), which would study the **chemical composition of Venus' atmosphere** during a 63-minute descent.
- **Psyche**, mission to explore an asteroid that could be made up almost entirely of iron and nickel;
- **Lucy** would tour 5 Trojan asteroids, in Jupiter"s orbit either ahead or behind the giant planet;
- **NEOCam** (Near Earth Object Camera), which aims to discover 10 times more near-Earth objects than have been discovered to date; and

Editor: We're rooting for Venus! And for Veritas over Davinci

ESA's Venus Express' amazing pictures of South Polar cloud vortex

9 November, 2015 – www.esa.int/spaceinimages/Images/2015/11/**Destination_Venus**



ESA's Venus Express spent 8 years studying Venus in detail before the mission ended in December 2014. One of the mission aims was to observe the planet's very dense atmosphere continuously over long periods in a bid to understand its dynamic behaviour.

The combination of greenhouse gas and perennial cloud layer led to an enormous greenhouse warming, leaving Venus' surface extremely hot – just over 450°C (840°F) – and hidden from our eyes.

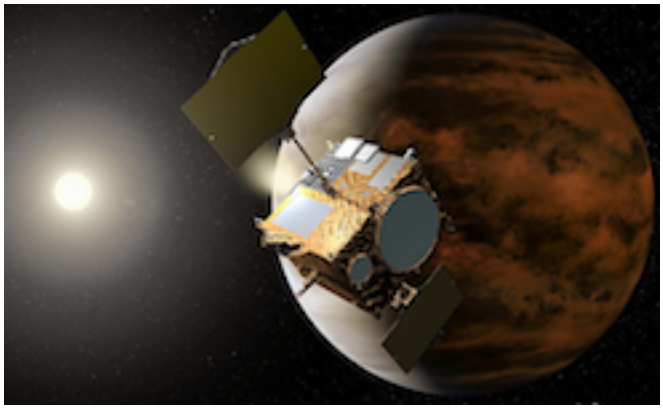
Winds on the planet's surface move very slowly, at a few kilometres per hour, the atmospheric density at this altitude is so great that they exert greater force than much faster winds would on Earth.

Winds at the 65 km-high cloud-tops whizz around at up to 400 km/h (250 mph), some 60 times faster than the rotation of the planet itself. This causes some especially dynamic and fast-moving effects in the planet's 'polar vortices' where the air converging on the pole accelerates sideways and spirals downwards, like water swirling around a plug hole. ##

Saved Japanese Probe "Akatsuki" Gets Final Chance to Orbit Venus

www.space.com/31245-**saved-japanese-probe-last-chance-orbit-venus**.html

1 December, 2015 - Five years ago, Japan's Venus Climate Orbiter spacecraft "Akatsuki" (aka Planet-C), after five and a half months traveling through space, failed to enter orbit around Venus due to a faulty thruster nozzle. Lacking the ability to reduce itseventually entering orbit around the Sun. JAXA mission engineers were able to develop work-arounds for a second attempt at orbit insertion.

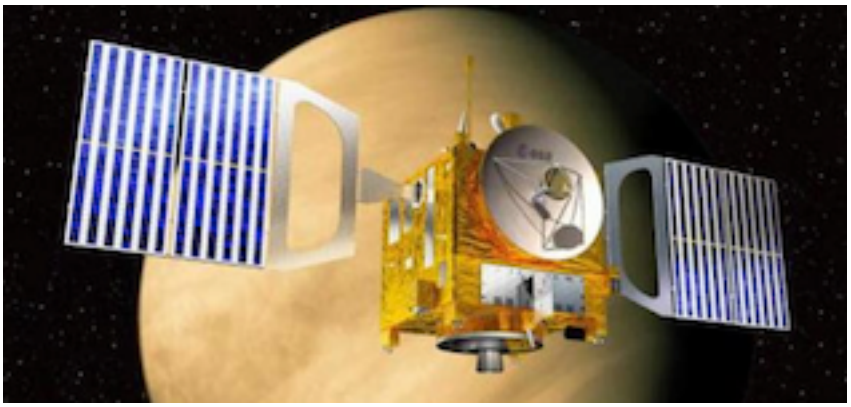


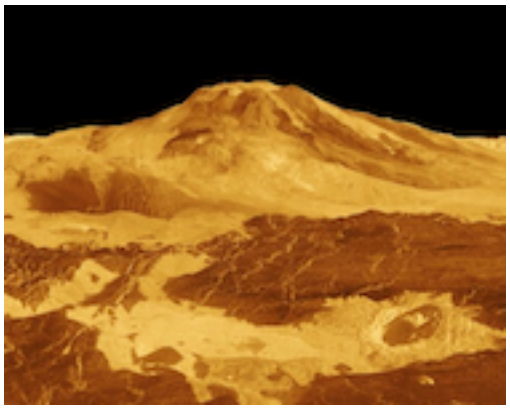
A second, final chance will arrive on Monday, Dec. 7, for Akatsuki to collect data on Venus' atmosphere from within an 8-9-day-long elliptical orbit. Originally planned to last at least two years, at this point the duration will depend on the life of the spacecraft's batteries.

The reactor control system (RCS) thruster should be able to get the spacecraft into Venus orbit — especially now that it's a bit lighter due to the discarding of unnecessary OME. ##

Success! Japanese Spacecraft Arrives at Venus 5 Years After 1st Try

9 Deceber, 2015 - www.space.com/31324-**venus-arrival-by-japan-akatsuki-spacecraft**.html
www.space.com/31325-**venus-photos-by-japan-akatsuki-spacecraft**.html
http://global.jaxa.jp/projects/sat/**planet_c**/





Japan's **Akatsuki** "Dawn" spacecraft has arrived in orbit around Venus, five years to the day after an engine failure scuttled its first attempt. Launched in May 2010 along with JAXA's IKAROS (Interplanetary Kite-craft. Accelerated by Sunlight), it was the first probe ever to deploy and use a solar sail in interplanetary space.

Originally Akatsuki was supposed to enter Venus orbit on Dec. 6, 2010, then study the planet's clouds, weather and atmosphere from above for at least two years to learn more about how the world became so hot and seemingly inhospitable to life. But the main engine quit during a crucial orbit-insertion burn, and Akatsuki astray.

The spacecraft has been circling the sun for five years, waiting for another shot at Venus. On Dec. 6), Akatsuki fired its small attittude-control thruster for 20 minutes to achieve Venus orbit).

The orbit period is 13 days and 14 hours - in the same direction as Venus' rotation. Akatsuki's current path takes it as close as 400 km (250 mi) to Venus surface, and as far away as 440,000 km (273,000 mi), a much more elliptical orbit than originally planned - a period of 30 hours and a(most distant point from Venus of 80,000 km (50,000 mi.)

Akatsuk will soon deploy and test three of its six instruments — the other three are in good condition — and then conduct initial observations for about three month. At the same time, fhe craft will maneuver to a less-elliptical final science orbit with a period of about nine days and an apoapsis around 310,000 km (193,000 mi) by April 2016.

Despite the long delay and the highly elliptical orbit, Akatsuki should still be able to accomplish most of its science goals. ##

JUPITER & ITS MOONS

Listening for Alien Life: Could New Tech Detect Microbe Movements?

1 October, 2015 - www.space.com/30709-**space-noise-sensor-alien-life**.html

Spacecraft may one day be able to detect alien life by listening to the sounds microbes make.

Scientists are testing a new microphone technology called the remote acoustic sensor (RAS), which is capable of capturing sounds within extreme and often inaccessible aerospace environments.

A miniaturized version of the device could theoretically make its way to Mars or to Jupiter's ocean-harboring moon, **Europa.**

Did Comets Spark Alien Life in Europa's Oceans?

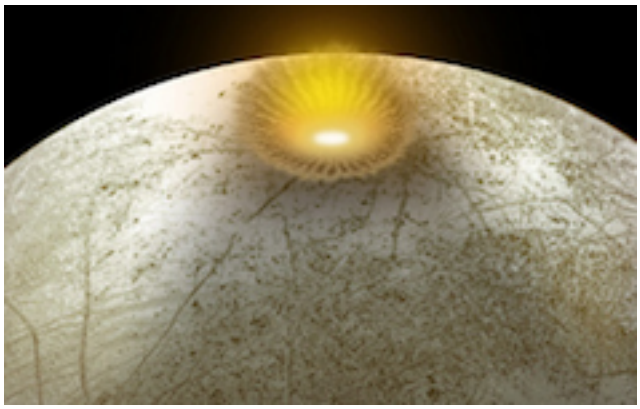
14 October, 2015 - www.space.com/30823-**comets-spark-alien-life-europa-oceans**.html

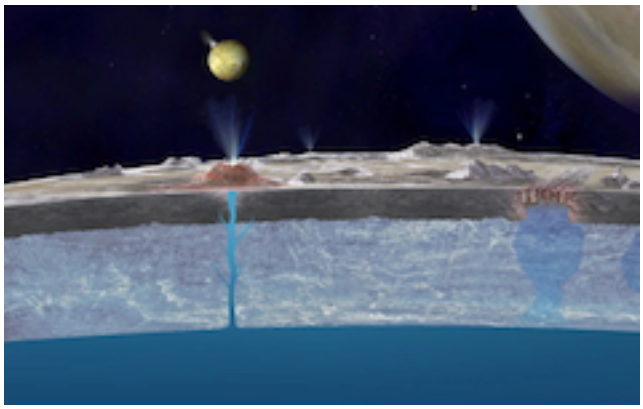
www.space.com/22207-**jupiter-moon-europa-water-ocean-infographi**c.html

20 October, 2015 - www.space.com/30868-**jupiter-moon-europa-comet-crashes**.html

If alien life swims in the ocean beneath Europa's icy surface, it might have got its start from comets cracking the icy shell to deliver vital pre-life ingredients. New simulations show that a specific family of comets, the so- called "**Jupiter Family Comets***," have the mass, velocity and opportunity to do the job -- penetrating the full range of likely Europan ice thicknesses.

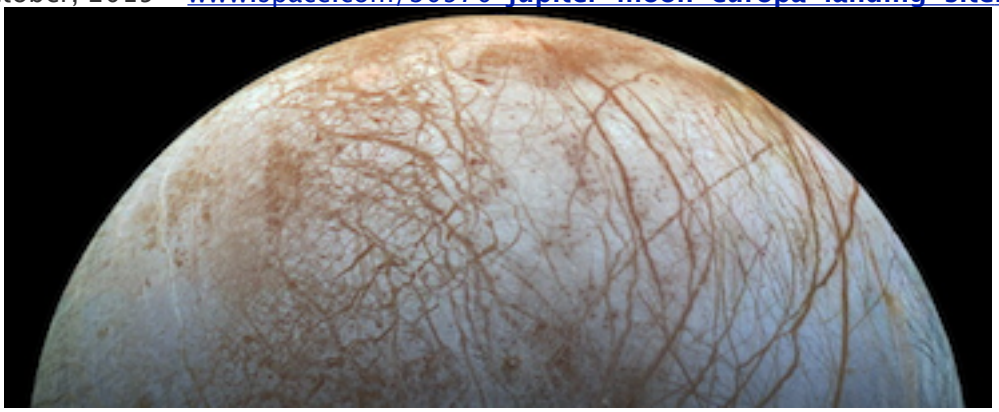
- http://astronomy.swin.edu.au/cosmos/J/**Jupiter-family+comets**





Search for Life: Where Should a Europa Lander Touch Down?

30 October, 2015 - www.space.com/30970-**jupiter-moon-europa-landing-site**.html?



Europa's complex chaos regions — which feature numerous cracks, ridges and other signs of geological activity — may offer a way to sample the moon's huge subsurface ocean of liquid water.

(**Editor:** we've been saying that for some time. When a crack occurs and/or spreads, ocean water and any lifeforms in it, will ooze upwards through the cracks. - We don't have to drill down many kilometers/miles to see if Europa's ocean is alive with life forms.)

NASA Europa Mission May Land on Potentially Life-Hosting Jupiter Moon

22 December, 2015 - www.space.com/31407-**nasa-europa-mission-lander**.html

NASA has already selected the nine primary science instruments for the Europa spacecraft for dozens of flybys to gauge the Jovian satellite's life-hosting potential. But the probe should be able to accommodate an additional 250 kg (550 lbs) of payload, and NASA would rather not let that "excess" go to waste. Under consideration are plume probes, penetrators, or even a small lander.

The mission aims to investigate the habitability of this moon and its ocean and is scheduled to launch in the early to mid-2020s and reach the Jupiter system 8 years later.

The probe would then perform 45 flybys of Europa over the next 2.5 years or so, studying the satellite with high-resolution cameras, a heat detector, ice-penetrating radar and other scientific gear.

None of the nine already-announced instruments were designed to hunt for signs of life. But it's possible that it could carry life-detecting gear. possibly a penetrator, which would slam into Europa's ice shell at high speeds, or a lander, which would touch down softly. ##

Did Jupiter Expel A Rival Gas Giant

1 November, 2015 - www.spacedaily.com/reports/**Did_Jupiter_Expel_A_Rival_Gas_Giant**_999.html

University of Toronto astrophysicists have found that a close encounter with Jupiter about four billion years ago may have resulted in another planet's ejection from the Solar System altogether.

The existence of a fifth giant gas planet at the time of the Solar System's formation – in addition to Jupiter, Saturn, Uranus and Neptune that we know of today – was first proposed in 2011. But if it did exist, how did it get pushed out?

Evidence points to Jupiter

Planet ejections occur as a result of a close planetary encounter in which one of the objects accelerates so much that it breaks free from the massive gravitational pull of the Sun.

Earlier studies proposed that giant planets could possibly eject one another did not consider the effect such violent encounters would have on known moons of the giant planets, and their orbits such as the modern-day trajectories of **Callisto** (Jupiter) and Iapetus (Saturn) respectively.

They then measured the likelihood of each one producing its current orbit in the event that its host planet was responsible for ejecting the hypothetical planet, an incident which would have caused significant disturbance to each moon's original orbit.

Jupiter was capable of ejecting the fifth giant planet while retaining a moon with the orbit of Callisto. But it would have been very difficult for Saturn to do so because Iapetus would have been excessively unsettled, resulting in an orbit that is difficult to reconcile with its current trajectory. ##

Why NASA Europa Probe Will Study Jupiter Moon's Dust

20 November, 2016 – www.space.com/31171-**nasa-europa-mission-dust-instrument**.html

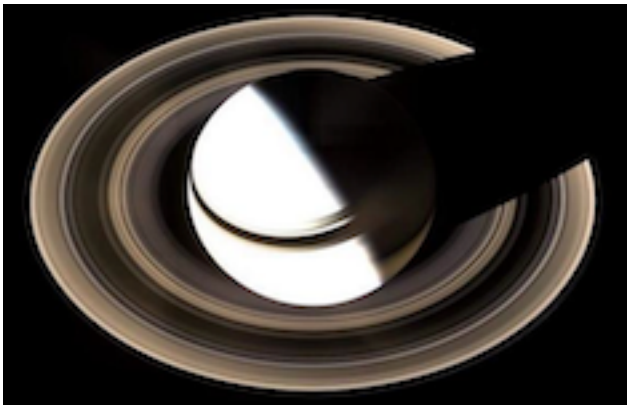
The question is whether or not Jupiter's moon Europa, which harbors an ocean of liquid water beneath its icy shell, can support life.

NASA plans to launch a robotic Europa flyby mission in the early 2020s to address this question. Some instruments will look for the distribution of liquid-water pockets within the ice shell; some will look at the turnover of surface material. One of the spacecraft's nine instruments — the Surface Dust Mass Analyzer (SUDA), will determine the composition of materials ejected from Europa's surface. ##

SATURN & ITS MOONS

Something strange is happening inside Saturn

29 September, 2015 – www.space.com/30665-**unraveling-saturn-ring-mystery**.html
www.space.com/21834-**fly-through-space-photos-in-saturn-s-rings-video**.html



The movement of waves in Saturn's rings offers clues to activity and conditions within the planet. Waves caused by the moons, which orbit outside the rings' sphere, always travel outward. But then there's a set of waves heading inward. That means there's something moving inside, too. ##

NASA team discover how water escapes from Saturn

www.spacedaily.com/reports/**NASA_team_discover_how_water_escapes_from_Saturn**_999.html
4 December, 2015 – Aninstruments on Cassini measures the planet's magnetosphere – the charged particles, known as plasma, that are trapped in the space surrounding Saturn by its magnetic field.

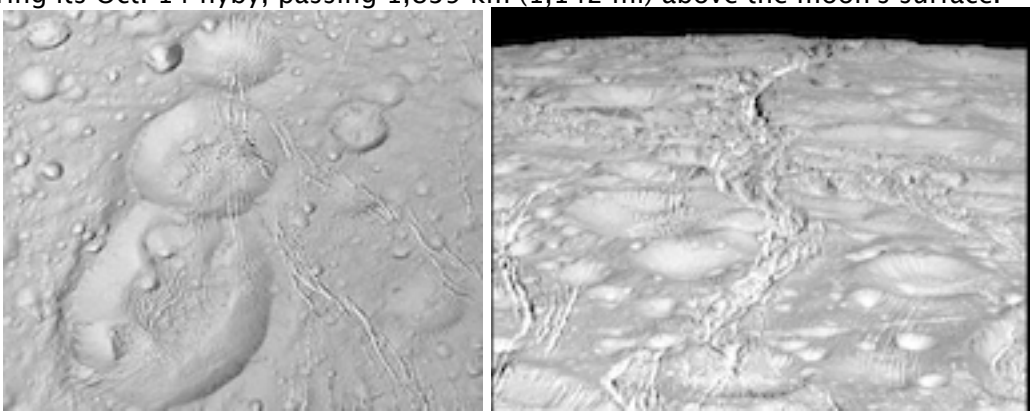
One of Cassini's past discoveries is that Saturn's plasma comprises water ions, which are derived from Saturn's moon Enceladus, which spews water vapors from Yellowstone-like geysers. Knowing that the water ions would not be able to accumulate indefinitely, the team of researchers set out to explain how the water ions escape from Saturn's magnetosphere.

The plasma found a place to exhaust out of the magnetosphere at a reconnection point - basically where magnetic fields from one environment disconnect and reconnect with magnetic fields from another environment. In the case of Saturn, researchers discovered the reconnection point was located at the back of the planet, where the magnetotail was connecting with the solar winds' magnetic field - as in a rotary or a traffic circle. Once you get into the rotary you have limited exit points. ##

Closest-ever Views of Saturn's moon Enceladus

www.spacedaily.com/reports/**Closest_ever_Views_of_Saturns_Moon_Enceladus**_999.html

16 October, 2015 - Cassini spacecraft began returning its best-ever views of the northern extremes of Enceladusduring its Oct. 14 flyby, passing 1,839 km (1,142 mi) above the moon's surface.

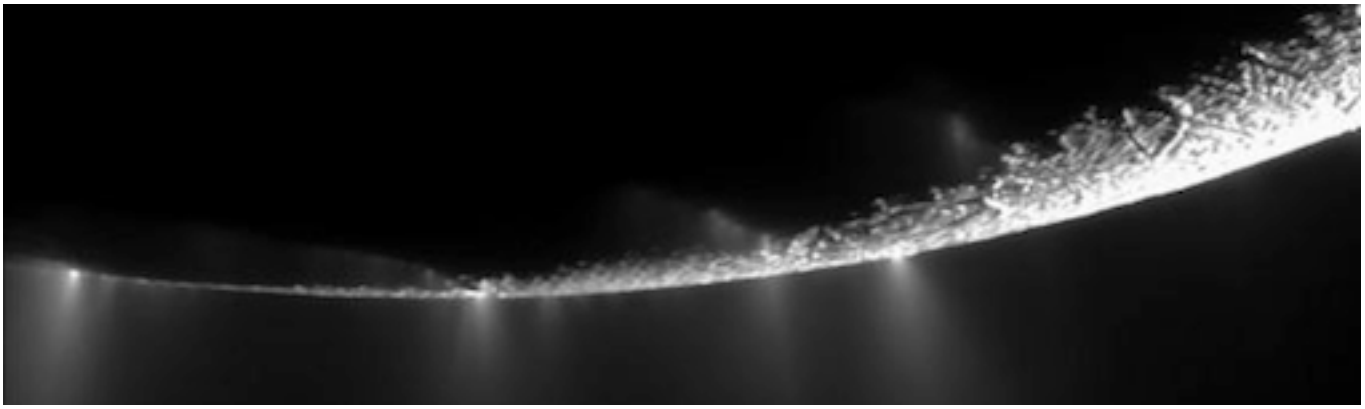


Full size image at: L http://www.jpl.nasa.gov/spaceimages/details.php?id=PIA20011
R. cassini-enceladus-photo-2.jpg

The new high-resolution Cassini images show a northern landscape of stark contrasts crisscrossed by a spidery network of gossamer-thin cracks that slice through the craters.

Cassini flies through a water plume ejected by moon Enceladus

28 October, 2015 - www.space.com/30944-**nasa-cassini-saturn-moon-enceladus-flyby**.html



Cassini flew low through a plume Oct. 28) at about 11:22 a.m. EDT (1522 GMT), zooming within a mere 50 km (30 mi) of Enceladus' frigid surface. During the encounter, it snapped photos and gathered **samples** that should help researchers learn more about the moon's life-hosting potential. (An ocean of liquid water lies beneath Enceladus' icy shell,. The plume material comes from this subsurface sea.) ##

The Geysers on Saturn's Moon Enceladus Are Mysteriously Losing Steam

16 December, 2015 - www.space.com/31385-**saturn-moon-enceladus-geysers-losing-steam**.html

The geysers, which blast material from Enceadys' subsurfce ocean into space from the moon's south polar region, were first spotted by NASA's Saturn-orbiting Cassini spacecraft back in 2005.

Now, a new study of Cassini data shows that the geysers' output has dropped by 30 to 50 percent since then.

It's possible that the fissures through which the geysers spray are narrowing as more and more material accumulates on their walls. ##

Deserts and dunes: Earth as an analogue for Titan

www.spacedaily.com/reports/**Deserts_and_dunes_Earth_as_an_analogue_for_Titan**_999.html

9 November, 2015 - Titan is the only natural moon in the Solar System to have **a dense atmosphere containing methane, a geologically active surface, and numerous surface lakes and seas.**

By comparing radar images of areas on Titan to those of Earth's deserts, **scientists have identified two distinct types of sand dune on Titan** - and discovered eroded structures that **indicate that Titan's climate may have once been very different.**

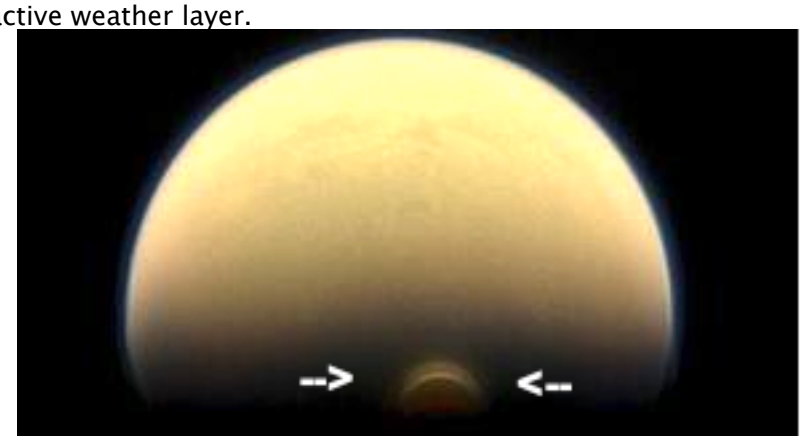
An example of a **yardang** in Central Asia. - https://en.wikipedia.org/wiki/**Yardang**

For detailed images and captions about yardangs on Titan see
http://sci.esa.int/cassini-huygens/56757-**sand-dunes-and-mega-yardangs-on-titan**/
and on Earth see
http://sci.esa.int/cassini-huygens/56756-**sand-dunes-and-mega-yardangs-on-earth**/

Cassini Finds Monstrous Ice Cloud in Titan's South Polar Region

www.spacedaily.com/reports/**Cassini_Finds_Monstrous_Ice_Cloud_in_Titans_South_Polar_Region**_999.html

15 November, 2015 - New observations made near the south pole of Titan by the Cassini spacecraft add to the evidence that winter comes in like a lion on this moon of Saturn. A monstrous new cloud of frozen compounds in the moon's low- to mid-stratosphere has appered in a stable atmospheric region above the troposphere, or active weather layer.



As winter sets in at Titan's south pole, a cloud system called the south polar vortex (small, bright "button" betweeb arrows) has been forming, as seen in this 2013 image.

In 2012 Cassini's camera had already imaged an impressive cloud hovering over Titan's south pole at an altitude of about 300 km (186 mi). A much more massive ice cloud system has now been found lower in the stratosphere, peaking at an altitude of about 200 km (124 mi), detected by Cassini's infrared instrument which obtains profiles of the atmosphere at invisible thermal wavelengths. The cloud has a low density, similar to Earth's fog but likely flat on top.

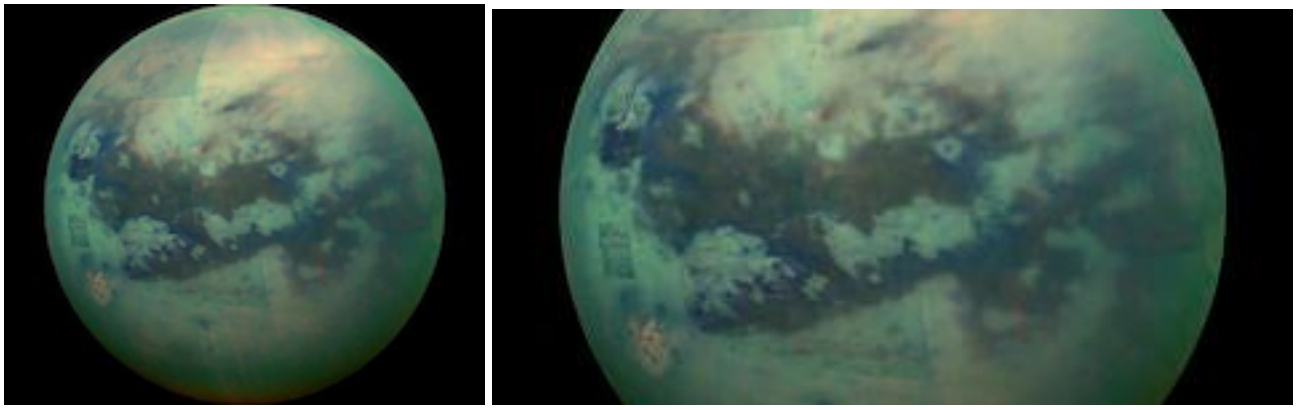
For the past few years, Cassini has been catching glimpses of the transition from fall to winter at Titan's south pole – the first we've seen the onset of a Titan winter. As each Titan season lasts about 7-1/2 Earth years, the south pole will still be enveloped in winter when the mission ends in 2017.

The ice clouds at Titan's pole don't form in the same way as Earth's familiar rain clouds. Titan's polar clouds form higher in the atmosphere by circulation in the atmosphere transports gases from the pole in the warm hemisphere to the pole in the cold hemisphere. At the cold pole, the warm air sinks, in a process known as subsidence.

The sinking gases – a mixture of smog-like hydrocarbons and nitrogen-bearing chemicals called nitriles – encounter colder and colder temperatures on the way down. Different gases will condense at different temperatures, resulting in a layering of clouds over a range of altitudes. ##

Peering Through Titan's Haze

4 December, 2018 – www.spacedaily.com/reports/**Peering_Through_Titans_Haze**_999.html



This composite image shows an infrared view of Saturn's moon Titan acquired during Cassini's "T-114" flyby on Nov. 13, 2015. The visual and infrared mapping spectrometer (VIMS) instrument made these observations: blue represents wavelengths centered at 1.3 microns, green represents 2.0 microns, and red represents 5.0 microns.

A view at visible wavelengths (centered around 0.5 microns) would show only Titan's hazy atmosphere (as in PIA14909). The near-infrared wavelengths in this image allow Cassini's vision to penetrate the haze and reveal the moon's surface.

During this flyby, the spacecraft's closest-approach altitude was 10,000 km (6,200 mi), considerably higher than those of typical flybys, which are around 1,200 km (750 mi). The high flyby allowed moderate-resolution views over wide areas.

The view looks toward terrain that is mostly on the Saturn-facing hemisphere of Titan. The scene features **the parallel, dark, dune-filled regions named Fensal** (to the north) **and Aztlan** (to the south), which form the shape of a sideways letter "H."

Several places on the image show the surface at higher resolution than elsewhere. These areas, called subframes, show more detail because they were acquired near closest approach. ##

PLUTO-CHARON & BEYOND

Pluto's binary companion Charon is cracked like an ice cube

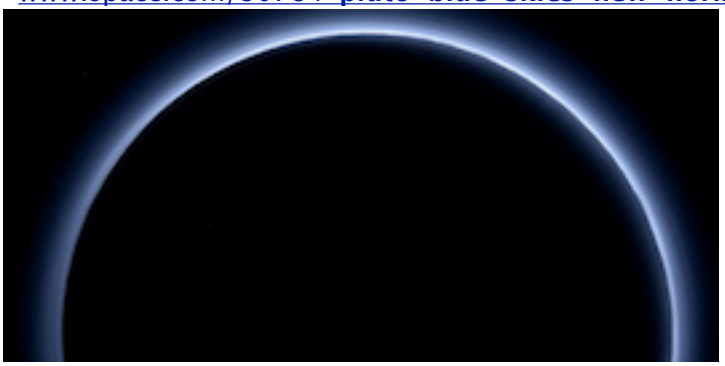
http://news.sciencemag.org/sifter/2015/10/**pluto-s-moon-charon-is-cracked-like-an-ice-cube**

2 October, 2015 – A giant chasm, deeper than the Grand Canyon, girdles Charon's belly, separating a pockmarked northern hemisphere from a southern hemisphere that is smoother and younger.

The southern hemisphere may have been resurfaced by water-based lavas, which poured out onto Charon's surface during a period of intense cryovolcanism. The epoch may have been triggered when a layer of water inside Charon froze, causing it to expand and crack. ##

Surprise! Pluto Has Blue Skies (Photo)

9 October, 2015 - www.space.com/30784-**pluto-blue-skies-new-horizons-photo**.html



Pluto's haze layer displays a blue color in this image from New Horizons' Ralph/Multispectral Visible Imaging Camera (MVIC). The blue color comes from complex organic molecules in Pluto's atmosphere called tholins, which are themselves probably gray or red but scatter light in blue wavelengths.

Pluto-Charon's Small Moons Nix and Hydra

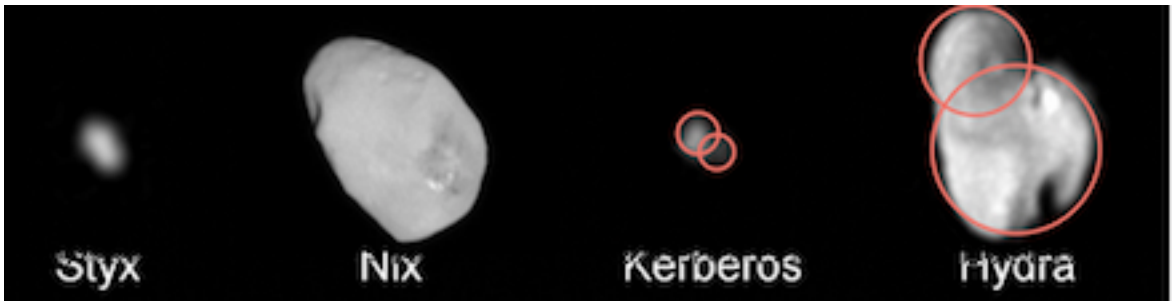
9 October, 2015 - www.spacedaily.com/reports/**Plutos_Small_Moons_Nix_and_Hydra**_999.html

The orbits of Pluto and Charon and their moons Styx, Nix, Kerberos and Hydra

The orbits line up like a miniature solar system, except with a binary system at the center, similar to the planetary system around the star Kepler 47. All four small moons are less than about 50 km (30 mi) in their longest dimension. Each has a lumpy shape because, unlike Pluto and Charon, they aren't big enough for gravity to squish them into a ball. **N**ix and **H**ydra were discovered in 2005, shortly before New Horizons launched in 2006, and their initials were a subtle nod to the **N**ew **H**orizons mission. ##

Pandemonium! Motion of Pluto's Moons Perplexes Scientists

www.space.com/31071-**plutos-moons-orbit-pandemonium-new-horizons**.html
www.space.com/31068-**plutos-four-tiny-moons-topsy-turvy-tumbles-animation**.html



10 November. 2015 – The orbits of Pluto-Charon's four smallest moons, only discovered recently, between 2005 and 2013, are even more chaotic than scientists had expected. "The way I would describe this system is not just chaos, but pandemonium. We honestly have not seen anything like this before, and we still don't know what to make of it."

Some of them are spinning incredibly fast, one is spinning backward against its orbit and some are tilted on their sides. Nix, is tilted on its axis by 132° and is rotating backward. What is so mysterious is that all four objects are spinning rapidly (it's difficult to imagine a collision that would affect all four of them), and that the gravitational pull of Pluto doesn't appear to have slowed them down. – "clearly something fundamental about the dynamics of the system that we do not understand." ##

New Horizons Pluto-Charon Probe Heads Toward 2nd Flyby Target

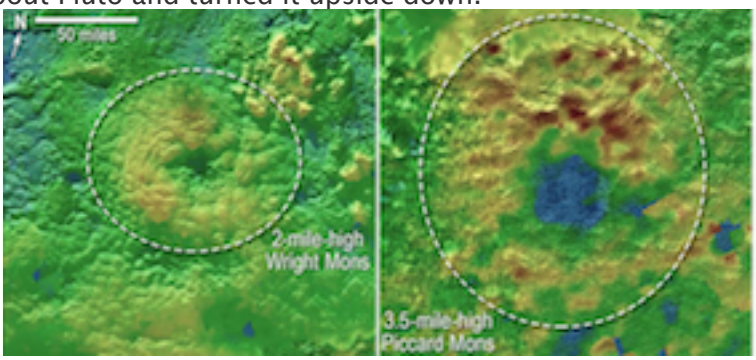
23 October, 2015 – www.space.com/30914-**new-horizons-engine-burn-second-flyby**.html
https://en.wikipedia.org/wiki/2014_MU69

New Horizons, which in July performed the first-ever flyby of the Pluto-Charon binary planet, fired up its engines October 22, in the first of four maneuvers designed to send the probe zooming past a small Kuiper-Belt object called 2014 MU69 on Jan. 1, 2019. This object is the size of Pluto's moon Nix. It will be interesting to compare its makeup with 6 bodies in the Pluto-Charon binary system. ##

4 Months after Pluto Flyby, New Horizons Yields Wealth of Discovery

www.nasa.gov/press-release/**four-months-after-pluto-flyby-nasa-s-new-horizons-yields-wealth-of-discovery**

9 November, 2015 – From possible ice volcanoes to twirling moons, NASA's New Horizons science team is discussing more than 50 exciting discoveries about Pluto. "The New Horizons mission has taken what we thought we knew about Pluto and turned it upside down."

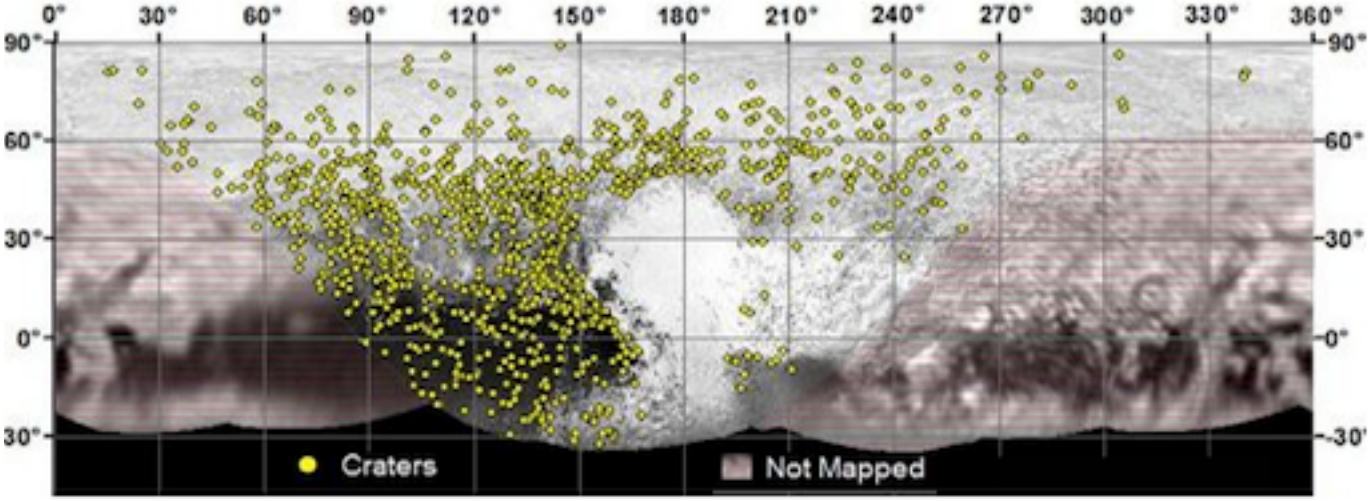


New Horizons geologists combined images of Pluto's surface to make 3-D maps that indicate **two of Pluto's most distinctive mountains could be cryovolcanoes** -- ice volcanoes that may have been active in the recent geological past. Using New Horizons images of Pluto's surface to make 3-D topographic maps, scientists discovered that two of Pluto's mountains, informally named **Wright Mons** and **Piccard Mons**, could be ice volcanoes. The color depicts changes in elevation, blue indicating lower terrain and brown showing higher elevation. Green terrains are at intermediate heights Both measure tens of kilometers or miles across and several kilometers or miles high.

Their appearance is similar to volcanoes on Earth that spew molten rock, but ice volcanoes on Pluto likely emit a somewhat melted slurry of substances such as water ice, nitrogen, ammonia, or methane. This will provide an important new clue to Pluto's geologic and atmospheric evolution. ##

Part of Pluto's Heart Was 'Born Yesterday'

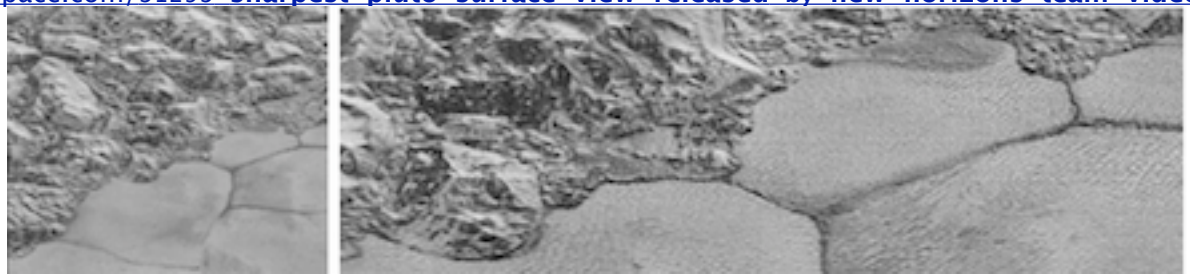
11 November, 2015 - www.space.com/31080-**pluto-heart-born-yesterday**.html



Counting craters across Pluto, shows that some regions of the planet are as young as 10 million years old while others are nearly as old as the 4.5-billion-year-old solar system. The relatively crater free at the center of the map, dubbed the heart for its 2-lobe shape, has been named **Sputnik Planum.** ##

Sharpest Pluto Surface View Released By New Horizons Team | Video

www.space.com/31293-**sharpest-pluto-surface-view-released-by-new-horizons-team-video**.html



Left: Original phoot - **Right:** Incredible detail of photo at left
This highest-resolution image fromNew Horizons spacecraft shows great blocks of Pluto's water-ice crust, jammed together in the informally named al-Idrisi mountains. Image released Dec. 4, 2015.

These new photos were taken with the long-range camera when the probe was just 16,000 km (10,000 mi) from Pluto's surface. At its closest approach, 15 minutes after this image was captured, New Horizons came within about 12,550 km (7,800 mi) of Pluto's surface. ##

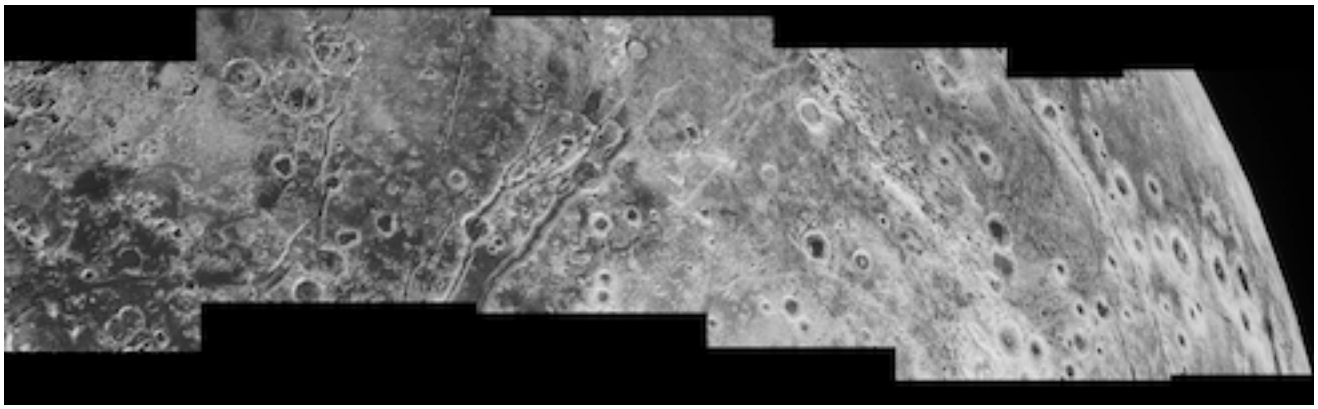
Epic Pluto Photo Brings Cratered Plains and Jagged Faults Into Focus

18 December, 2015 - www.space.com/31411-**pluto-epic-surface-photo**.html

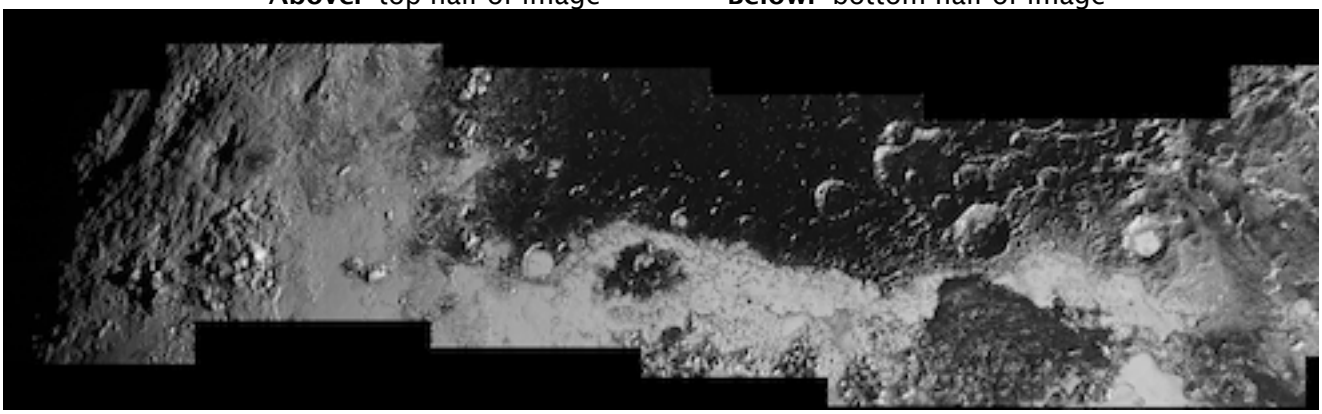
"We're much less than halfway through transmitting data about the Pluto system to Eart
h, but a wide variety of new scientific results are already emerging,"

The image below (rotated by TTSIQ editor), taken by New Horizons' Long-Range Reconnaissance Imager (LORRI), was taken just before the craft's closest approach to Pluto.

The top of the image shows simple cratered plains, unchanged by time, but the picture quickly grows more complex. Further down, the image reveals jagged faults, suggesting large-scale processes at work within the dwarf planet. Then, the photo reaches the dark (informally named) Cthulhu Regio and its strange overlap with the bright, active ices at the edge of the flat Sputnik Planum. Finally, the strange, 2.5-mile-high (4 kilometers) potential ice volcano Wright Mons appears with an oblong shadow just before the darkness, while the rest of the world is in the shadow of night.



Above: top half of image **Below:** bottom half of image



ON TO THE KUIPER BELT & BEYOND

V774101 – 'Mini-Pluto' Is Solar System's Most Distant Object

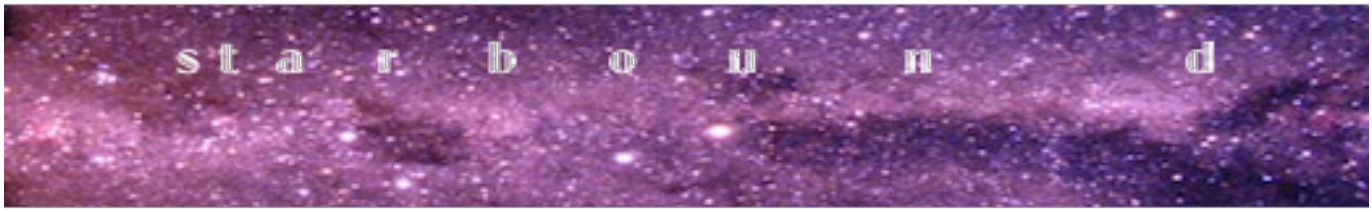
http://news.discovery.com/space/**mini-pluto-is-solar-systems-most-distant-object**-151111.htm

http://www.space.com/31100-**most-distant-dwarf-planet-found**.html

11 November, 2015 –newly found **V774101**, a planetoid about 103 times farther away from the sun than Earth — **roughly three times farther than Pluto** — **well beyond the Kuiper Belt** We don't yet know if V774101'a orbit transits into the Kuiper Belt, or if it is an Oort Cloud object. And It will take a year of observations to determine if its orbit brings the object near Neptune or not,

We don't yet know if V774101'a orbit transits into the Kuiper Belt, or if it is an Oort Cloud object. And It will take a year of observations to determine if its orbit brings the object near Neptune or not,

It appears to have 1/3rd the diameter of Pluto, c. 800 km (c. 500 mi.) more like Ceres, ##



OUR CLOSEST STAR: THE SUN

EARTH-BOUND TELESCOPES

Third Observatory to Close on Sacred Hawaiian Mountain

29 October, 2015 - www.space.com/30962-**third-observatory-to-close-mauna-kea**.html

A British-built observatory located on Hawaii's tallest mountain, the dormant volcano Mauna Kea, announced last week that it would be closing, meeting the request of Hawaii's Gov. David Ige **to shut down 25 % of the telescopes on the mountain, in order to facilitate the construction of the Thirty-Meter Telescope** (TMT)

Gigantic New Telescope Breaking Ground in Chile

www.space.com/31060-**giant-magellan-telescope-chile-groundbreaking-soon**.html
www.space.com/15020-**giant-magellan-telescope-video-animation**.html
www.space.com/31079-**giant-magellan-telescope-groundbreaking-travelogue**.html
www.space.com/31111-**giant-magellan-telescope-groundbreaking-ceremony**.html

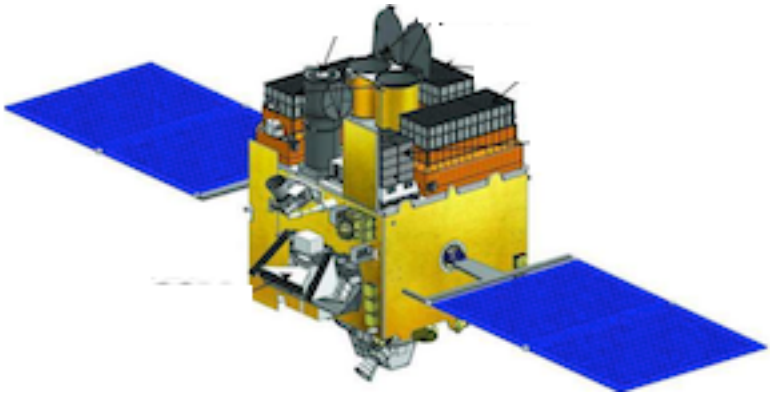
8 November, 2015 - The groundbreaking ceremony for the Giant Magellan Telescope (GMT) — a huge instrument that astronomers will use to hunt for signs of life in the atmospheres of alien planets, probe the nature of dark energy and dark matter, and tackle other big cosmic questions — took place November 11, at the Las Campanas Observatory in the Chilean Andes.

When it's finished, the GMT will consist of seven 8.4 m wide (27.6-ft) primary mirrors — the largest single-piece astronomical mirrors ever made — arranged into one light-collecting surface 24 m (80 ft) across, as well as seven smaller secondary mirrors that will change shape to counteract the blurring effects of Earth's atmosphere. The finished observatory will boast about **10 times the resolving power of the Hubble Space Telescope**, ##

SPACE TELESCOPES

India Launches 1st Astronomy Satellite

29 September, 2015 - **www.space.com/30689-india-first-astronomy-satellite-launch**.html
http://spacenews.com/**pslv-rocket-launches-indias-1st-astronomy-satellite/**



Launched into a near-equatorial low Earth orbit, the 1,513-kg (3,335 lb) **Astrosat** is operating from an orbit of 650 km (404 mi) in altitude inclined 6° to the equator, Astrosat is expected to deliver **optical, ultraviolet and X-ray images of black holes and other phenomena** in a five-year mission. ##

Will the 'Super Hubble' Space Telescope Find Alien Life?

30 September, 2015 - www.space.com/30694-**will-super-hubble-telescope-detect-alien-life**.html
http://www.**hdstvision**.org/

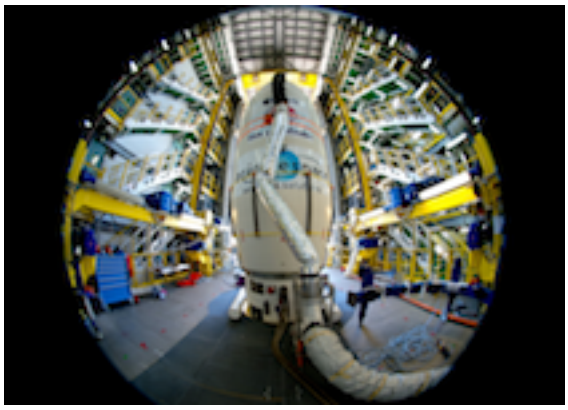
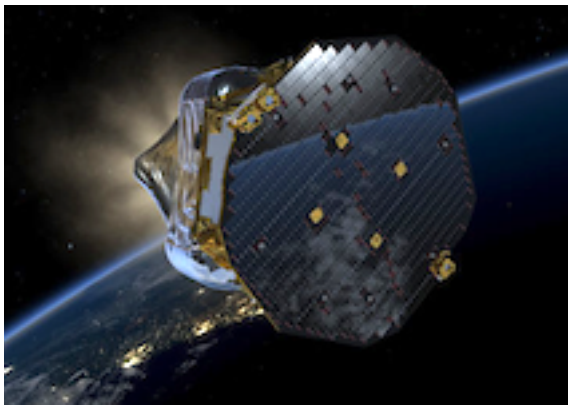
Simulated images of a galaxy 10 billion light-years from Earth, as seen by the Hubble Space Telescope (left) and the proposed High Definition Space Telescope (right), with 25 times the Hubble telescope's resolving power.

Called the High Definition Space Telescope (HDST), the instrument is essentially a supersize Hubble Space Telescope, with 100 times its ability to detect faint starlight.

If it advances beyond the concept phase, it would launch in the 2030s. With a mirror 25 times the size of Hubble's, HDST could delve deep into the universe's past to trace how gasses enriched with the elemental ingredients of life moved in and out of galaxies. ##

ESA's Lisa Pathfinder Ready for Launch

30 November, 2015 - http://m.esa.int/spaceinimages/Images/2015/11/LISA_**Pathfinder_ready_for_launch**
www.space.com/31247-**free-floating-gold-platinum-cubes-at-heart-of-gravity-waves-probe**-video.html
http://m.esa.int/Our_Activities/Space_Science/**LISA_Pathfinder_en_route_to_gravitational_wave_demonstration**

http://www.space.com/31247-free-floating-gold-platinum-cubes-at-heart-of-gravity-waves-probe-video.htmlFinal preparations are under way at Europe's Spaceport in Kourou, French Guiana, for the launch of LISA Pathfinder, ESA's technology demonstrator that will pave the way for detecting gravitational waves from space. Liftoff is planned at 04:15 GMT (05:15 CET) on 2 December.

This image was taken with an ultra-wide angle fisheye lens, the spacecraft hidden from view, encapsulated in the 'upper composite' of its Vega rocket. Only the aerodynamic fairing at the top of the fully assembled launcher is visible, while the lower stages are hidden by the movable access platform. ##

OUR MILKY WAY GALAXY

Our Milky Way Galaxy Has a Mysterious 'Great Dark Lane'

6 November, 2015 - www.space.com/31046-**milky-way-has-great-dark-lane**.html

A similar dust ring in another galaxy

A previously unidentified highway of dust extends across the Milky Way, between the sun and the central bulge of the galaxy, scientists have found. Called the "Great Dark Lane" by the astronomers who announced it, the dusty road twists in front of the bulge of the galaxy. "For the first time, we could map this dust lane at large scales, as our new infrared maps cover the whole central region of the Milky Way.

Stellar Graveyard Reveals Clues About Milky Way's Ancient Birth

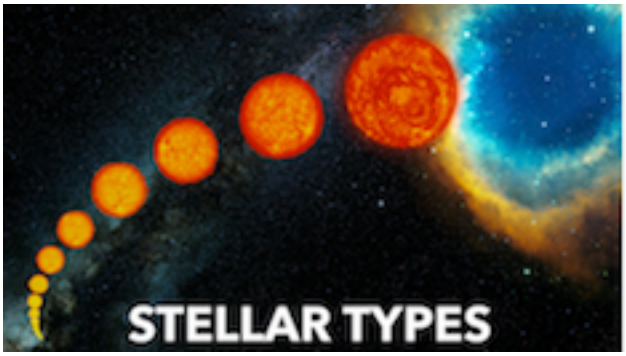
18 November, 2016 - www.space.com/31150-**milky-way-white-dwarfs-hubble-photo**.html

http://www.space.com/21279-**cannibal-white-dwarf-feeds-on-companion-star-video**.html

By studying the motion of stars over nearly a decade in the Hubble SWEEPS Field, shown here, scientists have been able to better understand the early years of the Milky Way. The Hubble Space Telescope has peered far back in time, detecting clues about how the Milky Way galaxy came together, shortly after the universe's birth. Focusing on the Milky Way's dense central bulge, astronomers spotted a population of superdense stellar corpses called white dwarfs white dwarfs that are remnants of stars that formed about 12 billion years ago.

How to tell Star Types apart (infographic)

www.space.com/30885-**telling-star-types-apart-infographic**.html



SEARCH FOR EXO-PLANETS & LIFE

An exoplanet extracted from the bright

2 Oct., 2015 - http://www.sciencemag.org/content/350/6256/52.7.full?utm_campaign=email-sci-twis

Direct imaging of Jupiter-like exoplanets around young stars provides a glimpse into how our solar system formed. The brightness of young stars requires the use of next-generation devices such as the Gemini Planet Imager (GPI). Using the GPI, Macintosh et al. discovered a Jupiter-like planet orbiting a young star, 51 Eridani (see the Perspective by Mawet). The planet, 51 Eri b, has a methane signature and is probably the smallest exoplanet directly imaged. These findings open the door tounder-standing solar system origins and herald the dawn of a new era in next-generation planetary imaging.

20 Years On, Future Bright for Exoplanet Science

15 October, 2015 - www.space.com/30811-**alien-planets-search-20-years-anniversary**.html

www.space.com/30240-**alien-planets-exoplanet-search-methods-infographic**.html

Galaxy's strangest star could be the product of a stellar flyby—or aliens

http://news.sciencemag.org/sifter/2015/10/**galaxy-s-strangest-star-could-be-the-product-of-a-**

stellar-flyby-or-aliens?

14 October, 2015 - Astronomers are struggling to explain bizarre light patterns from a star, 1,500 light years away, that appears old, but is shrouded in debris like a much younger star. The debris could be the remains of comets dragged into the star's orbit by another star that came exceptionally close. Culd be surrounded by the massive technological constructions of an alien race? ##

Has the Kepler Space Telescope Discovered an Alien Megastructure?

15 October, 2015 - www.space.com/30832-**kepler-telescope-alien-megastructure**.html
www.space.com/30849-**bizarre-kepler-signal-alien-intelligence-speculation**.html
https://en.wikipedia.org/wiki/**Kardashev_scale**
www.space.com/30043-**seti-search-for-extraterrestrial-intelligence-infographic**.html

Exoplanets aren't the only thing Kepler can detect — stellar flares, star spots and dusty planetary rings can also pop up. But there's also been speculation that Kepler may have the ability to detect more than natural phenomena.

If they're out there, Kepler may also detect the signature of **artificial structures** orbiting other stars. Imagine an advanced civilization that's well up on the Kardashev scale and has the ability to harness energy directly from its star. This hypothetical alien civilization may want to construct vast megastructures, like supersized solar arrays in orbit around their host star, that could be so big that they blot out a sizable fraction of starlight as they pass in front. ##

Search For Intelligent Aliens Near Bizarre Dimming Star Has Begun

19 October, 215 - www.space.com/30855-**alien-life-search-kepler-megastructure**.html

Astronomers have begun using the Allen Telescope Array (ATA), a system of radio dishes about 300 miles (483 kilometers) northeast of San Francisco, to hunt for signals coming from the vicitnity of KIC 8462852, a star that lies 1,500 light-years from Earth.

KIC 8462852 dimmed oddly and dramatically several times over the past few years. The dimming events were far too substantial to be caused by a planet crossing the star's face, researchers say, and other possible explanations, such as an enormous dust cloud, don't add up, either. ##

What Would an Alien Megastructure Look Like? Sci-Fi Authors Weigh In

27 October, 2015 - www.space.com/30941-**alien-civilization-megastructure-kepler**.html
www.space.com/20155-**hunting-intelligent-aliens-extreme-seti**.html
http://i.space.com/images/i/000/035/994/original/dyson-sphere-151014a-02.jpg?1444849451

'Alien Megastructure' Mystery May Soon Be Solved

28 October, 2015 - www.space.com/30948-**dimming-star-alien-megastructure-mystery**.html

KIC 8462852 is a large star that lies about 1,500 light-years from Earth. The numerous dimming events, , dropping in brightness by up to 22%, observed by the Kepler space telescope between 2009 and 2013, seem too substantial to be caused by an orbiting planet,

These big dips have spurred speculation that the star may be surrounded by some type of alien megastructure — a hypothesis that will be put to the test if and when KIC 8462852 dims again.

The simplest measurements we can take — just looking in different wavelengths of light — should rule out, or suggest, alien megastructures right away. ##

No Sign of Aliens around Strange Dimming Star

6 November, 2015 -www.space.com/31054-**no-alien-megastructure-signal-strange-star**.html

If alien civilizations are broadcasting from around a strangely behaving star, they aren't chatting loud enough for humans to hear them from Earth, new observations show. The star KIC 8462852 garnered popular attention in October, when scientists announced that it showed evidence of

periodically dimming by 20 percent or more, which some people theorized could be caused by the shadow of an alien megastructure.

However, observations of KIC 8462852 by researchers at the SETI (Search for Extraterrestrial Intelligence) Institute in Mountain View, California, have so far picked up no radio signals that could indicate extraterrestrial communications. ##.

Comets May Have Caused 'Alien Megastructure' Star's Strange Dimming

30 November, 2015 - www.space.com/31211-**alien-megastructure-dimming-star-exocomets**.html

A faraway star's mysterous dimming was most likely caused by comets, a new study suggests — though it doesn't rule out the much-ballyhooed possibility of an "alien megastructure" in the system.

Observations by NASA's planet-hunting Kepler space telescope revealed that the star KIC 8462852, which lies about 1,500 light-years from Earth, dipped in brightness dramatically, by up to 22%, in 2011 and 2013.

Such deep brightness dips puzzle astronomers, who have advanced a number of possible explanations, from a gigantic asteroid collision to a cloud of broken-apart comets to an enormous energy-collecting structure built by an advanced alien civilization. ##

Earth Bloomed Early: A Fermi Paradox Solution?

27 October, 2015 - www.space.com/30889-**earth-bloomed-early-fermi-paradox-solution**.html
http://hubblesite.org/newscenter/archive/releases/2015/35/full/

There's a problem; It looks like humanity is the only "intelligent" species in our corner of the universe. **What gives?** According to a new study based on data collected by the Hubble Space Telescope and NASA's Kepler Space Telescope, it might be that Earth (and all life on it) is an early bloomer. By extension, the logical progression from this new study is that we're not hearing from advanced alien civilizations because, in short, the universe hasn't had the time to spawn many more habitable worlds.

Small “dim” stars could still support life

30 October, 2015 - news.sciencemag.org/space/2015/10/**small-dim-stars-could-still-support-life**

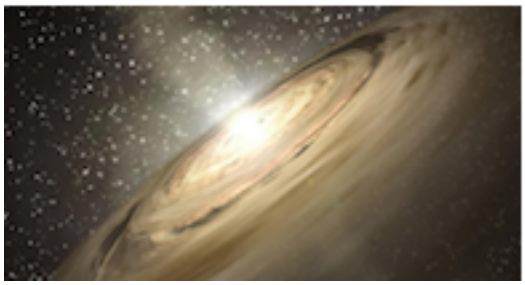
Life may be possible around red dwarfs after all. Researchers had long assumed that the small suns, which make up about three out of every four stars in the Milky Way, were too dim to provide enough light to any photosynthetic organisms on planets that orbited them.

New research based on calculations of exactly how much visible light would be available—such organisms would get enough light to survive, much like plants in Earth’s Arctic Circle subsist on significantly less light than their counterparts at lower latitudes.

This hypothetical alien world would need to orbit pretty close to its red dwarf—about as close as Mercury is to our sun—to get this light, exposing the planet to sterilizing doses of radioactivity. But after a few billion years these red dwarfs would be no less radioactive than our sun. If the researchers are right about both of their contentions, this **increases the probability of finding life on other worlds a thousandfold**, with the **nearest world where life could evolve less than 10 light-years away**. ##

Dust Gaps Around Young Stars Not 'Proof' of Exoplanets

4 November, 2015 - www.space.com/31054-**no-alien-megastructure-signal-strange-star**.html



Dusty disks, like the one shown below circling the star, are the breeding grounds of planets. When visible or near-infrared observations show a gap in a disk like this, it is often interpreted as

evidence for an unseen planet. However, new research shows that a gap could be a sort of cosmic illusion and not the sign of a hidden planet after all. ##

Flying Telescope Catches Glimpse of Alien Planet

4 November, 2015 - www.space.com/31008-**sofia-flying-telescope-finds-exoplanet**.html

For the first time ever, astronomers have used instruments onboard the world's largest airborne observatory to examine a massive planet beyond Earth's solar system.

Although the new observations represent a proof-of-concept run, they revealed that the airplane-based observatory can study exoplanets while combining the advantages of a space-based telescope and the easy access of ground-based instruments. ##

Closest Eaeth-size Alien Planet Found - May be Venus Twin

11-20 November, 2015 - www.space.com/31085-**closest-earth-size-exoplanet-venus-twin**.html
www.space.com/31076-**zombie-star-tears-asteroid-to-shreds-what-remains-animation**.html
www.space.com/31188-**earth-sized-planet-discoverers-share-breakthroughs-in-hangout**.html
www.space.com/31086-**venus-twin-exoplanet-gj-1132b**-explained-infographic.html

One of the dire frustrations of studying planets around other stars is their distance from Earth, which makes it onerous or impossible to get many basic details about them. Exoplanets are doubly frustrating because any light they emit (light that would give hints about what's happening on the surface) is often overwhelmed by the light of the parent star.

But the new planet, called **GJ 1132b**, uncovered by the MEarth-South telescope array on Cerro Tololo in Chile. is the closest transiting, Earth-size, rocky planet ever spotted, orbiting a fairly dim star, and appears to be a rocky world with an atmosphere. While its surface temperature indicates that it may have more in common sith Venus than Earth, it is so perfectly primed for Earth-based studying, that it has beeb hailed as "arguably the most important planet ever found outside the solar system."

GJ 1132b, it crosses the face of a nearby **red dwarf star only 40 light-years away.** These so-called transits — mini-eclipses, really — have allowed researchers to gauge GJ 1132b's **size as just 1.2 times that of Earth**. Other measurements have revealed it boasts **a similar density to Earth**.

Editor: Keep in mind that the only planets we are capable of finding - with any telescope - are those that pass in front of their sun, meaning we are looking at a system edge on - and only 1 in a hundred systems will have that lineup. We have yet to find a planet any other way. ##

To Find Alien Worlds, First Look at Our Sun

18 November, 2015 - www.space.com/31148-**find-alien-worlds-look-at-sun**.html

One well-trusted method of finding an exoplanet is to see how much wobble it induces in its parent star. Right now, the state of the art precision for detecting planets a few dozen light-years away via this method is about one meter per second, which is produced by planets more massive than Earth.

But if something disturbs the surface of the star — say, a sunspot — this can mess with the measurements and produce false positives.

A team of researchers is hoping to get around this by doing a test study on our own sun. If it works out, their project will allow them to detect Venus orbiting the sun using this "radial velocity" technique. This will be a proof of cibcept for finding Earth-size or smaller planets around other ##

Stanford astronomers observe the birth of an alien planet

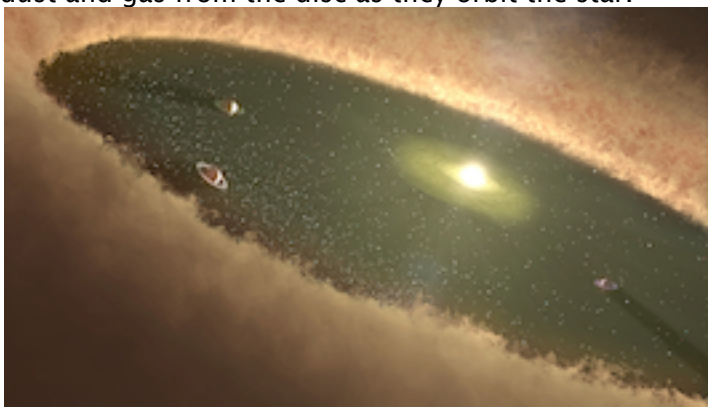
https://astronomynow.com/2015/11/19/**stanford-astronomers-observe-the-birth-of-an-alien-planet/**

www.space.com/31146-**alien-planet-formation-photographed**.html

19 November, 2015 - Since prehistory, humans have speculated about how the planets in our solar system were formed. Today, astronomers announce evidence of an exoplanet being born that could move us one step closer to understanding the process of planet formation around other stars.

The alien planet, called **LkCa 15 b**, orbits a star **450 light-years away** in the Taurus-Auriga Star Forming Region and appears to be on its way to growing into a world similar to Jupiter.

The planet is forming in a transition disc, a doughnut-like ring of dust and rocky debris orbiting its parent star. The central clearings within transition discs are believed to be created by the formation of planets, which sweep up dust and gas from the disc as they orbit the star.



This illustration shows how planets could form in a transition disc around a star similar to LkCa 15. By isolating the hydrogen-alpha light from the vicinity of that star, astronomers were able to identify a planet in the early stages of formation.

New Kepler Mission Cranking Out Exoplanet Finds

2 December, 2015 - www.space.com/31256-**new-kepler-mission-exoplanet-finds**.html

Kepler's SecongLight - How Kepler 2 works

http://i.space.com/images/i/000/051/848/i02/**kepler-k2-mission-infographic.jpg**?1449080650

The Kepler planet-hunting spacecraft is "working really well" despite changing its techniques due to mechanical problems. Under a new mission called "**K2**", Kepler has found 234 planetary candidates in the first year of searching - beyond the expectations of the community, as Kepler cannot point as precisely as it used to due to a reaction wheel (stabilization) problem. Until 2013, Kepler stayed pointed at a spot in the Cygnus constellation, looking for planets passing in front of its stars. That mission appeared to end for good when two of the four reaction wheels on Kepler failed, likely due to age.

Kepler had used three reaction wheels to stabilize its position in space. After the failure of one wheel, in an alternate K2 mission. Kepler now uses the pressure of the Sun to stay stable, but it has to swing its view rom time to time to make sure the sun stays out of its viewfinder.Unexpectedly, the new method is working almost exactly as well for bright stars as Kepler worked before its malfunction, ##

In Alien Solar Systems, Twin Planets Could Share Life

6 December, 2015 - www.space.com/31297-**alien-planets-could-share-life**.html

Alien planets that are close neighbors to each other around the same parent star could help each other support life, creating what scientists are now calling "multihabitable systems."

Past research suggested that billions of exoplanets are potentially habitable in the Milky Way.

Two exoplanets that astronomers recently discovered around the star Kepler-36 are so close together that they could experience a "planetrise" similar to moonrise on Earth. Their sun, Kepler-36, is located about 1,200 light-years from Earth in the constellation Cygnus. If this system was scaled up "to the size of the Earth's orbit, then the two planets would only be 15 million km or 9.3 million mi apart at their closest approach — only 40 times the distance to the Moon. (At best, Mars and Earth are about one-half of an AU apart, or 200 times the distance between Earth and the Moon - 5 times the distance separating the pair around Kepler-36.

This instance raises the possibility of "**multihabitable systems**" with two or more Earth-sized planets orbiting near each other in the habitable zones of their stars. A computer model suggested that climates might be stable on planets in such systems. The seasons and climate on Earth depend on its obliquity, or the 23.5-degree tilt of the Earth's axis relative to its orbit around the Sun — the scientists found that it was unlikely that gravitational interactions between planets on closely neighboring orbits would trigger large changes in the obliquities of the orbits of those worlds. ##

Half of Kepler's Giant Exoplanet Candidates Are False Positives: Study

11 December, 2015 - www.space.com/31320-**kepler-giant-exoplanets-false-positives**.html

A team of astronomers followed up on 129 huge potential exoplanets spotted by Kepler using a ground-based telescope and found that 52% of these objects are actually stars, while another 2% are "failed stars" known as brown dwarfs, without enough mass to support sustained fusion - the essence of being a "star" - in their cores. The space telescope spots alien planets by noticing the tiny brightness dips caused when worlds cross their parent stars' faces, or "transit," from Kepler's perspective.

Kepler Space Telescope Infographics

www.space.com/13828-**alien-planets-kepler-telescope-infographic**.html
www.space.com/17383-**kepler-planet-hunting-nasa-telescope-infographic**.html
www.space.com/24827-**kepler-space-telescope-exoplanet-bonanza-explained-infographic**.html

Planet Construction Sites Are Cleaner Than Predicted

www.space.com/31384-**planet-construction-sites-are-cleaner-than-predicted**-image-+-artist-animation.html - **Image and Artist Animation**

So-called Super-Jupiters apparently clean up after themselves. The Atacama Large Millimeter/submillimeter Array (ALMA) reveals cavities in the disc surrounding 4 stars, caused by two processes: (1) intense winds coming off the young stars and (2) the forming of planets aggregating dust by gravity, as they become more massive. ##

Rocky Planet Found Around Star with Least Metal Yet

25 December, 2015 - www.space.com/31456-**rocky-planet-found-unlikely-star**.html

Astronomers have found a star with an incredibly low concentration of heavy elements that still has a sizable planet around it — the most metal-poor star ever discovered with an orbiting, rocky planet. The planet found circling the unlikely star suggests that other Earths could be more common than once thought. The star, called HD175607, and its Neptune-size planet are about 147 light-years from Earth. The star is a yellowish dwarf, with about 0.74 times the mass of the sun, and it contains fewer heavy elements than any other star of its kind that has rocky planets. ##

INTERSTELLAR TRAVEL

The Tau Zero Foundation - Pioneering Interstellar Spaceflight

https://tauzero.aero - "Beyond the interest of other space groups"

Mission and Methods - "The Tau Zero Foundation is a global volunteer group of scientists, engineers, writers, and entrepreneurs working together to advance the goal of interstellar flight.

Using the dream of interstellar space travel as both a long-range goal and a catalyst for near-term progress, the Foundation supports advancements in science, technology, and education.

The Foundation seeks out and directs support to those who can make credible progress toward the goal of star flight, including leading research pioneers and promising graduate-level students. The

Foundation also strives to engage and educate the public during every step of this journey of discovery. Our motto, "Ad astra incrementis" means "to the stars in ever-increasing steps."

- **Challenges** - How difficult is interstellar flight and why? How far and how fast do you need to go to travel throughout the galaxy? Find out with the **Transgalactic Travel Guide** https://www.tauzero.aero/TG_travel_guide/TransGalacticTravelGuide_FINAL.htm
- **Humanity's Journey** - How does this quest affect humanity today... and ultimately? How does society today speed or impede progress?
- **Destinations** - Where are other habitable planets, and other points of interest?
- **Getting There** - What can we seng, how will we propel it, how long before we learn what it found? ##

OUR UNIVERSE

Peering into the Past: Our Universe as a Time Machine

8 October, 2015 - www.space.com/30787-**our-universe-is-a-time-machine**.html
www.space.com/30240-**alien-planets-exoplanet-search-methods-infographic**.htm

Although time machines remain a sci-fi fantasy, the vast distances of the universe make it possible to peer back in time and see things as they appeared billions of years ago. Scientists make use of the "universal speed limit" of light to observe the early universe with telescopes such as the Hubble.

Mysterious Dark Matter May Not Always Have Been Dark

4 November, 2015 - www.space.com/31013-**stealth-dark-matter-universe-missing-mass**.html

The nature of dark matter is currently one of the greatest mysteries in science. The invisible substance — detectable via its Path finfluence on "normal" matter — is thought to make up five-sixths of all matter in the universe. Lawrence Livermore scientists have devised a new model of dark matter. It identifies it as naturally "stealthy" today, but would have been easy to see via interactions with ordinary matter in the extremely high-temperature plasma conditions that pervaded the early universe. ##

Ancient Cosmic Crash Site Hints At How Galaxies Formed | Video

www.space.com/31313-**ancient-cosmic-crash-site-hints-at-how-galaxies-formed-video**.html
360 million years ago a galactic smash-up led to the creation of the ringed elliptical galaxy NGC 5291 and many satellite dwarfs. One such, NGC 5291N, may be a throwback to the Universe's early years.

STARGAZING EXCURSIONS

Star Ships: New Sciences Cruises Offer Pristine Cosmic Views

29 October, 2015 - www.space.com/30953-**science-cruises-offer-pristine-cosmic-views**.html

Princess Cruises and Discovery Channel have paired up to make science-themed "Discovery at Sea" cruises that include activities like stargazing from locations on the open ocean, far from city lights. ##

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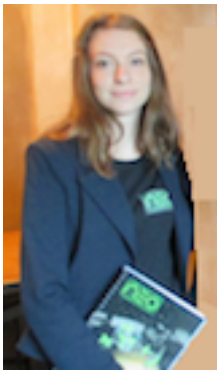

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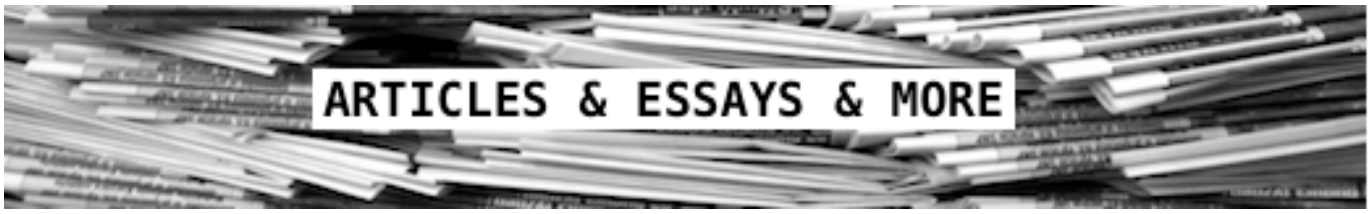


"Are we alone?" is a question with many answers, depending on __

By Peter Kokh

From time immemorial, people everywhere have looked up at the heavens and wondered if out there somewhere there were other worlds, some like ours, some very different, with peoples like us, or quite different physically and culturally. Many cultures have traditions of having been visited by superior creatures from the skies. What nature produces once, it must be able to do again, many times.

Yet many religions insist that we are alone, the only people the "Lord" has chosen to create. Why the prophets of such religions think that they are glorifying the Maker by limiting Him to just one world, when if infinite, He should be capable of creating an infinite number of worlds, is beyond me.

It does not seem possible then that we are alone. In the articles below we take a look at a number of interrelated topics and try to throw some light on each of them.

We do not wish to offend anyone. Rather we hope that after reading these articles, you are even more filled with awe, wonder, and a desire to share life with others, elsewhere and wlsewhen.

We live in a time when we are able to explore the Solar System where we were born, and when we are beginng to find evidence of other such systems, countless numbers of them.

Isn't it wonderful!! PK

Understanding Light-Time ("space-time" as the "there-then")

By Peter Kokh - Reprinted from MMM #47, August 1991

In the ordinary theater of human affairs, it is quite practical to pretend that an absolute "now" of simultaneity exists, that distance is distance and time time. As we move out from the surface of our home/womb world, however, we find ourselves increasingly dealing with distances that can only be traversed - even in theory - at an every less commensurate rate. Distance Away becomes the equivalent of "Time Ago" or "Time not yet" To handle such "separations" or dislocations in "space-time" the term "light-year" and its derivatives have been invented.

It is 1.4 light seconds one way Earth to Moon;

500 light seconds (8 minutes 20 seconds) Sun to Earth.

3-14 light minutes one way Earth to Mars;

Moving out, Neptune is 1/6th of a light day "away/ago" and the round trip span across Neptune's orbit is a full light day "away/ago."

Only comets are known to inhabit reaches a light week to light months in the "there-then", and the nearest known neighboring star or star system, Alpha A-B binary system and Proxima Centauri, is so removed that it is all of **4 plus years* out of synch with solar time**. (The average distance/ dissynchronicity between closest neighbors in our part of the galaxy is 6.3 light years, so we are lucky! Barnard's Star also lies within that figure.)

Imagine ever more remote ranges of space as a series of ONION SKIN LAYERS. Considering the minimum time needed for round-trip travel/intercourse or for exchange of communication intercourse, we might designate these "onion skin layers" as follows:

CONTEMPORARY SPACE in the sense of Co-Generational, i.e. sharing the same generation, describes all space out to 10-13 light years. Within that range, round trip intercourse/exchange can take place within 20-25 years. The ambiguity of the "now" increases from "the instant" to "the generation" as one approaches that limit. Within "space" as so defined, lie such familiar names as **Alpha Centauri**, **Sirius**, **Epsilon Eridani**, **Procyon**, and at the extreme, **Tau Ceti**.

CONSECULAR SPACE, i.e. wherein the ambiguity of "the now" degrades to the **sharing of the same century**, lie star systems out to 50 light years. Familiar examples are **Altair**, **Fomalhaut**, **Vega**, **Capella**, and **Arcturus**.

CO-MILLENNIAL SPACE, i.e. wherein **exchanges of information can be completed within a thousand years**, include stars out to 500 LY. Stars and worlds within this range "share" our universe if we extend the unstated time element of "our" to include 1491-2491 A.D.

SUB-EPOCHAL SPACE includes **the rest of our Milky Way galaxy and its satellite galaxies like the Magellanic Clouds**, out to 500,000 LY. We share **only the same sub-million-year relevance**.

GEO-GALACTIC-EPOCH-SHARING SPACE extends out to 5 million LY, **allowing affinity and connection within the same 10 million year time frame** between our galaxy and the **Great Galaxy in Andromeda, M31**.

GEO-GALACTIC- PERIOD-SHARING galaxies lie **within 50 million LY from one another**.

GEO-GALACTIC- EON-SHARING galaxies **within 500 million years from one another**, can claim no more than sharing the same billion years.

Beyond that, **BIG-BANG SHARING galaxies** and what worlds they may harbor more distant = dissynchronous from one another than 500 million LY, share no more than all of time itself from the common beginning on. [So what about "Parsecs"? A parsec (about 3.258 LY) is a unit of dislocation taken from parallax measurements that seems more sophisticated because it has no explicit reference to Earth-specific measures like the year (it does have an implicit reference to the arbitrary Earth-standard division of the circle into 360°). What astronomers with airs gain by use of the term is more than lost by the dropping any explicit reference to time.]

All of the above by way of a "reality check" for the article that follows. <<MMM >>

EMPIRE: One Fortunate Result of the Speed-of-Light Barrier is that Multi-Star "Empires" cannot exist.

By Peter Kokh - Reprinted from MMM #47, August 1991

"GIVENS" 1 Neither matter nor information can exceed the speed of light.

2 'Usable' shortcuts through the fabric of space-time will never be found.

You may be an incurable romantic dreamer, unwilling to accept these statements as facts-of-life with a "big F". Self-delusion is your privilege. This discussion is for the rest of us!

* Rule of Thumb: A 6-months-round-trip time limit on information flow, sets a proven distance limit for sustained effective exercise of authority in Europe's control of settlement of the Americas.
* This figure doesn't come out of a hat, but is based on historical experience and precedent on Earth, and it is our belief that it will continue to hold valid as we move out beyond circum-solar space.
* Beyond that range, simple logistics makes it urgently practical to be totally self-reliant rather than dependent in even the slightest way on the mother civilization, no matter how advanced the parent world, no matter how crude and primitive the settlement or colony or outpost.

In effect, that would set a limit of 3 light months out MAX! to any form of centralized authority. While this is 500-some times further out than Neptune & Triton or Pluto-Charon, it is only 1/17th the way to the nearest star system. That means that Earth=Terra=Tellus could not even establish an effective empire over the Sun's own Oort comet cloud.

Once we send out settlers (likelier in the low-maintenance travel-ready form of eggs and sperm i.e. genetic materials) to even the nearest stars, they and their progeny will be very much on their own. If it takes nearly nine years (if not much, much longer) for Earth HQ to respond to a dire outpost emergency with so much as bare advice, why bother asking, or listening for that matter? The immediate and permanent need for total self-reliance will assert itself rather quickly as we prepare to leave the immediate parochial vicinity of the home system. As a corollary, it would be foolhardy to depart, "forsaking" circumsolar civilization, with anything less than enough personnel and gene pool, seeds or seed bank, tools and information to function as if the rest of humanity no longer existed - or cared (this latter a not too unlikely scenario).

While many people appreciate the vastness of space in some inadequate way, very few have any sense of the equally vast, equally distancing effect of time dissynchronization with distance. The further removed in interstellar space-time, the less relevancy to one another can any two oases of intelligent resource-using life share or maintain. [See the previous article.]

* **Extra-solar settlement will be only weakly self-repeating.** It'll take each newly settled system perhaps one to several centuries to fully mature as a center of civilization in its own right with enough divertible, discretionary resources and energy to support interstellar repeater forays on its own.

* **Mature off -shoot pockets of Humanity and Gaia-Humanity** (where Earth-native or Earth-derived vegetation and animal life form the imported cradle for settlement in the absence of given suitable indigenous varieties) will effect one another in a totally multi-centric fashion, each being the center of out-spreading ripples of information: history, culture, science, art.

* **Living languages are ever being regenerated by their speakers** and drift too rapidly to serve as a means of communications between Alma Mater Earth and Alumnae worlds, light-generations or lightcenturies apart, the likely spacing of suitable settlement worlds. Either some frozen dead language, such as Latin, or some totally new construct especially tailored for efficient and unambiguous radiotransmission - in either case with absolutely pre-fixed vocabularies would work best. Such an immutable Lingua Franca must be agreed upon before the first star-bound settler ship leaves our Sol's system, and be treated as sacred, in effect "revealed," set forevermore. New terms must be transmitted as cumbersome paraphrases of the originally agreed upon vocabulary. Otherwise communication will break down irretrievably, progressively becoming mutual gibberish.

* **All this means that <u>there can be no interstellar "empires"</u>** in the sense of structured constituencies in which authority spreads out from a center - other than the 'authority' of the common petrified language. The Mother System might be tempted to reserve to itself a sole and privileged right to add new terms to the unifying tongue, but such terms would have to be transmitted along with periphrastic definitions for as long as needed to reach the furthest offspring communities.

Being "Keeper of the Language", however, is as far as the the mother world's authority could possibly extend. Even this quasi-priestly prerogative could be a bad precedent, one inviting challenge. Those alumni pockets furthest from the home-worlds would have the least reason for confidence that the parent civilization "yet" survives, and would be the most tempted to start rival papacies, thus beginning a slide into a communications anarchy from which there might be no recovery. Alas, if language is to unify, it must be a standard equally respected by all, mother worlds included.

* **The good side of these rather dim prospects for "interstellar and galactic empires" is** that, to the extent even benevolent, i.e. paternalistic "empires" are necessarily wicked, we won't have to worry about fighting them, about throwing off the yoke of some "Imperial Authority". There can be no "Wicked Emperor of the Zenith". Alas, such a wealth of dramatic and exiting "space opera" is forever fantasy - however much fun it may be to read!

* **[Gaia-Humanity may yet spread as "Reaches" or "Diaspora"** [discrete autonomous scatterings] rather than as true structured Empires. Each daughter system will be a unique "alternate continuation of Earth history" and of the mother civilization and heritage - each with its own flavor unique blend of unrepeated possibilities. Leaving the vicinity of old Sol will establish an Epoch of Divergence.

For a weak parallel, consider the many English-speaking nations of Earth, all with a very definite feeling of kinship, yet each fully independent and self-guiding. Out among the stars, only the feeblest analog of such a commonwealth could be maintained. Yet the affinity of common origins and predivergence cultural wealth will be cultivated as a treasured heritage.

* It follows from all this that in any contacts with the "reaches" or "diaspora" of other intelligent resource-transforming races, neither "side" will be able to act, or react, as a unit in any fashion at all. Rather it must be pre-agreed that each settled system is an equally responsible representative of the entire "family of human [or other] civilizations".

Nor would the "diasporas" of various 'neighboring' species necessarily compete for the same cubic or square real estate. One might prefer G-type suns with planets already sporting indigenous flora and fauna, like Pleistocene Earth. Another might prefer raw pre-Cambrian worlds around hotter yellow-white F-type suns, or seek out endowed but sterile worlds to transform to suit from scratch. Another may prefer systems in which there is ample debris to use as building blocks for space colonies, but without "distracting" planets. Another may prefer the ice-firmamented oceanic Europa-like moons of gas giant planets around feeble M-type red dwarfs or even around isolated brown dwarf substars, etc.

etc. Thus it is possible that one or more separately originating diaspora could peaceably interpenetrate the same space-time and be only vaguely aware of one another's existence. But more likely, different families of civilizations are not likely to be neighbors in both space and time at once.

Social, political, economic, and ethnic injustices may persist in all inhabited solar systems anywhere. But whatever the evils lurking within each, relations between systems at interstellar levels are likely to be limited to an "angelic" plane. The virtual quarantine imposed by the vastness of space-time allows little opportunity for anything else. Contact between independently arisen civilizations will seldom go beyond the most tenuous awareness of the other's existence, with the skimpiest of (rather worthless) surmises about mutual similarities and differences.

* **The one exciting exception to all this is the possibility of "Twin Civilizations"** in well-separated binary G-star systems (say a few light weeks apart) such as **Zeta Reticuli.**
https://en.wikipedia.org/wiki/Zeta_Reticuli – (follow link at bottom to Zeta Reticuli in Science Fiction)

> "A wide binary star system in the southern consstellation of Reticulum. From the southern hemisphere the pair can be seen as a naked ey e doube stare in very dark skies. Based upon parallax measurements, this system is located at a distance of about 39 light years (12 parsecs) from the Earth. Zeta² Reticuli is orbited by a circumstellar debris disk. Both stars are solar analogs."

* However unlikely in any given case, separate races could arise around each sun in such systems at least somewhere in this vast multibillion-galaxied Universe. But that they would be near-contemporary to one another, even within a hundred million years or so, is demanding a lot of parallel evolution or compensating divergences.
* That possibility aside, even **a solitary race spreading to a favorable and fertile planet around the other luminary of such a wide twin sun system, would probably be greatly advantaged by having such a sheltered interstellar springboard opportunity, and find itself the more highly motivated to become a truly Starfaring species.**

We of Earth are given **a great 1-2 boost first by an uncommonly large natural satellite, the Moon**, and second by a resource-rich Asteroid Belt – assets that not all otherwise equivalent civilizations may enjoy. If we fail to become truly System-faring despite these handy stepping stones, it would reflect poorly on our species' character.

We have no such handy "training ground" for extrasolar adventures, discounting the Oort Cloud of comets. In this regard, it is statistically more than likely that some few other civilizations will have a natural edge on us.

In other words, even such gossamer, ghostlike interstellar networks as might arise rarely here and there throughout the Universe, are unlikely ever to count among their number one spreading out from Earth. If we beat those odds, it will certainly be to our credit. <<<MMM>>>

Are we alone, in our Milky Way Galaxy? at least at this time?

By Peter Kokh

We have been a broadcasting civilization for about a century, peanuts. The chance that there would be another "contemporary" civilization nearby is also peanuts. Space is huge, huge, huge, huge,

Time is long, very very very very long. Civilizations may have come and gone "nearby." Civilizations broadcasting "now (on our receiving end) are less likely to be nearby than far away. Do check out the first article in this issue, in case you passed it by.

The further away a "current" civilization is from us, the doubly longer would be the time to receive a response, and the less likely that civilization is likely to still thriving when the response arrives.

Practical Tactics

We need to be looking for worlds like ours, big enough but not too big, with active plate tectonics so the surface is a mix of ocean and continents, the poles inclined to its ecliptic, but not too inclined, old enough to go through the many stages of the deveopment of life - it has taken 4.5 million years for Earth to "flower" - give rise to an intelligent species. Is this typical? Unusually long? Unusually short? How long has our civilization been a "broadcasting and listening" one?

The Megapolicene Era (a new term for newly identified geological era)

The way our civilization is proceding, we will be short-lived. Taking care of our environment comes way down the list of priorities of those who run our economies. Earth is now entering the Megapolicene era, **the era when megacities "move" more rock and soil per period of time than do natural geological processes.** Humankind has become a geological force!

Unless those interested only in "profits NOW" correct their extreme nearsightedness - and the outlook for that does not look good - our time as a broadcasting species may prove quite short.

Hopefully, in time, a future generation will pick up the pieces, rebuild the economy on less myopic principles, and remain a broadcasting one.

What kind of worlds around what kind of Suns?

Currently, the astronomers out there looking for other "Earth-like" worlds are taking the term too loosely - a "rocky" planet "roughly" in the size and mass bracket as Earth. Hey, it takes a lot more than size and location to make a planet "Earthlike!." Readers who followed the Star Trek TV Series, will be familiar with the term **"M-Class Planet."** Here is my definition in the MMM Glossary - http://moonsociety.org/publications/m3glossary.html#hydro_tectonic

> **Hydrotectonic Worlds** - "Earth-like planet", "M-Class Planet" - We've all heard these phrases but no one seems to have tried to get at the essence of what they mean. "Hydrotectonic" is our definition: active tectonic processes in the presence of water, i.e. continents and oceans. Mars does not even come close. Any tectonic activities on Mars ground to a halt long ago, probably due to insufficient water and too swift an internal cooling.

In other words, **"rocky planet give or take half the mass to double the mass of Earth" does not cut it as "Earthlike"** because it sells Earth's special character short, very short.

What kind of Sun could a truly "Earth-Like" (i.e. "M-Class") plamet host a spacefaring civilization?

Suns significantly more massive suns and thus hotter than ours - type F and beyond - do not live long enough to have a properly located and sized planet evolve advanced mammals, much less intelligent ones. "F-Class" suns may have planets where life has begun, but will not last long enough to see life reach the stage it has on Earth. Planets around F-Class Suns, are thus ripe for coloniization.

Suns significantly cooler and less massive than ours - the so called Red Dwarts - tend to be unruly beasts giving off wave after wave of life-squelching radiation. An otherwise "Earth-like" planet would tend to be locked in its rotation, one side always facing its sun, subjected to wave after wave of radiation outburrsts, one side always facing away, frozen. Scenarios have been put forth in which a few such worlds might still develop life - but advanced life? Give me a break!

The planet hunters have deemed that planets up to three times Earth's in mass, could still be "Earth-Like" - We are quite skeptical.

Another Kind of Life Bearing Planet: "Europids"

Most readers wiill be familiar with scientists' keen interest in Europa and other moons (and possibly planets in other systems) that have an ice crust covering a substantial ocean below, kept liquid by the host planet's (Jupiter's) gravitational flux as the moon, in an elliptical orbit, gets a bit closer then a bit farther from its planet in each orbit. Could there be life in that ocean? If so, Europids, not other Earths, could be by far the most numerous class of life-bearing worlds in the universe. And we will find

them around all types of stars, including "Brown Dwarfs" not quite massive enough to trigger fusion in thier cores and become true stars.

That said, there would seem to be no "route to intelligence" in these oceans under their icy "firmaments."

The Search to Date

The Kepler Space Telescope, looking at a very small, presumably typical, area of the sky, has yet to find "Earth's Twin." So if other Earth's, "M-Class" ones, are only one in ten thousand, **there must still be 30 million ones in our Milky Way Galazy alone.** And if we weed out those "too young" or "too old" we might still have thousands of other truly Earthlike planets in our galaxy at the stage of evolution that Earth enjoys.

Their distances from us? Anywhere from a "few" light years to 200,000 light years away.

If we are looking for another world hosting a civilization at our stage, and nearby, we are asking a lot.And maybe that Is all for the better. We will sooner or later, find worlds with clear signs of thriving life. That will be an achievement. But finding a world at our stage (we have been "broaccasting" for only a century or so) nearby, are astronomical. Here and there in the galaxy, we may find neighboring contemporary civilizations. The odds are low. But what then?

Returning to the Star Trek Television series: Fans of the series will be familiar with **the "Prime Directive" principle of not etablishing contact with civilizations at a lower stage.** Why? Because our showing up on their world or in their media would interfere with their natural cultural evolution. No one can argue with that, and a civilization which did interfere with the natural development of one at a lower stage.

The more distant another Civilization, the less possible any "Conversation."

All of these considerations suggest that "establishing 2-way contact" with another civilization will be something that happens exceedingly rarely. Our chances of winning such a lottery, are not good.

But that should not interfere with our expectation that here and there and now and then there are other civilizations at our stage or higher throughout the Galaxy and throughout Time.

Multiply that by the number of other Galaxies in our universe.

The Milky Way may host millions of civilizations, throughout its reaches, throughout its lifetime.

This becomes a matter of "intelligent faith" - and we should be surprised if ever we "make contact" or pick up a message that has not been garbled by static and other interference as it passes through thousands of light years of time-distance.

And if a message is more than "Hi, we are doing well and are blessed, and we hope you are too. Bye now!" - then we should be worried.

Messages? Maybe, Conversation? Forget about it.

The Speed of Light - science fiction aside - is an absolutel. "Tunnels" through space time? Bah Humbug! It would be an extremely lucky throw of the dice, if we found a contemporary civilization within say 50 light years, enablign a limited exchange of information over a 100 year (round trip) period.

Physical Evidence? Implied Messages?

Recently, there has been some speculation that we may have found "signs" of an advanced civilization that has constructed a network of solar power systems surrounding its home star. We should soon know whether or not this "tell tale evidence" is for real or not. But if so, the only "message" we could get from it is "Hey, you can do this too! Good luck!"

Some other suggestions have been put forth about the detectability of physical energy-harvesting systems an advanced race has errected. The betting odds are that we will find some natural explanation for what we are seeing, or think we are seeing. But even if it is for real, the only "message" will be, **"Hey, you can do this too, if you don't trash your home planet first!"**

Both the enormity of space, even within our own Galaxy - a speck of dust in the universe at large - and the enormity of time, billions of years - suggest that if ever two civilizations make contact, it will be exceedingly rare, and very limited. "Hi There, we're trying to make civilization work here, and expect that you are doing the same."

The Upshot – Yes there are other civilizations out there, probably milllions if not billions in our own galaxy throughout its reaches and throughout its lifespan, and likewise in billions of other galaxies in our universe – not to forget other universes, each in their own space and time.

All we can do is be humbled by all this, try our best to get our own Megapolicene civilization from crashing in on itself through economic greed and environmental indifference.

Are We Alone? Not by a long shot?

Some people have a dogmatic or emotional need to believe we are alone and misweigh or misinterpret every shred of evidence accordingly. But "they," our counterparts, must be everywhere -- granted too far apart in both space and time to be contemporary neighbors, **though all averages include exceptions**.

But it is enough to know they are there, that however different we may be physiologically or culturally, we all share the same creative condition. We are born, we struggle to make sense of it all, we die. I look up there and say "Hi all of you!" knowing that in all corners of the universe others are looking up into their star-filled skies, realizing this very commonality as well, and saying "hi" in return.

Who needs words? Who needs messages? Who needs proof?

Meanwhile we all give glory to the wondrous creative forces that have brought us into being and nourished us to the point where we are aware of one another even if only in such a mystical way.

Everywhere, life must be hard, full of hardships and tribulations, joys and suffering, yet eminently worth the struggle. And are we not all, wherever and whoever we are, made of stardust? Stardust from brighter stars that have lived fast and hot and then strewn their fusion dust into the void to become the stuff of new stars, planets and plants and creatures?

"OF STAR DUST THOU ART

AND TO THE STARS THOU SHALT RETURN." PK

"Alien" [Source?] superimposed on field of stars by editor.
"May your world and civilization live long and prosper!"

Travel faster than the Speed of Light? - No way! - But .....

By Peter Kokh

Let me start by saying that we "can" travel "at" the speed of light, in the sense that **we are getting better and better at extracting unsuspected information from the light that comes our way from distant stars.** That is quite clear from all we are learning, well beyond first analysis, more and more about the stars and star systems we have been looking at. It is like getting to know a person better and better as time goes on.

This is becoming quite clear from ever-continuing "information-digging" into the starlight coming our way from the stars being investigated via the Kepler Space Telescope. We can hope that the working lifetime of this space telescope can be extended indefinitely, or at least "as long as feasible" - well beyond the original expectations.

Worm Holes anybody?

- Help yourself, not for me! And they are likely to be one-way only.

One-way "Arks?"

If these are populated with generartion after generation of humans, upon arrival at a suitable "farmable" world, the generation of "pioneers" arriving, will have no feel for living on a real much vaster, open-sky world and may be most reluctant to debark from their self-limited "worldcule" of generations.

Seed and Gene Ark Ships

On the other hand, an ark of stored genetic material of persons of many talents, operated by machines and robots through a journey of indefinite length, might work. Upon approaching (20-30 years away) a suitable, colonizable worldl, one "uninhabited" by intelligent beings, human eggs could be fertilized - picking male-female gene pairs that will provide the kind of pioneers that will have a chance on the new world ahead - with these fertilized eggs incubated till birth, then raised and educated by nanny robots, so that on arrival, a freah adult generation with perfectly matched talents can debark and begin settlement and taming of a new world, populated by animals of various kinds, with farmable areas to plant with seeds from Earth to complement any edible native plants.

Thus our Terrestrial Civilization can give birth to offspring on worlds far far away, the distance and time being irrelevant. The culture and knowledge of the home planet will be available as reference material.

But even the "bad stuff" from Earth can be educational, lest this brave new world fall into any of the pits that we have.

Could Earth have been so seeded?

All the evidence is that humans are indigenous, evolved from native stock at every point.

Would such settlement derail natural evolution of "people" on such planets?

These Arks should be programmed to pass over worlds that are on their own way to someday evolve indigenous intelligent beings and civilizationz.

One way to be sure that we are not derailing an evolutionary sequence that could evolve its own intelligent populations, is to target F spectrum Suns ("Yellow Whites") that are not likely to survive long enough to give birth to native intelligent beings.

F spectrum stars live a couple of billion years at best - it has taken Earth four and a half billion years to evolve intelligent beings - us. The shorter life span of F-spectrum stars thus makes any otherwise suitable and fertile planet suitable for colonization without aborting any native sentient evolution.

[from https://en.wikipedia.org/wiki/F-type_main-sequence_star]

Some of the nearest F-type stars known to have planets include Tau Boötis, HD 10647, HD 33564, HD 142, and HD 60532.] [Procyon A is a "late stage" F star]

The upshot of this scenario is that we just may stumble on **advanced civilizations on planets around F-spectrum stars**, planets not old enough to have given birth to life of its own. If we do, we will know that at least one civilization has succeeded in replicating itself among the stars.

[**Read the whole article "Welcome Matt Worlds"** (originally in MMM #45) reprinted in the **Starbound Theme issue** http://www.moonsociety.org/publications/mmm_themes/mmmt_Starbound.pdf]

Could Earth have been visited by people from other worlds?

If so, and if the visitors took pains not to be noticed and not to interfere with the natural cutural evolution of native humans. Anything more than that would go against "**The Prime Directive**" not to interfere with evolving cultures, a rule that should suggest itself to spaefaring peoples anywhere/when.

The legends we have in various Earth cultures of visitors from the skies, if ever found to be true, would suggest that the visitors saw some need to interfere with a culture "on a wrong track." We can only speculatea about that. It does make great science fiction, and does sell books. No doubt about that.

Nature never does anything just once.

There must be other peoples, who evolved and struggled as we do, elsewhere and elsewhen – throughout most galaxies and the universe at large. There has to come a point in all cultures that people realize this. Without having to know "where" or "when" or "how" we can look up at the stars and say

> "Hi, you our there. We share your chalenges, your struggles, your setbacks, your achievements. We too live and strive and struggle, sometimes succeeding, sometimes failing. Isn't it wonderful. As different as we may be physiologically, in our appearance, our histories, our cultures, we share the wonders of being alive, of having the chance to strive for better futures. We share this universe. Isn't it wonderful! ?"

So why should we have a need to "discoveer" other races of beings, to find their leavings, even to meet them? We know that we all share the same "creatural conditions and challenges" and are driven by the same mysitcal forces within.

To all you peoples anywhere/anywhen, we say, **"Live long and prosper."** PK

ROCKETS – Finally like we always imagined: fully reusable: One stage only, taking off & landing "on their tails"

By Peter Kokh




Thank you Jeff Bezos & Elon Musk!

It was Wernher von Braun who got us off track: for him, only the (explosive) payload was important.

See news items above, pages above

What's Gong on with the International Lunar Decade?

By David A. Dunlop, Chair NSS International Committee

A friend wrote to me recently to inquire about the International Lunar Decade Campaign that I have been working on as Chair of the NSS International Committee. I wrote back to him describing some of the history of this initiative from my perspective which I have included below. I have links to related publication which provide more rich detail.

---- I ----

I mentioned that I was working with Russell Cox and Pamela Clark, (then at Goddard) on the idea of promoting an international campaign to further explore the Moon based on the 60th Anniversary of the International Geophysical Year of 1957-58. Russell Cox had suggested this during the LEAG 2012 Meeting at Goddard. During 2013 and 2014 a number of presentation were made about this including at SSERVI, LPI-SC, ISDCs, Lunar Cube Workshops, etc.

http://www.hou.usra.edu/meetings/leag2013/pdf/7016.pdf

---- II ----

November of 2014 there was a Next Giant LEAP Conference in Hawaii, organized by Jim Crisafulli of the Office of Aerospace Development, Hawaii Dept of Business, Economic Development, and Transportation, and a Declaration in Support of an International Lunar Decade was made at that Conference. https://ildwg.wordpress.com/the-international-lunar-decade-declaration/

In attendence were not only NSS officers, but NASA employees, and ESA's Dr. Bernard Foing. The Title **International Lunar Decade** was suggested by Vid Beldavs, a professor at the Photonika Institute at the University of Latvia. That is a much better simpler Title (than International Lunar Geophysical Campaign for example which hitckhikes on the IGY connection and on the few who even know that history) in communicating with the public.

---- III ----

In the aftermath of the Next Giant LEAP conference an International Lunar Decade- Working Group was formed to promote this idea including representatives of NSS (including me as working Secretary), the Space Portal at NASA AMES (Dan Rasky and Bruce Pittman), Jim Nall at NASA Marshall, Russell Cox, Bernard Foing, Vid Beldavs, Gary Barnhard, of XISP and Space Development Foundation and being Chaired by Jim Crisafulli. A number of 2015 presentations have been made at:

1 European Geophysical Union inApril,

2 European Lunar Symposium in May,

3 Lunar CubeWorkshops in April in Florida and October in San Jose,

5 IAC in Jerusalem.

6 At the LEAG Meeting last October in Columbia, Maryland. Jim, Bernard, Vid and I submitted an abstract (http://www.hou.usra.edu/meetings/leag2015/pdf/2055.pdf) and made the presentation. Kim Holder from the NSS Moon wards chapter and I also had a poster presentation (http://moonwards.com/img/ILD-CGER-website.png). I asked LEAG for an ILD endorsement and they asked in response for an ILD White Paper).

7 A Return To The Moon Conference-International Lunar Decade Workshop was organized at the ISDC in Toronto. NSS also made its own Declaration of support for an ILD at the ISDC NSS

(ILD Declaration: http://www.nss.org/news/LunarDeclaration.pdf)

I wrote a couple of articles in Ad Astra Magazine.

http://www.nss.org/adastra/volume27/v27n2.html

http://www.nss.org/news/releases/NSS_Release_20150601_lunardeclaration.html

I also received an invitation to make a presentation about the ILD at the Science and Technology sub-Committee of COPUOS in February 2016 in Vienna by the then incoming Chair of COPUOS which I accepted.

8 Today there is a meeting at ESTEC in Holland organized by Bernard Foing, the Moon 2020-2030 Conference where the ILD Campaign. attached is the ILD Handout for that meeting which we recently developed.

We will continue to press forward in 2016 in many of these same venues and others.

---- IV ----

The Global Exploration Roadmap (GER) was developed in 2013 by 12 of the14 members of the International Space Exploration Coordination Group https://www.nasa.gov/sites/default/files/files/GER-2013_Small.pdf(China and Australia did not sign-off on this document). Kim Holder and I developed an Evolved International Lunar Decade Global Exploration Roadmap to capture many of the trends and activities which were not reflected in "the official GER." which is of course a politically correct document which papers over the huge difference in priorities between the US-NASA and the other major space faring powers that want to return to the Moon as their first priority.

---- V ----

Interestingly in October NASA Published its " Journey To Mars" document laying out its strategy for exploring Mars (https://www.nasa.gov/content/nasas-journey-to-mars)

Of course "hidden" in plain sight is a huge cislunar infrastructure development program (which "carefully" does not include NASA's participation the lunar surface) but which does involve

1 both International and Commercial partners who are acknowledged as interested in returning to the lunar surface,

2 Navigation and Communications infrastructures in cislunar space

3 An Earth-Moon Lagrange station

---- VI ----

In July NexGen LLC published its Evolvable Lunar Architecture study which online a cost feasible within NASA's Projected steady state purchasing power budget which has caused some shock waves at NASA HQ (http://www.nss.org/docs/EvolvableLunarArchitecture.pdf.) Also MIT published a Multi-Commodities Network Flow Model for Space Exploration Logistics which similarly showed great cost reductions relative the Mars Design Reference Architecture 5 (http://strategic.mit.edu/JSR_Final_Manuscript_Ishimatsu.pdf).

---- VII ----

On the one hand the "Journey To Mars" is a reinforcement of NASA's (Obama White House Mars First Agenda).

Bill Gerstenmaier's announcement a couple of days ago of the NASA's move to abandon the ISS by 2024 (http://www.sciencealert.com/leading-nasa-official-says-the-us-is-abandoning-its-post-on-the-iss-for-a-very-good-reason) shows:

1 the budget sequester constraints driving NASA's projected exploration program.

2 the political power of the Mars program advocates to continue to own and control the limited resources for Mars missions

3 the political power of Senator Shelby now chair of the Senate Appropriates Committee to feed limited forward projected resources into the SLS-Orion program including **a once a year launch cadence.**

4 the remaining strategic divide between NASA and its "international partners" as expressed by the 2013 GER.

---- VIII ----

On the other the impact o the Evolvable Lunar Architecture Report and the MIT study reinforce the strategic importance of developing lunar ISRU for fuel production and an architecture for fuel distribution via depots in LEO and at E-M Lagrange. This makes the case for Commercial Investment in the area even more important and this also supports the trend toward reusable rocket launchers by Space-X Falcon 9R and Falcon Heavy, Blue Origen's New Shepherd, ULA's Venture fly--back first stage engines, and ESA's Ariane 6 fly-back first stage engines.

---- IX ----

I think that many in NASA are waiting for the next Presidential Administration to come up with another " new Presidential NASA legacy and forward strategic policy" that is not so publicly anti-lunar and that is more strategically aligned with international priorities but also innovative space commercialization and reusable space architectures.

---- X ----

I think that even with the NASA HQ Mars clique pushing for "all the Money Now for the Mars Agenda" that the pendulum is starting to shift. The Next President will want their own policy imprint and impact on NASA's budget and want to establish their own "legacy in that regard.

A The old guard would have us scrap the reusables which are the strategic death threat to the SLS-Orion B program pork barrel. The SLS-Orion is the back hole sucking up NASA's limited program development budget and expanding to eat other initiatives as time moves forward.

B A The fuel depots are not part of the SLS-Orion architecture.

C The fuel depots need a customer base which can be provided by

1 other space faring nations and their luna priority space exploration programs.

2 the reusable launch vehicle and in-space only vehicles

3 a high flight rate for human space mission in LEO which can be supported by space tourism.

4 space architectures which evolve existing capabilities and system toward reuse and refueling.

5 A business case which provide commercial investors some assurance that the space agencies can help them

"buy down the risks" finance and demo disruptive and game chaining technologies, and provide a contractual

base for stable return on investments.

---- XI ----

The ILD Campaign is nicely positioned to advocate for

1 an expanded international space agency customer base and further expansion of a commercial development strategy lunar space.

2 Even though NASA is not going to the Lunar surface we are seeing that NASA is financing development of Lunar Cube initiatives Lunar Flashlight, Lunar IceCube, LunarH-Map, and also Lunar Swirls which is being picked up by KARI. Affordable Lunar Cube scale technology is a key to greatly expanded international participation.

3 The Resource Prospector is another NASA initiative with strong internal support to conduct lunar surface "ground truth" of remote sensing data and the verification of operationally useful frozen volatile deposits.

4 NASA seems to be consciously letting ESA step into the Lunar surface base development vacuum which the Obama administration Mars First Program priority has created. (That may translate into a Euro-Russo-Chinese lunar base development initiative based on national space agency monopolies).

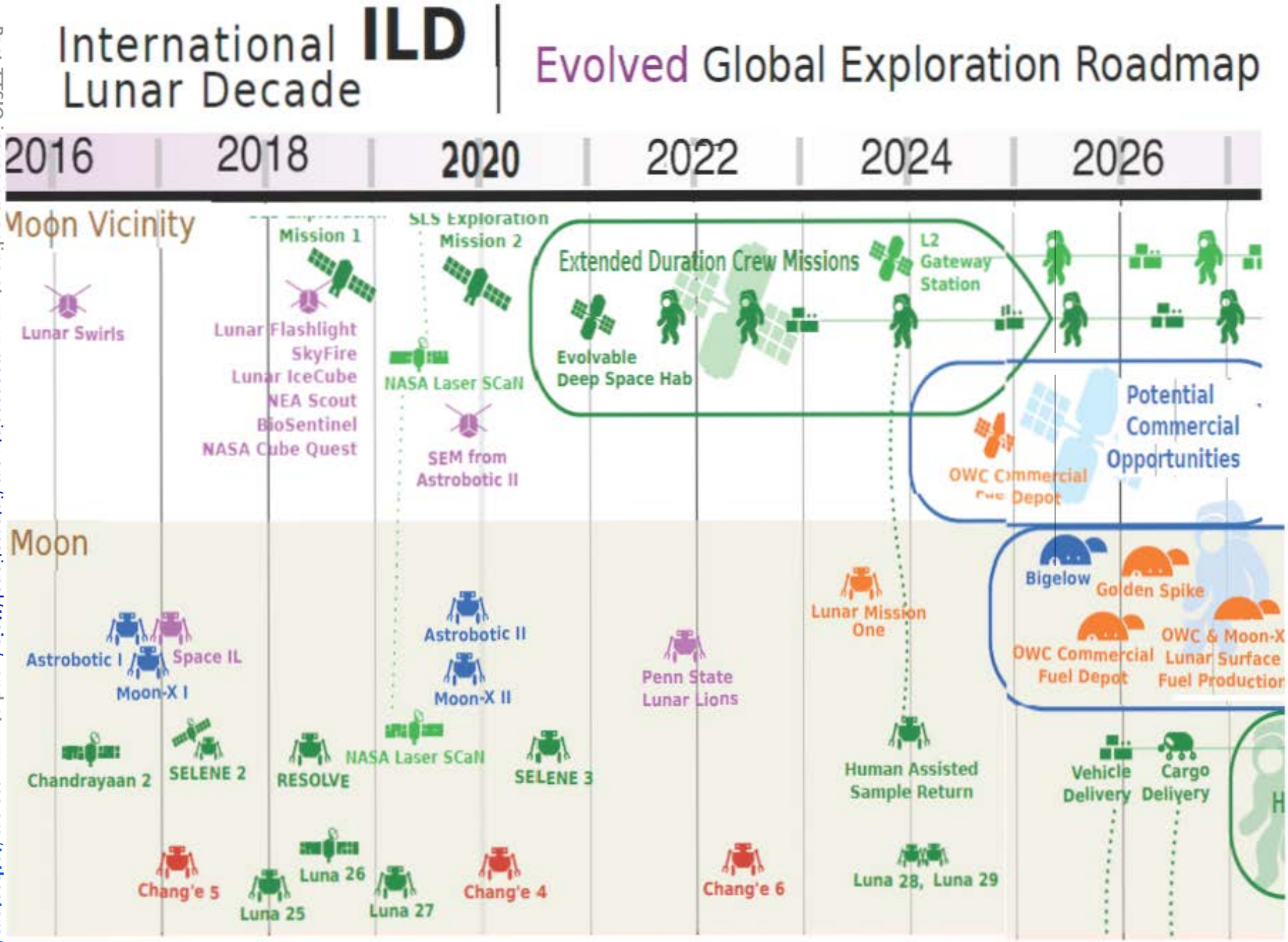
5 On the other hand the technology trend of reusable launchers and refillable architectures will likely counter this unaffordable “national space monopoly- public employment driven” program approach. Some sort of hybrid strategy is likely strategy is likely to emerge which is where the Pubic Private partnerships come into play.

6 The scientific lunar exploration campaign is already well developed by the LEAG Roadmap and SKG's and that is the foundation for an expanded adaptation by the **International Science Council.** (ISC) There is no need or interest in reinventing all the work that has been put into that ongoing process. The IUGG was the originating and organizing mechanism for the IGY before there were any space agencies in place to do something similar. Today the ISC has an even greater number of member organizations, the most influential of which is COSPAR. So that is in my opinion a way forward in expanding the potential customer base and of increasing international engagement and especially of the 8 missing G-20 group in the ISECG which might add to the resource base. I think that the ISC could also spring board for an **International Lunar Survey Working Group** that would both support scientific exploration, a common geodetic mapping framework, and support also for development and commercialization of lunar resources.

There are a number of project initiatives which also tie into this but that is a matter for another time.

That is a long response to a question about what's going on with the International Lunar Decade.

Dave Dunlop, Chair NSS International Committee ##



Comments on the Interational Lunar Decade Report Above

By Peter Kokh

This is an impressive iist of proposed missions. But except for some of the proposed missions to the Moon's South pole water ice preserves, most of these suggestions will increase our knowledge about the Moon itself, but not necessarily prepare the way for human settlements, needed in the long run if we are really serious about tapping lunar resources to build an Earth-Moon Economy, the foundation for successful spread of human settlements to Mars, and someday, beyond.

Here is a list of misssions I would like to see as part of the Interntional Lunar Decade effort

√ A mission to one (preferably several) "pits" which expose lunar lavatubes below.

It is not enough to lower a probe down and take some neat pictures. We need to scamper down the pile of talus debris at the bottom of the hole, representing material that has fallen from above when a meteor impact made its bullseye hit over the top of a hidden lava tube.

- We need a probe that can climb down and explore in both directeions far enough to flash photo the ceilings, walls, and floors and give us a good idea of what such tubes are really like. Half a dozen such missions would do well.
- Designing the needed equipment will be quite a project, and it would be good to come up with a different design approach for each such mission, again, the best way to "hit the nail on the head" in at lest one such site.
- Spider type legs, designed so as not to get easily caught in cracks or voids between rocks.
- For each mission, a plurality of probes, working as a team, with the leadership role able to switch between probes.
- The descent cable should be designed to relay information from the probes below to the lander on the rim of the lavatube pit.

√ An orbiter above (perhaips a pair orbiting in tandem as in the GRAIL mission) capable of detecteing and mapping lunar lavatube networks below the surface - at least those in the uppermost lave flood layers. If there is more than one way to do this, we need to try them all.

If we are going to put lunar lavatubes to good use, for example industrial and agricultural parks and safe repositories, whidh are going to be "area-intenseive" (needing a lot of shielded acreage) we want to find all the near surface lavatube networks on the Moon. These will be predominantly on the nearside where the maria (seas of congealed lava flows) are abundant. But we need to map such assets on the farside as well.

A challenge to university students to come up with designs for both such orbiters and for tube probes might be the best way to get design of needed equipment underway.

√ Check these past articles in Moon Miners' Manifesto for further ideas

http://www.moonsociety.org/publications/mmm_themes/mmmt_lavatubes.pdf

√ Design and test on the Moon the most efficient ways to store power

Those who insist on starting humn occupation at the poles are scared silly of the lunar nights, and there is no need to be. Batteries of different types, flywheels, even, beleive it or not, **hydroelectric** could be a simple way, Pump used water up a crater wall, or from within a lavatube to the surface furing the dayspan when solar power is available, and there store it under glass to be purified by the suns rays, then allowed to fall through turbines in the lavatube during the nightspan. Crater walls and surface to tube bottoms offer plenty of elevation even in the Moon's low "sixthweight" gravity.

√ Fly a probe to produce a topogrphical map of the Moon with better elevation data.

If we are going to build roads on the Moon, especially through the rugged highlands, we need far better data on elevation differences (5-10 m) to pick the easiest routes, needing the least regrading.

√ Take a second look at a north polar site rather than the south.

An International Space University group determined that there is a north polar peak with as much solar exposure as the South Polar site, if not more. The distance from the North Pole to the nearest mare coast (where basalt is available) is less than half that from the South Pole. Even if this exposure calculation is off by a day or so, the advantages of being closer to mare basalt should tilt the decision.

PK

ONLINE OP-ED ARTICLES FROM OTHER WRITERS WORTH READING

Aldrin: Apollo 11's 50th Anniversary Should Kick Off Crewed Mars Effort

www.space.com/30792-**buzz-aldrin-astronauts-mars-nasa**.html - Buzz Aldrin

Lakes on Mars - SETI Editorial

www.marsdaily.com/reports/**Lakes_on_Mars___SETI_Editorial**_999.html - Nathalie A. Gabrol

Mars colonisation still far off

www.marsdaily.com/reports/**Mars_colonisation_still_far_off_Amitabh_Ghosh**_999.html - Amitabh Ghos

Will Space Miners Save the Earth?

http://tasmaniantimes.com/index.php?/weblog/article/**will-space-miners-save-the-earth**/ Kim Pearl

Space Pioneers look towards a Stellar Economy

http://spacepioneers.com.au/articles/casc.html#**Toward_a_Solar_Economy** - Kim Pearl

New ESA Head Proposes International Lunar Base

www.thespacereview.com/article/2857/1 - Jeff Foust

Moon Over Mars: Why US Needs a Lunar Mission First

www.space.com/31009-**america-needs-lunar-mission-first-not-mars**.html - Leroy Chiao, Elliot Pulham

Better Way to Get to Space

www.space.com/31052-**its-not-rocket-science-we-need-a-better-way-to-get-to-space**.html

Overcoming non-technical challenges to cleaning up orbital debris

www.thespacereview.com/article/2863/1 - By Al Alzandua

The Lunar Electrical Power Utility

www.thespacereview.com/article/2860/1 = By V. Beldavs, D. Dunlap, J. Crisafulli, and B. Foing

Bolden: NASA 'Doomed' If Next President Dumps Journey to Mars

www.space.com/31039-**nasa-doomed-next-president-dumps-journey-mars**.html

Financing Space Companies in an Age of Complexity

http://www.thespacereview.com/article/2873/1 - by Eric R. Hedman

Expanding the Space Industry

www.thespacereview.com/article/2874/1 - by Jeff Faust

Powering a Moonbase through the Lunar Night

www.thespacereview.com/article/2882/1 = By Robewr Arnold

pace Resources

www.thespacereview.com/article/2883/1 - Jeff Faust

Look for 'Jupiters' to Find Solar Systems Like Ours (Op-Ed)

www.space.com/31409-**look-for-jupiters-to-find-solar-systems-like-ours**.html - Stefano Meschiari

Now Is the Time to Colonize Mars

http://www.space.com/31388-**elon-musk-colonize-mars-now**.html - Elon Musk

List of Recent Feature Articles and Essays in Our Sister Publications

Ad Astra [Latin (ancient Roman): "To The Stars"]
Sent to all National Space Society Members as a primary membership benefit
(with choice of print hardcopy or downloadable pdf file)

WINTER 2015

12 Wiliam Tell at Three Billion Miles; New Horizons Visis Pluto (-Charon) Clifford McMurray
14 ISDC 2016: Space Beyond Borders; the Inside Scoop - Luisa Fernanda Zambrano-Marin
22 Back to the Moon; Getting There Faster for Less - Charles Miller and Sarah Preston
28 'Tis Not Too Late To Seek A Newer World: Finding Planets Outside our Solar System - Lance Frazer
32 **Breakthrough in Artificial Intelligence and Educqation Helps Stuents Reach for the Stars** - Lynne Zielinski, Fred Becker, Alice Hoffman
36 **Tweeting from Space** - Travis Kirchneer
38 **How to Chnnge a Life - a long-standing NSS learning program Inspires Young Minds to seek space-focuse Futures** - Mark Barthelemy

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www.MMM-MoonMinersManifesto.com

OCTOBER 2015 - MMM # 289

2. In Focus: New Companies, Forces, Plans that could Accelerate the Future - Peter Kokh
3.The Moon: a Better Way to a Closer View - Dave Duca
4.Kepler Shipyards: an Innovative new force that could reshape the future
6.Kepler Shipyards: a sudden setback, but determined to continue
While on things "Kepler" - Kepler Space Telescope Findings to date - Peter Kokh
7.Early Conclusions from Kepler Telescope Findings - Peter Kokh

NOVEMBER 2015 - MMM # 290

2 In Focus: Coming up: MMM's Year #30 - Peter Kokh
3. Musings about Lunar Tourism - Dave Dietzler
4. Up West on the High Frontier - Dave Dietzler
6. Opening the Lunar Frontier: The role tele-tourists can play - Peter Kokh
7. Cleaning up" the Wolverton Black Water Treatment System - Dave Dietzler
8. Bad attitudes can torpedo Our Space Dreams: Right attitudes lead to success _ collected by Peter Kokh

DECEMBER 2015 - MMM # 291 - MMM's 29th Anniversary Issue

2, In Focus: "Are we alone?" is a question that has many answers, depending on _____!
3. Understanding Light-Time ("space-time" as the "there-then")
4. EMPIRE: One Fortunate Result of the Speed-of-Light Barrier is that Multi-Star "Empires" cannot exist.
5. Are we alone? In our Milky Way Galaxy? At least at this time?

International Space Advocacy Organizations Encouraging Student Participation

National Space Society (US) – http://www.nss.org – NSS
NSS currently has chapters in Australia, Canada, Germany, France, Netherlands, Brazil, and India
http://www.nss.org – http://chapters.nss.org/a/lists/

NSS' International Space Development Conference – ISDC
The "ISDC" is usually held the weekend of the last Monday in May (Memorial Day weekend) in various locations, hosts students from around the world, many of them presenting their entries to NASA's annual Space Settlement Design Contest. Usually, The Moon Society and SEDS participate in this conference.
http://isdc.nss.org

The Moon Society – http://www.moonsociety.org – TMS
The Moon Society has informal relationships with the Calgary Space Workers, Calgary, Alberta, Canada and with the Sociedad Espacial Mexicano, Mexico, with individual members in many countries.
The Moon Society's **Moon Miners' Manifesto India Quarterly** – the "older sister" to To The Stars International Quarterly, has been going to students and others in India and Elsewhere since August 2008. Older issues are available as free pdf downloads at:
http://www.moonsociety.org/india/mmm-india/
With the previous issue, TTSIQ#6, that publication replaces M3IQ.

Students for the Exploration and Development of Space – SEDS – http://www.seds.org
SEDS has had more success in setting up chapters around the World than any other Space organization.
How to Stars a SEDS Chapter – http://wiki.seds.org/index.php?title=Start_a_SEDS_Chapter
http://seds.org/chair/ChapterExpansionKit30.pdf
SEDS-Earth – http://earth.seds.org/index.php – This is the international chapter.
There are chapters of SEDS around the world: (USA), **India, Nigeria, United Kingdom, Philippines**, and more; SEDS-Earth is a central node for communication between these worldwide chapters.

YURI's NIGHT – https://yurisnight.net – http://en.wikipedia.org/wiki/Yuri's_Night
An Annual Celebration around the world, on April 12th, celebrating the first manned flight in space by Yuri Gagarin, of the Soviet Union, who piloted the first manned space capsule, **Vostok 1**, and made a complete orbit and landed safely in 1961.

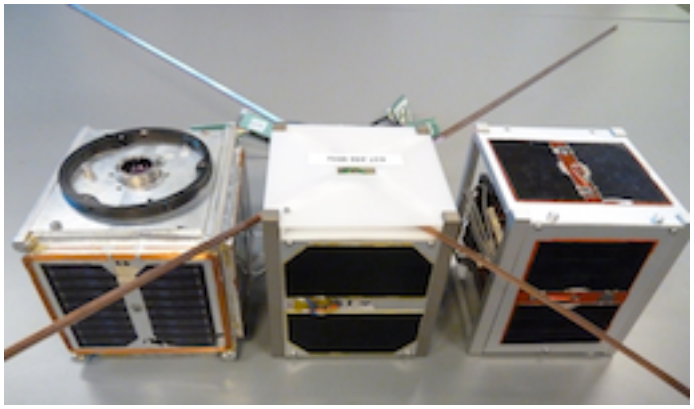
STEM – The STEM Academy – http://www.stem101.org/about.asp
[STEM: an acronym for **Science**, **Technology**, **Engineering**, and **Math**]
The STEM Academy, Inc. is a national non-profit status organization dedicated to advancing economic development by improving STEM literacy for all students. State and national standards based K-16 STEM curriculum to create student pathways for industry and post-secondary advancement.

Available Space Topic STEM Videos
- http://www.nasa.gov/audience/foreducators/expeditions/stem/
- http://www.nasa.gov/audience/foreducators/expeditions/stem/stem-**science**-index.html
- http://www.nasa.gov/audience/foreducators/expeditions/stem/stem-**tech**-index.html
- http://www.nasa.gov/audience/foreducators/expeditions/stem/stem-**eng**-index.html
- http://www.nasa.gov/audience/foreducators/expeditions/stem/stem-**math**-index.html

AUSSATS Cubesat Starts its Mission

www.esa.int/Education/CubeSats_-_**Fly_Your_Satellite/AAUSAT5_CubeSat_starts_its_space_mission**

9 October 2015 - According to radio transmissions received by radio amateurs around the world, AAUSAT5 is alive and kicking! The **student-built** AAUSAT5 CubeSat was deployed from the International Space Station (ISS) on 5 October, together with ESA's technology demonstration CubeSat GomX-3. Both CubeSats have now started their mission in space.



The student-built AAUSAT5 CubeSat was deployed from the International Space Station (ISS) on 5 October at 16:05 CET, together with ESA's technology demonstration CubeSat GomX-3. Both CubeSats have now started their mission in space.

Thousands of Kids get involved in "Motion Commotion" For World's largest Youth-led Science Experiment

7 October, 2015 - http://www.spacedaily.com/reports/prnewswire-space-news.html

Hundreds of thousands of youth across the United States, and some globally, are conducting the world's largest, youth-led science experiment as part of **4-H National Youth Science Day (4-H NYSD)**, in communities across the nation.

The experiment was designed by Oregon State University Cooperative Extension in partnership with Vernier Software & Technology and challenges youth to explore the physical and human factors of motion in distracted driving. ##

Moon Memories: See Thousands of Apollo Photos on Flickr

8 October, 2015 - www.space.com/30791-**nasa-apollo-moon-photos-online.**html

A huge new **online gallery** gives people around the world an up-close look at NASA's iconic **Apollo moon missions of the late 1960s and early 1970s**.

More than 8,400 unprocessed scans have now been uploaded into the online **Project Apollo Archive**. The entire gallery — with each picture organized by the magazine or film on which it was shot — is available on the photo-sharing service Flickr.

Xtronaut Game Kickstarter Success Supports Space-Science Outreach Programs

www.spacedaily.com/reports/prnewswire-space-news.html?rkey=20150924PH09950&filter=1639

24 September, 2015

Xtronaut Games and **STEM Education Programs a**re Designed Around **Real-World Space Mission Science, Technology,** and **Challenges**

NASA and "The Martian" Teamed Up to Inspire Students About Mars

10 October, 2015 -

www.spacedaily.com/reports/prnewswire-space-news.html?rkey=20150924PH09950&filter=1639

More than **10,000 students from across the country** recently participated in **a digital learning network** at Kennedy Space Center, scientists, astronauts & cast members from the film "The Martian."

NASA Challenge: ways to use Mars' Natural Resources for Astronauts

www.marsdaily.com/reports/**NASA_Challenge_Seeks_Ways_to_Use_Mars_Natural_Resources_for_Astronauts**_999.html

9 October, 2015 - Living off the land is different when the land is 140 million miles away, so NASA is looking for innovative ideas to use Martian resources to help establish a human presence on Mars.

The In Situ (on location) Resource Utilization Challenge offers the public an opportunity to submit designs for structures on Mars that would use existing material.

The agency plans to award **$10,000 to the first-place winner**, with **$2,500 each for two second-place submissions.** Students as well as adults can apply. ##

NASA Seeks Student Experiments for Edge-of-Space Balloon Flight

www.nasa.gov/press-release/**nasa-seeks-student-experiments-for-edge-of-space-balloon-flight**

26 October, 2015

Graduate and undergraduate university students are invited to compete for the opportunity to fly experiments to the edge of space aboard a high-altitude scientific balloon.

NASA is accepting applications from graduate and undergraduate university students to fly their science and technology experiments to the edge of space on a scientific balloon mission.

NASA is planning for a **fall 2016 launch** for the next High Altitude Student Platform (HASP) mission, a joint project between NASA and the Louisiana Space Consortium (LaSPACE) in Baton Rouge.

Explore the Moon (Virtualy) with these Awesome Global Maps

23 Oct0ber, 2015 - http://www.space.com/30904-awesome-moon-maps-nasa-usgs.html

The US Geological Survey (USGS) recently posted online two Moon maps — a photo mosaic and a topographic map — that were constructed using images and dara captured by NASA's long-running Lunar Reconnaissance Orbiter (LRO) spacecraft. ##

Astronaut's #spacerocks Contest to Award Space Patches for Song Titles

www.collectspace.com/news/news-102615a-**tim-peake-spacerocks-contest.html**

British astronaut **Tim Peake**'s #spacerocks contest challenges his **Twitter followers** to name his favorite songs. Winners will receive what Peake describes as "possibly the coolest ever patches flown in space," pictured above. Peake is the European Space Agency's first astronaut to represent the UK government.

NASA Grants to Broaden STEM Education for Underserved Students

www.nasa.gov/press-release/**nasa-awards-grants-to-broaden-stem-education-for-underserved-students**

18 November, 2015 - NASA's Minority University Research and Education Project (MUREP) selected **four minority serving institutions for cooperative agreement awards totaling approximately $2 million to help strengthen science, technology, engineering and math (STEM) curricula at the schools.**

The grants, which provide up to a total of $500,000 to each school. The schools will have three years to create and implement their program. The goal is to increasing the number of historically underserved students studying STEM fields relevant to NASA's diverse exploration mission

The selected institutions are:

* University of Hawaii, Honolulu
* Howard University, Washington
* The University of Texas at El Pasom
* Elizabeth City State University, North Carolina

Through MUREP's competitive awards, NASA provides financial assistance to minority serving institutions, including **historically black colleges and universities, Hispanic serving institutions, Asian American and Native American Pacific Islander** serving institutions, tribal colleges and universities, and other minority serving institutions and eligible community colleges. These institutions recruit and retain **underrepresented and underserved students, including women, girls and persons with disabilities**, into STEM fields. ##

For more information on the award process, visit: **http://nspires.nasaprs.com**

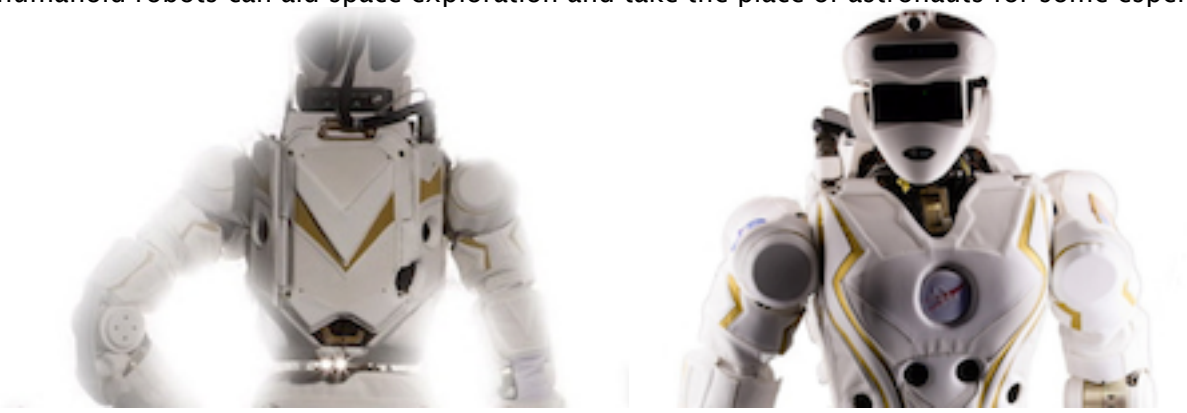
Build your own Robot Kit

www.scientificsonline.com/shop/robotics?Page=1&Sort=featured - **$26.95**

NASA's Awesome Humanoid Robots Just Joined 2 University Teams

28 November, 2015 - www.space.com/31226-**nasa-humanoid-robots-join-mit-northeastern**.html
www.space.com/23929-**nasa-valkyrie-humanoid-robot**.html

NASA awarded one robot each to the college robotics programs at the Massachusetts Institute of Technology (MIT) and Northeastern University. They will conduct further research and development into how humanoid robots can aid space exploration and take the place of astronauts for some esperiments.



Valkyrie was designed for the DARPA Robotics Challenge taking place in December 2013.

Both schools will receive versions of NASA's R5 robot, once named Valkyrie, initially designed to aid in search-and-rescue efforts and disaster response. It resembles the superhero, but with a white metal body and glowing NASA logo on its chest. ##

SPACE Apps For Studying The PLANETS

www.planet-science.com/categories/extras/**planet-science**-loves/2011/10/**top-space-apps**.aspx
https://itunes.apple.com/gb/app/**planets**/id305793334?mt=8
https://itunes.apple.com/gb/app/**f-sim-space-shuttle**/id352670055?mt=8
https://play.google.com/store/apps/details?id=de.dbware.**sunandmoon**&feature=search_result
http://www.nasa.gov/content/**new-nasa-app-shares-excitement-for-deep-space-missions**

ASTRONOMY Apps For Enjoying The Sky At Night

4 Top Android Astronomy Apps For Enjoying The Sky At Night
www.makeuseof.com/tag/great-android-astronomy-apps/

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http://www.hongkiat.com/blog/stargazing-apps/ (10 free aps)

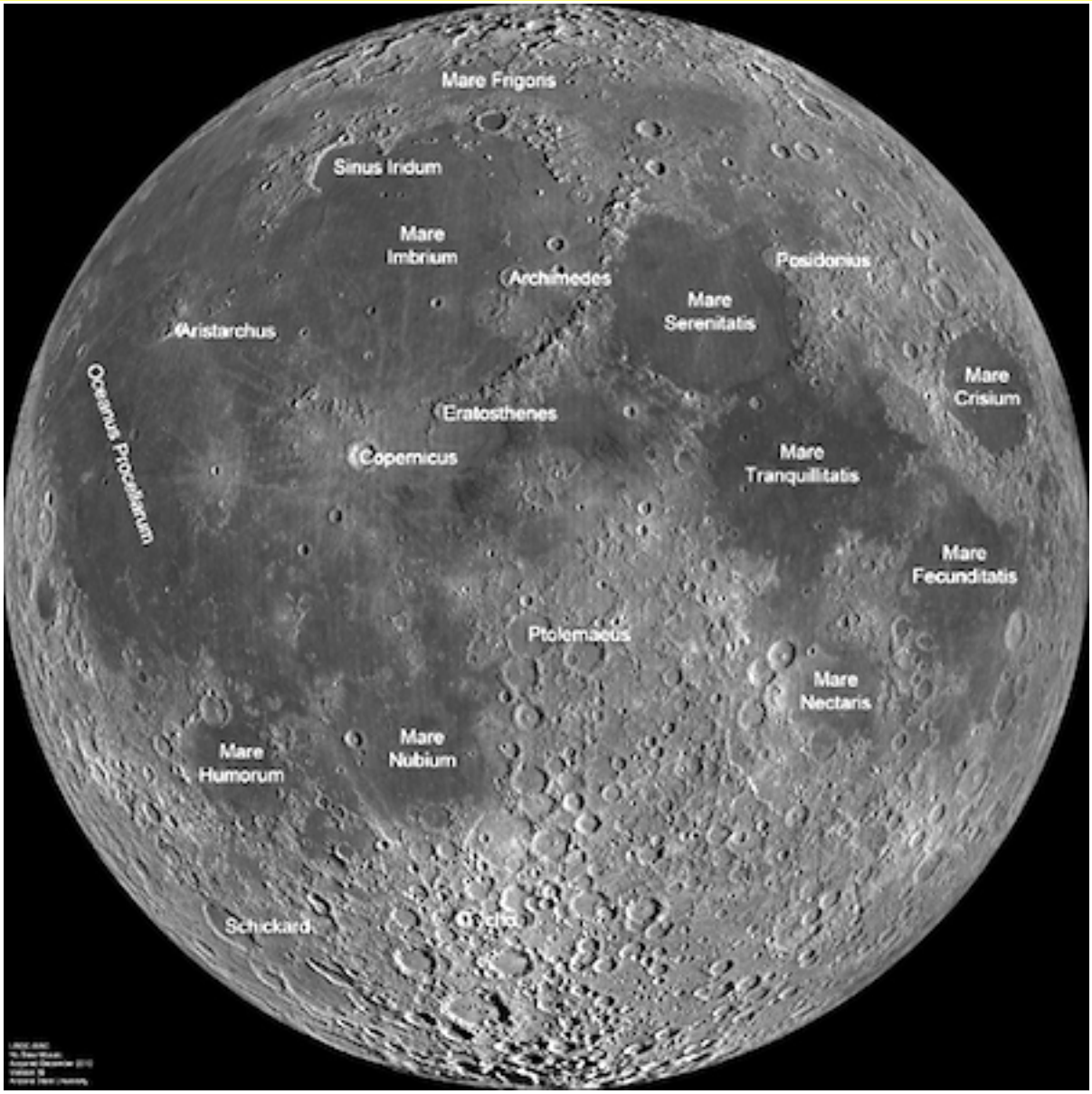
5 Best Astronomy Apps for Android TABLETS
www.makeuseof.com/tag/great-**android-astronomy-apps**/

10 Best Astronomy Apps for I-PHONES
www.iphoneness.com/iphone-apps/top-astronomy-applications-for-iphone/

Best Buys in Telescopes

www.space.com/31231-**best-inexpensive-telescopes**.html
www.space.com/31229-**best-beginner-telescopes**.html
www.space.com/31228-**best-portable-telescopes**.html
www.space.com/31227-**best-hobbyist-telescopes**.html - assembly required

How to See the Moon: Telescope Viewing Tips



www.space.com/14296-**moon-telescope-viewing-skywatching-tips**.html
www.space.com/31048-**how-to-observe-the-moon-telescope-binocular**s.html
www.space.com/31047-**how-to-photograph-moon-telescope**.html

Before looking at the Moon with your new telesope, take a good look at it with your naked eyes.

The Moon is large enough to show some detail to the naked eye. As it moves in its orbit around the Earth, the sun's light strikes it from different angles, sometimes illuminating only a thin crescent from behind, at other times shining full on, making it a full Moon. These are called the Moon's phases.

Chose a Moon Map: With a lunar map and perhaps a photograph of the Moon as a guide, you can easily study the Moon and identify a number of its most prominent features.

Usually, a lunar map will be oriented to show the Moon as it would appear to your unaided eye or through binoculars: with its north side up. But many telescpes provide an inverted (upside-down) view, and some even give a reversed (mirror-image) view. Some telescopes even do both.

If your telescope turns Moon upside-down while your map shows the moon right-side up, just turn the map upside down. On the other hand, you'll get a reversed view if you're using a telescope where the eyepiece fits into a right-angle attachment called a star diagonal. In such a situation you'll have to mentally flip the Moon in your eyepiece right-for-left to match the Moon on paper. ##

Moon Miners' Manifesto Resources

http://www.moonsociety.org/chapters/milwaukee/mmm/

MMM is published 10 times a year (ex. Jan July). The December 2015 issue begins year # 30.

Most issues deal with the **opening of the Lunar frontier**, suggesting how pioneers can make best use of **local resources** and learn to **make themselves at home,** through psychological, social, and physiological adjustment**.**

Some of the points made will relate specifically to **pioneer life** in the lunar environment. Much of what will hold for the Moon, will also hold true for **Mars and for space in general.** There is one Mars theme issue each year. O**ther space destinations** are discussed: the asteroids, moons of Jupiter and Saturn), even the cloud tops of Venus.

Issues #145 (May 2001) forward through current are as pdf file downloads with a Moon Society username and password. Moon Society International memberships are $35 US; $20 students, seniors – join online at:

http://www.moonsociety.org/register/

MMM Classics: All the "non-time-sensitive editorials and articles from past issues of MMM have been re-edited and republished in pdf files, one per publication year. A 3-year plus lag is kept between the MMM Classic volumes and the current issue. **As of December 2011, the first twenty-two years of MMM, 200 issues, will be preserved in this directory,** These issues are freely accessible to all, no username or password needed, at:

www.moonsocietyorg/publications/mmm_classics/

MMM Classic Theme Issues: introduced a new series to collect the same material as in the Classics, but this time organized by theme. The first MMM Classic Theme issue gathers all the **Mars** theme articles from years 1-10 in one pdf file. A second pdf file collects all the Mars Theme issues from year 11-20. The 2nd Classic Theme is "**Eden on Luna**," addressing environmental issues underlying lunar settlement. **Asteroids**, **Tourism, Research**, **Select Editorials, and Analog Programs** have been added. New Theme Issues will be coming: Lunar Building Materials, The Lunar Economy, The Lunar Homestead, Modular Architecture, Modular Biospherics, Frontier Arts & Crafts, Frontier Sports, Other Solar System Destinations, and so on.

www.moonsociety.org/publications/mmm_themes/

MMM Glossary: The publishers of MMM, the Lunar Reclamation Society, has published a new Glossary of "MMM-Speak: new words and old words with new meaning" as used in Moon Miners' Manifesto.

www.moonsociety.org/publications/m3glossary.html

The initial addition includes over 300 entries, many with illustrations. Additional entries are under construction. It is hoped that new members will consider this to be a "Read Me First" guide, not just to Moon Miners' Manifesto, but to our vision and goals.

All of these resources are available online or as free access downloads to readers. But TTSIQ does need your help!

To The Stars International Quarterly Advisors, Liaisons, Contributors, Reporters, Illustrators

If this publication is to help spread the word about Space worldwide, among the public at large, especially among the students and younger people, it must become a truly International publication. We need people from many fields and many nations to join our team.

If you can add to the usefulness and vitality of this publication, in any of the ways listed above, or in fields we had not thought of, write us at: ttsiq@moonsociety.org [This email address goes to the whole editorial team]

Tell us about yourself; your interest in space, and how you think you can make this publication of real service in the education of the public worldwide, and in the education of young people on whom our future rests.

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http://www.nss.org/tothestars/ and http://www.moonsociety.org/international/ttsiq/

To The Stars International Quarterly #14, January 2016 – INDEX

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