Is Space Law Taking Off?

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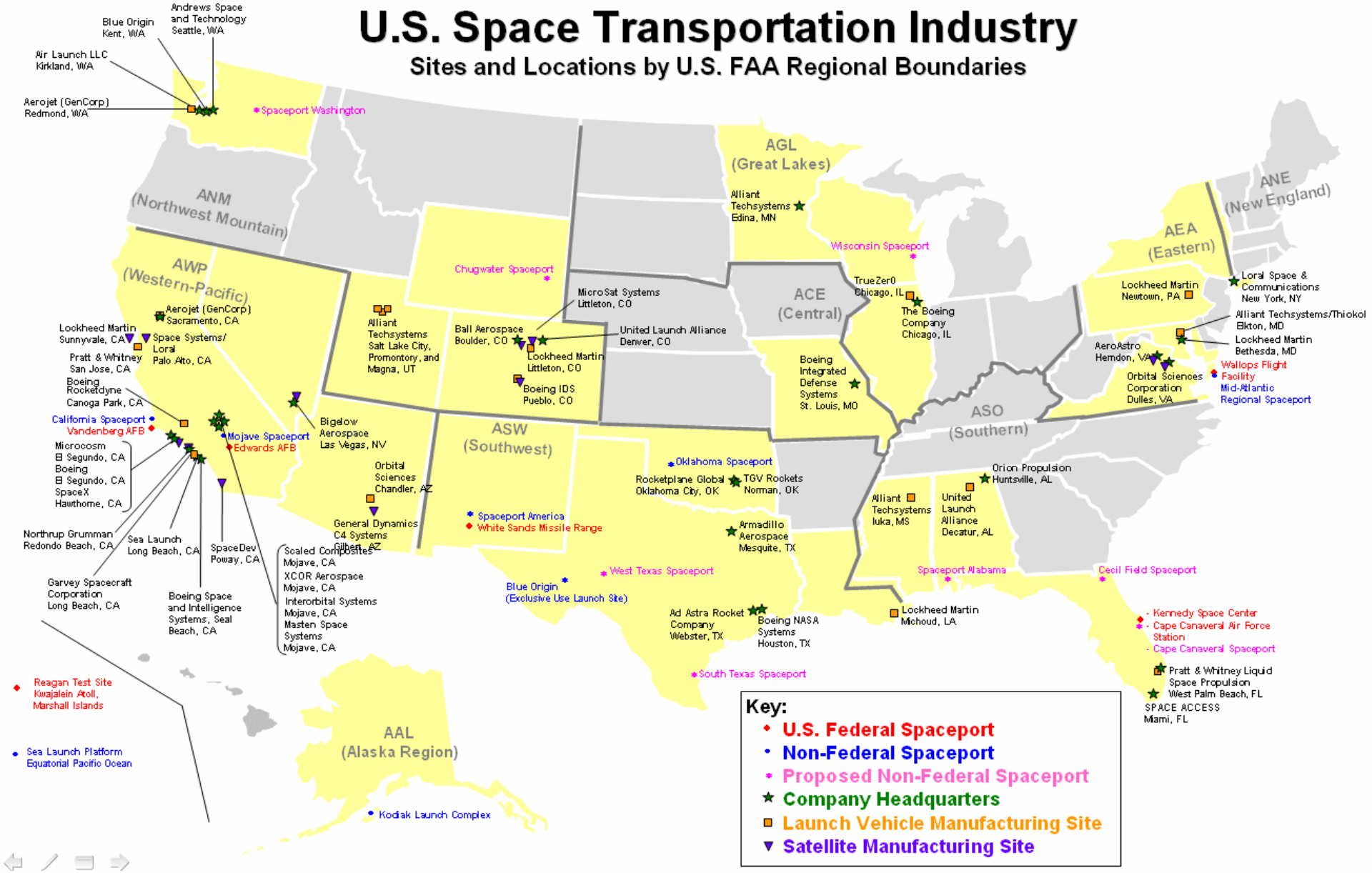
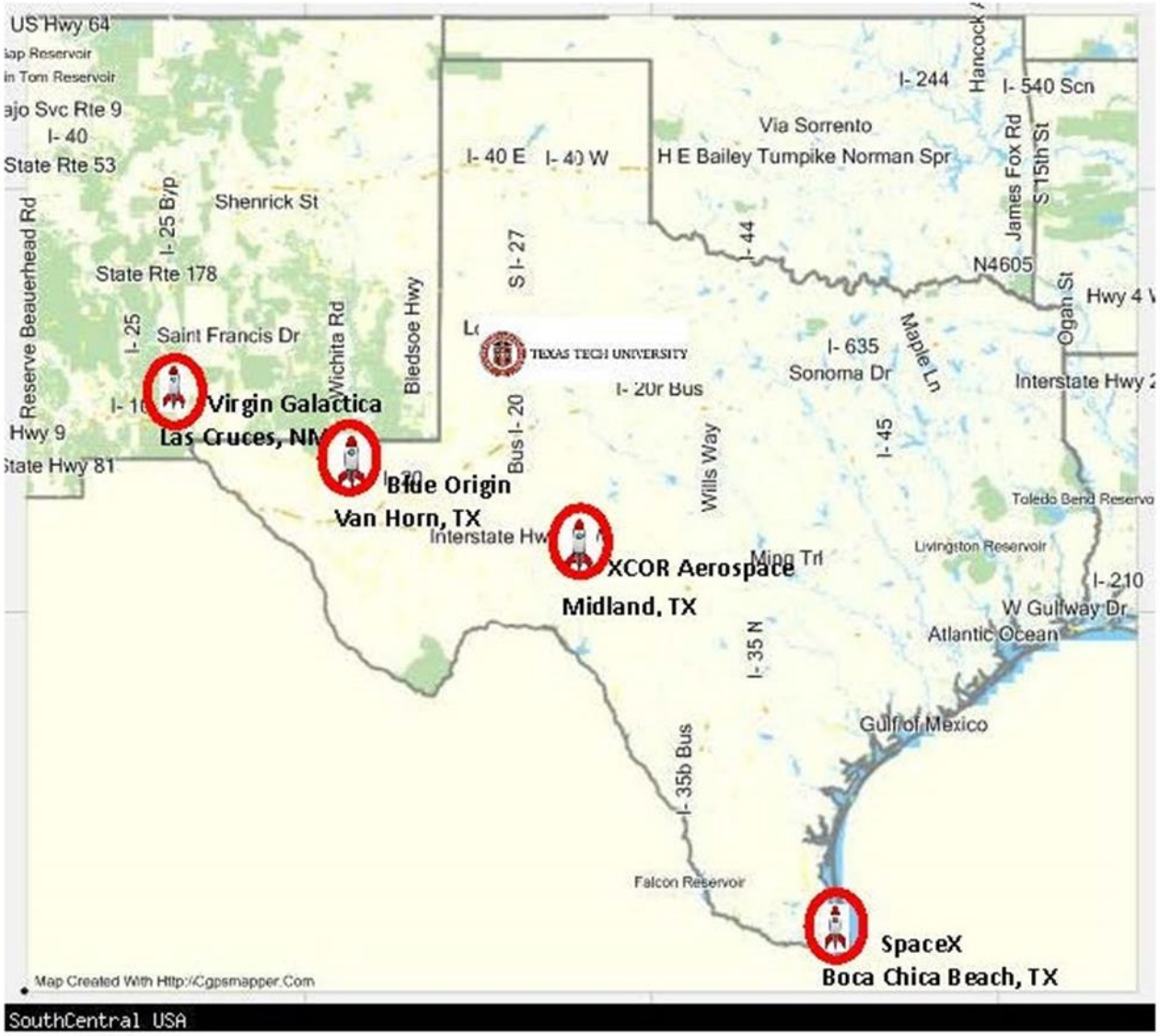
Director, Science, Engineering and Technol

Law Concentrations

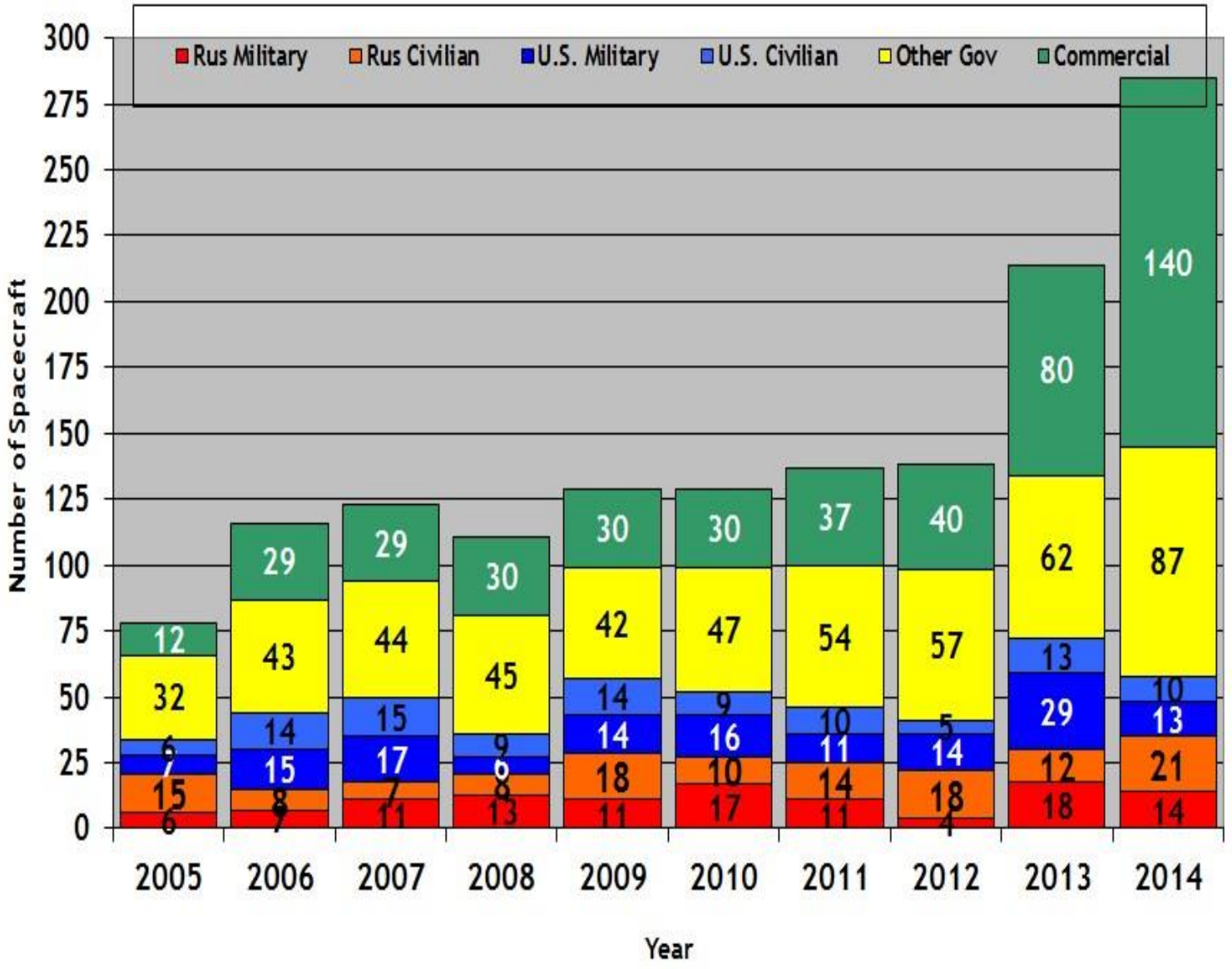
Texas Tech University School of Law


U.S. Space Transportation Industry
Sites and Locations by U.S. FAA Regional Boundaries
Andrews Space and Technology Seattle, WA
Blue Origin Kent, WA
Air Launch LLC Kirkland, WA
Aerojet (GenCorp) Redmond, WA
Spaceport Washington
ANM (Northwest Mountain)
AWP (Western-Pacific)
AGL (Great Lakes)
ACE (Central)
ASW (Southwest)
ASO (Southern)
AEA (Eastern)
ANE (New England)
AAL (Alaska Region)
Alliant Techsystems Edina, MN
Wisconsin Spaceport
Chugwater Spaceport
TrueZero Chicago, IL
The Boeing Company Chicago, IL
Lockheed Martin Newtown, PA
Loral Space & Communications New York, NY
Alliant Techsystems/Thiokol Elkton, MD
Lockheed Martin Bethesda, MD
Wallops Flight Facility Mid-Atlantic Regional Spaceport
AeroAstro Herndon, VA
Orbital Sciences Corporation Dulles, VA
MicroSat Systems Littleton, CO
United Launch Alliance Denver, CO
Ball Aerospace Boulder, CO
Lockheed Martin Littleton, CO
Boeing IDS Pueblo, CO
Boeing Integrated Defense Systems St. Louis, MO
Alliant Techsystems Salt Lake City, Promontory, and Magna, UT
Aerojet (GenCorp) Sacramento, CA
Lockheed Martin Sunnyvale, CA
Space Systems/ Loral Palo Alto, CA
Pratt & Whitney San Jose, CA
Boeing Rocketdyne Canoga Park, CA
California Spaceport Vandenberg AFB
Microcosm El Segundo, CA
Boeing El Segundo, CA
SpaceX Hawthorne, CA
Northrup Grumman Redondo Beach, CA
Sea Launch Long Beach, CA
SpaceDev Poway, CA
Garvey Spacecraft Corporation Long Beach, CA
Boeing Space and Intelligence Systems, Seal Beach, CA
Scaled Composites Mojave, CA
XCOR Aerospace Mojave, CA
Interorbital Systems Mojave, CA
Masten Space Systems Mojave, CA
Mojave Spaceport
Edwards AFB
Bigelow Aerospace Las Vegas, NV
Orbital Sciences Chandler, AZ
General Dynamics C4 Systems Gilbert, AZ
Spaceport America
White Sands Missile Range
Oklahoma Spaceport
Rocketplane Global Oklahoma City, OK
TGV Rockets Norman, OK
Armadillo Aerospace Mesquite, TX
Orion Propulsion Huntsville, AL
Alliant Techsystems Iuka, MS
United Launch Alliance Decatur, AL
West Texas Spaceport
Blue Origin (Exclusive Use Launch Site)
Ad Astra Rocket Company Webster, TX
Boeing NASA Systems Houston, TX
Lockheed Martin Michoud, LA
South Texas Spaceport
Spaceport Alabama
Cecil Field Spaceport
- Kennedy Space Center
- Cape Canaveral Air Force Station
- Cape Canaveral Spaceport
Pratt & Whitney Liquid Space Propulsion West Palm Beach, FL
SPACE ACCESS Miami, FL
Reagan Test Site Kwajalein Atoll, Marshall Islands
Sea Launch Platform Equatorial Pacific Ocean
Kodiak Launch Complex
Key:
U.S. Federal Spaceport
Non-Federal Spaceport
Proposed Non-Federal Spaceport
Company Headquarters
Launch Vehicle Manufacturing Site
Satellite Manufacturing Site

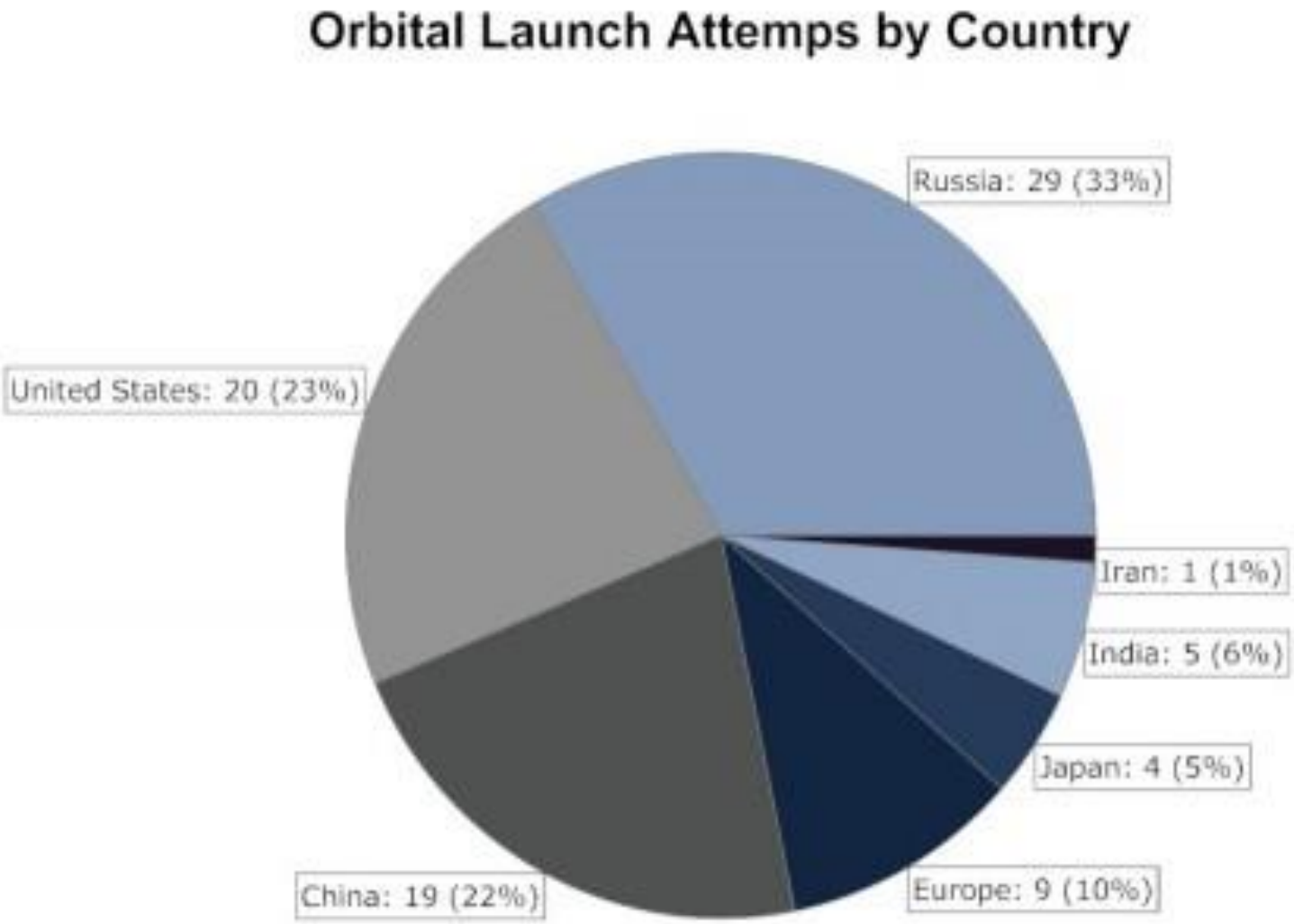
Space Industries in the West Texas region



Number of Spacecraft Launched, 2005-2014



2015


Orbital Launch Attemps by Country
Russia: 29 (33%)
United States: 20 (23%)
Iran: 1 (1%)
India: 5 (6%)
Japan: 4 (5%)
China: 19 (22%)
Europe: 9 (10%)

Recent legal questions

- Whether asteroid miners will own the minerals they claim?
- Whether nuclear weapons can be used as a defense against asteroids striking the earth, when international law prohibits the use of nuclear weapons in space?
- Whether the world will recognize U.S. domestic law giving mining companies ownership of minerals they recovery on asteroids, despite the Space Treaty which prohibits any nation from owning any planet?
- Who is liable for damage from debris from space?

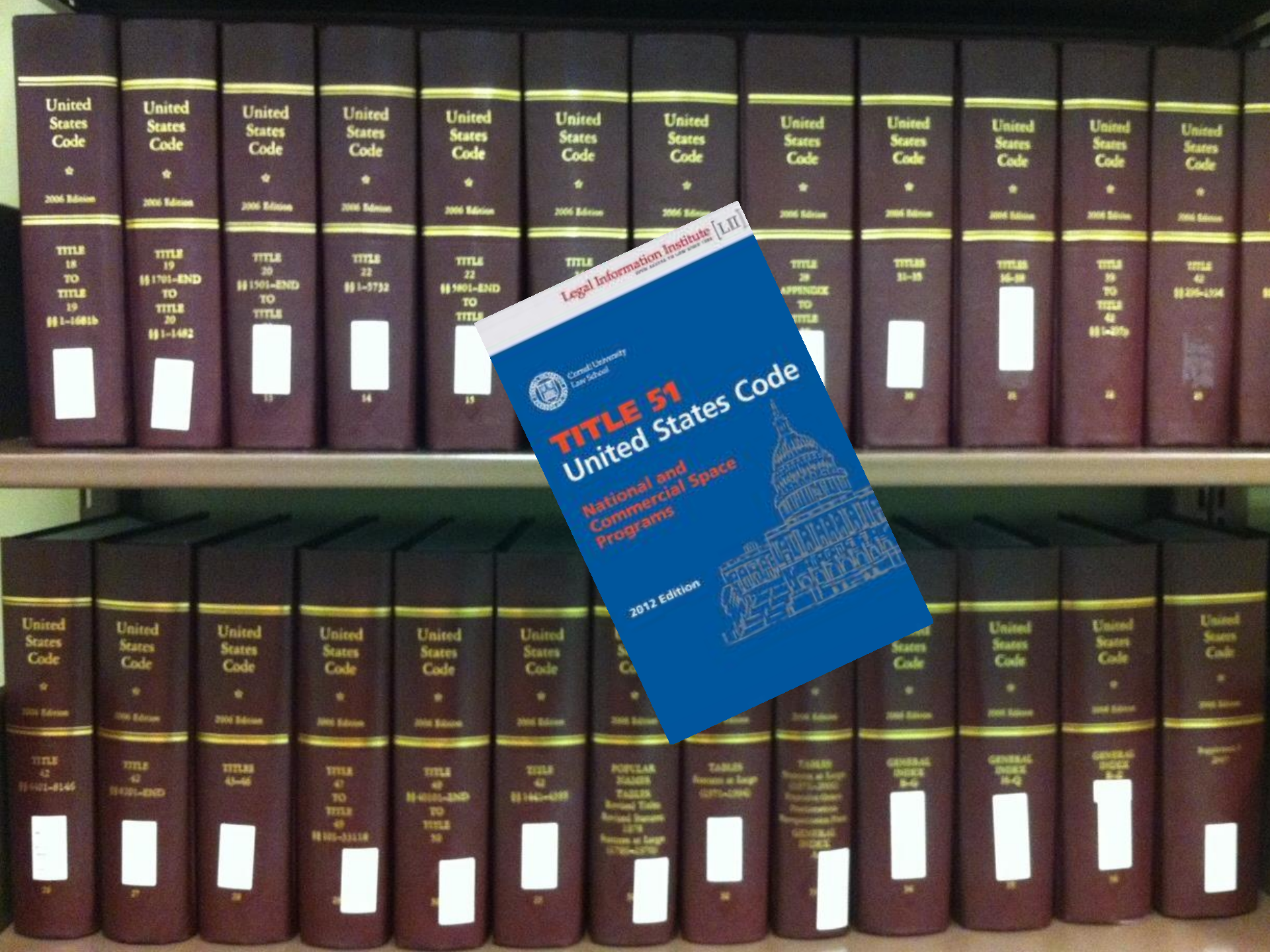
Who is liable for space debris?

Federal jurisdictional questions

- Should we reconsider the earlier interpretation of NEPA that it does not apply in Outer Space?
- NASA plans to mine water from the moon in 2018 on the NASA's RESOLVE Mission

Civilian Space Industries

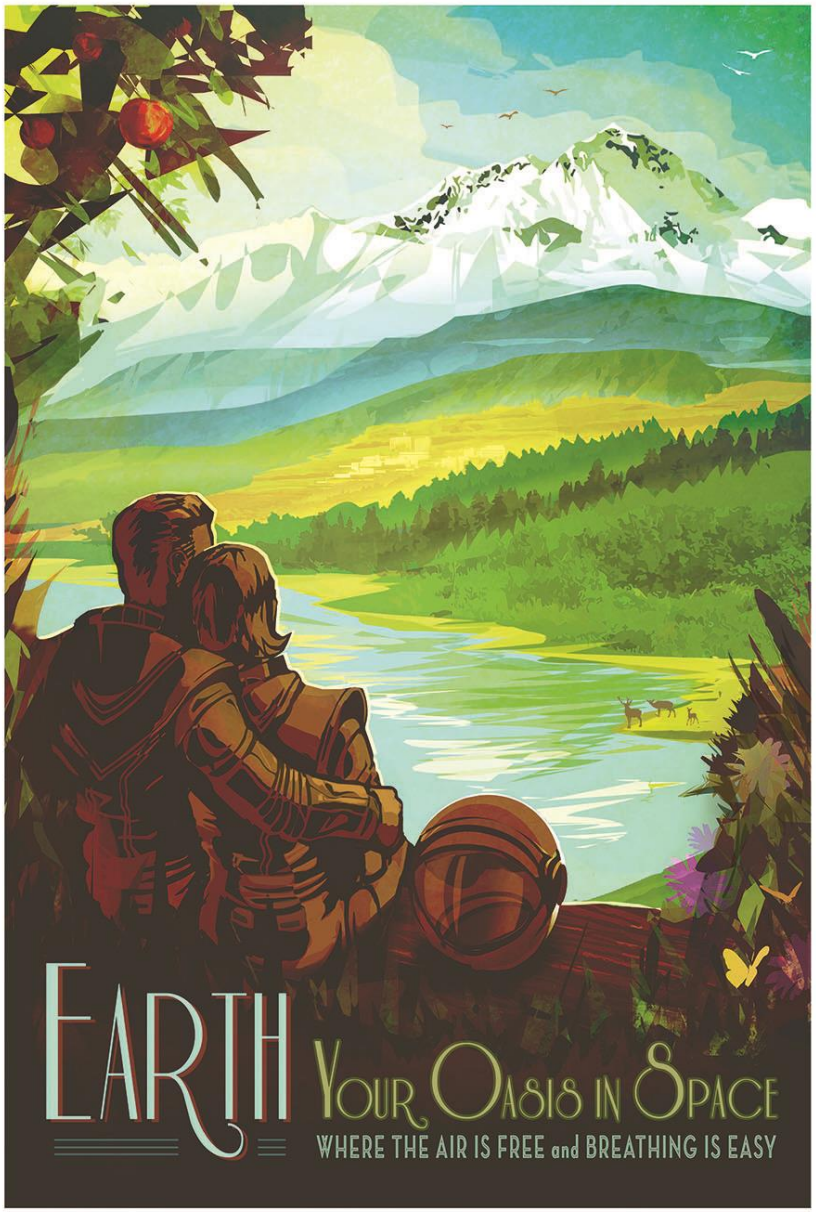
- Rapid development of state space law
- Tourism liability law
- Workforce development and training including lawyer workforce


United States Code
2006 Edition
Legal Information Institute
LII
Cornell University Law School
TITLE 51
United States Code
National and Commercial Space Programs
2012 Edition

Changing the image of lawyers in space?

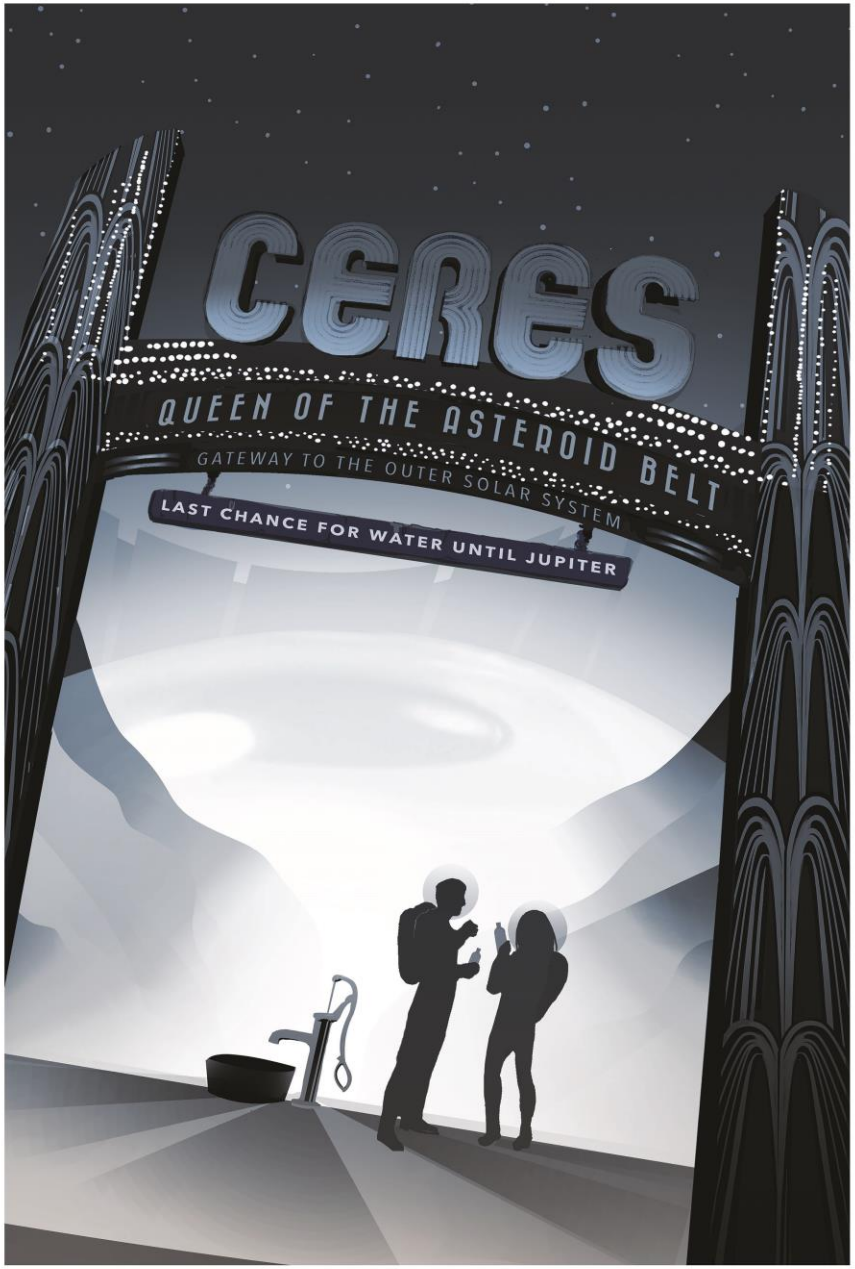
When *Popular Mechanics* did a story on my Space Law course for Spring 2017, in their May 2016 edition, they mainly lamented the end of the lawless frontier.

- Space X has a plan to reach Mars by 2018
- Russian wants to use nuclear power to reach Mars in 45 days
- Citizen lobbyists are urging the Senate to fund NASA so they can get to Mars



There's no place like home. Warm, wet and with an atmosphere that's just right, Earth is the only place we know of with life – and lots of it. JPL's Earth science missions monitor our home planet and how it's changing so it can continue to provide a safe haven as we reach deeper into the cosmos.

NASA Jet Propulsion Laboratory
www.jpl.nasa.gov



Ceres is the closest dwarf planet to the Sun. It is the largest object in the main asteroid belt between Mars and Jupiter, with an equatorial diameter of about 965 kilometers. After being studied with telescopes for more than two centuries, Ceres became the first dwarf planet to be explored by a spacecraft, when NASA's Dawn probe arrived in orbit in March 2015. Dawn's ongoing detailed observations are revealing intriguing insights into the nature of this mysterious world of ice and rock.

NASA Jet Propulsion Laboratory
www.jpl.nasa.gov

The discovery of Enceladus' icy jets and their role in creating Saturn's E-ring is one of the top findings of the Cassini mission to Saturn. Further Cassini mission discoveries revealed strong evidence of a global ocean and the first signs of potential hydrothermal activity beyond Earth – making this tiny Saturnian moon one of the leading locations in the search for possible life beyond Earth.

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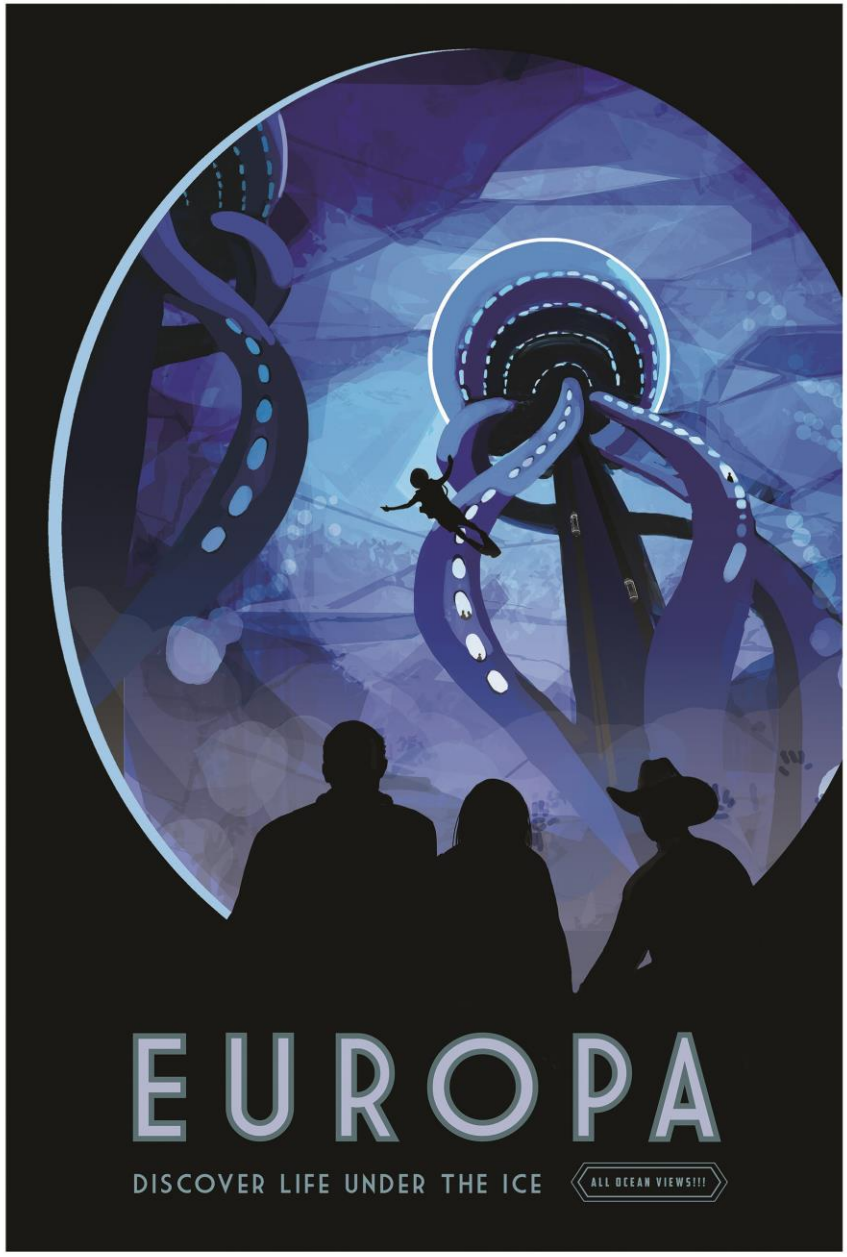

Astonishing geology and the potential to host the conditions for simple life make Jupiter's moon Europa a fascinating destination for future exploration. Beneath its icy surface, Europa is believed to conceal a global ocean of salty liquid water twice the volume of Earth's oceans. Tugging and flexing from Jupiter's gravity generates enough heat to keep the ocean from freezing. On Earth, wherever we find water, we find life. What will NASA's Europa mission find when it heads for this intriguing moon in the 2020s?

NASA Jet Propulsion Laboratory
www.jpl.nasa.gov

National Aeronautics and Space Administration

NASA's Voyager mission took advantage of a once-every-175-year alignment of the outer planets for a grand tour of the solar system. The twin spacecraft revealed stunning details about Jupiter, Saturn, Uranus and Neptune – using each planet's gravity to send them on to the next destination. Voyager set the stage for such ambitious orbiter missions as Galileo to Jupiter and Cassini to Saturn. Today both Voyager spacecraft continue to return valuable science from the far reaches of our solar system.

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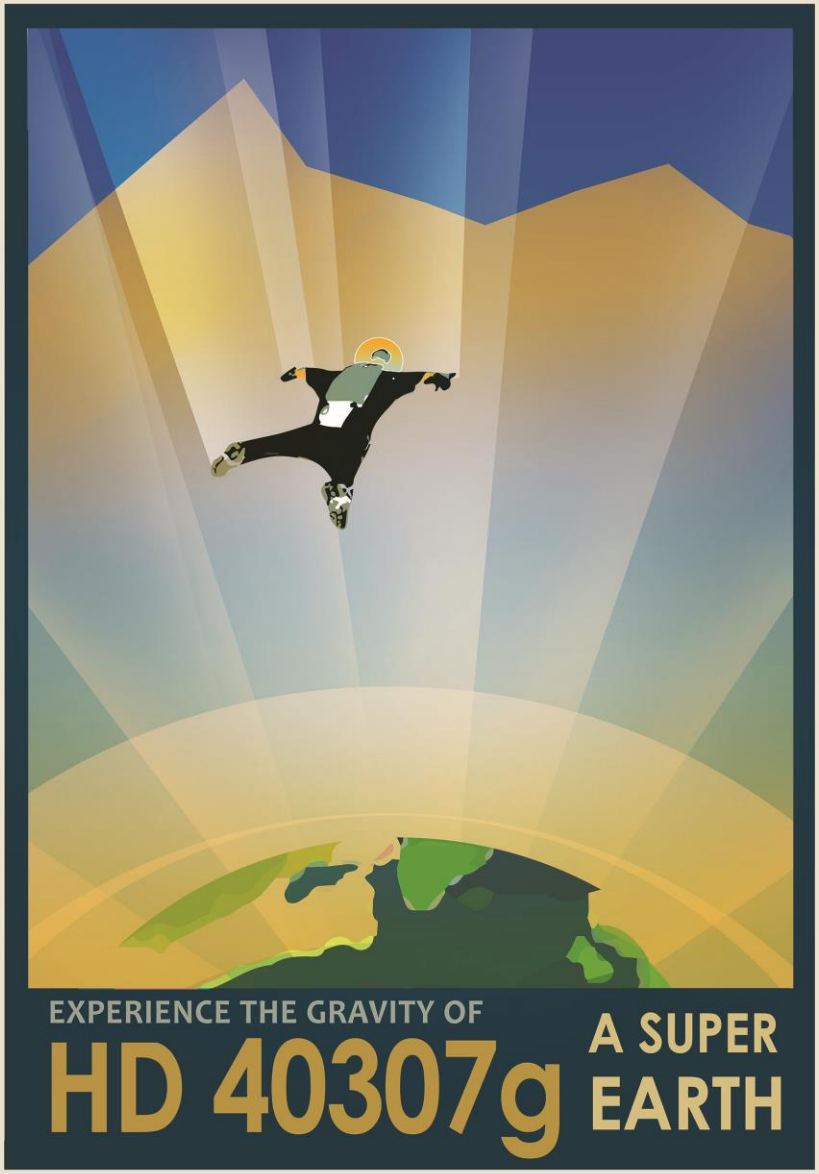
Exoplanet Travel Bureau



Twice as big in volume as the Earth, HD 40307g straddles the line between "Super-Earth" and "mini-Neptune" and scientists aren't sure if it has a rocky surface or one that's buried beneath thick layers of gas and ice. One thing is certain, though: at eight times the Earth's mass, its gravitational pull is much, much stronger.

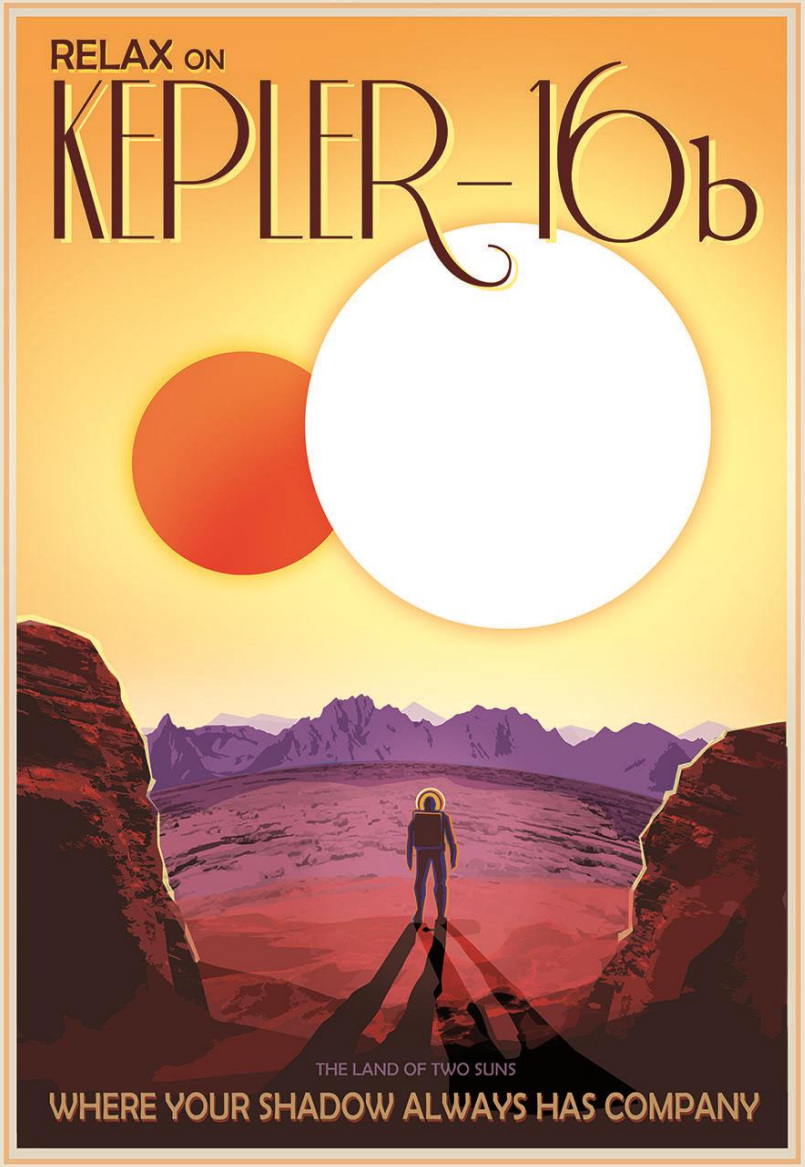
NASA's Exoplanet Exploration Program. Jet Propulsion Laboratory, Pasadena CA.
exep.jpl.nasa.gov

www.nasa.gov

National Aeronautics and Space Administration

Exoplanet Travel Bureau

RELAX ON KEPLER-16b



Like Luke Skywalker's planet "Tatooine" in *Star Wars*, Kepler-16b orbits a pair of stars. Depicted here as a terrestrial planet, Kepler-16b might also be a gas giant like Saturn. Prospects for life on this unusual world aren't good, as it has a temperature similar to that of dry ice. But the discovery indicates that the movie's iconic double-sunset is anything but science fiction.

NASA's Exoplanet Exploration Program, Jet Propulsion Laboratory, Pasadena CA.
exep.jpl.nasa.gov

www.nasa.gov

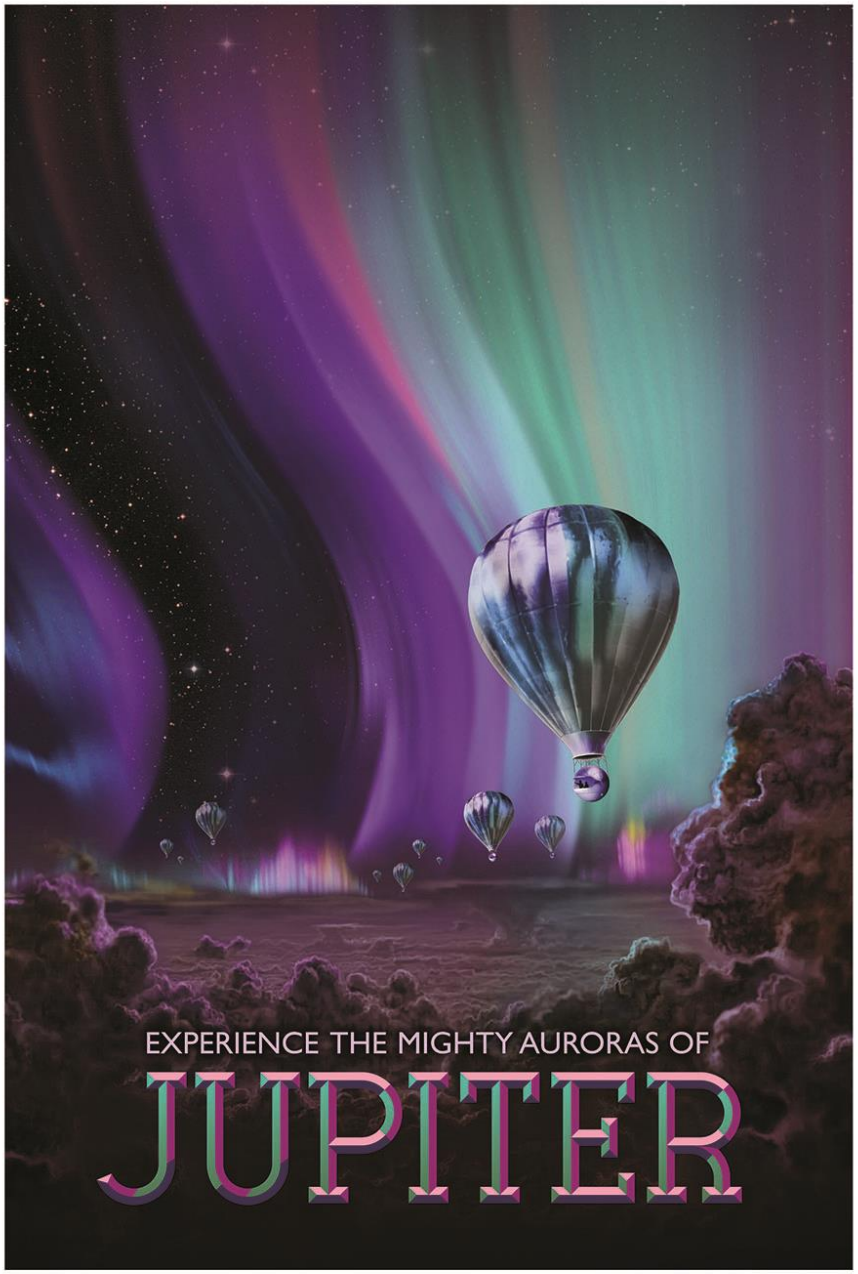
National Aeronautics and Space Administration

Exoplanet Travel Bureau

Kepler-186f is the first Earth-size planet discovered in the potentially 'habitable zone' around another star, where liquid water could exist on the planet's surface. Its star is much cooler and redder than our Sun. If plant life does exist on a planet like Kepler-186f, its photosynthesis could have been influenced by the star's red-wavelength photons, making for a color palette that's very different than the greens on Earth. This discovery was made by *Kepler*, NASA's planet-hunting space telescope.

www.nasa.gov

NASA's Exoplanet Exploration Program, Jet Propulsion Laboratory, Pasadena CA.
exep.jpl.nasa.gov



The Jovian cloudscape boasts the most spectacular light show in the solar system, with northern and southern lights to dazzle even the most jaded space traveler. Jupiter's auroras are hundreds of times more powerful than Earth's, and they form a glowing ring around each pole that's bigger than our home planet. Revolving outside this auroral oval are the glowing, electric "footprints" of Jupiter's three largest moons. NASA's Juno mission will observe Jupiter's auroras from above the polar regions, studying them in a way never before possible.

NASA Jet Propulsion Laboratory
www.jpl.nasa.gov

NASA's Mars Exploration Program seeks to understand whether Mars was, is, or can be a habitable world. Missions like Mars Pathfinder, Mars Exploration Rovers, Mars Science Laboratory and Mars Reconnaissance Orbiter, among many others, have provided important information in understanding of the habitability of Mars. This poster imagines a future day when we have achieved our vision of human exploration of Mars and takes a nostalgic look back at the great imagined milestones of Mars exploration that will someday be celebrated as "historic sites."

NASA Jet Propulsion Laboratory
www.jpl.nasa.gov

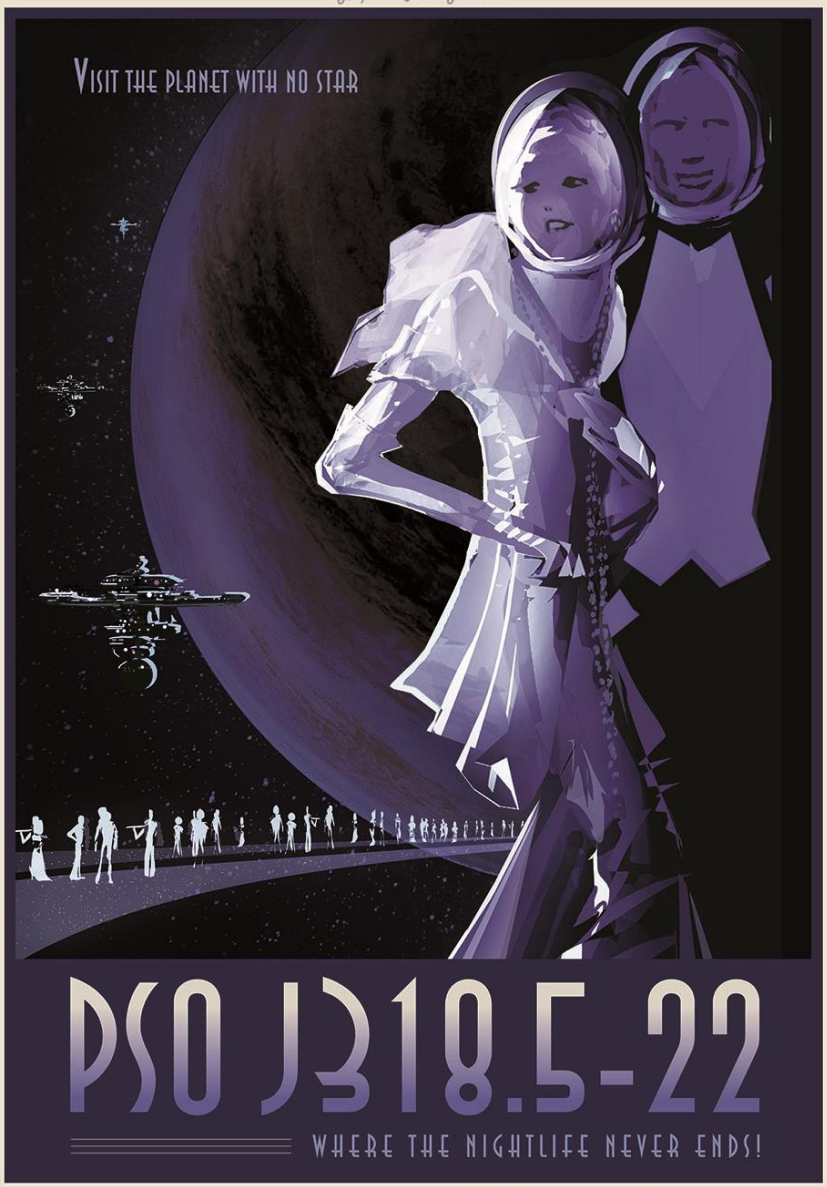
While there is much debate over which exoplanet discovery is considered the "first," one stands out from the rest. In 1995, scientists discovered 51 Pegasi b, forever changing the way we see the universe and our place in it. The exoplanet is about half the mass of Jupiter, with a seemingly impossible, star-hugging orbit of only 4.2 Earth days. Not only was it the first planet confirmed to orbit a sun-like star; it also ushered in a whole new class of planets called Hot Jupiters: hot, massive planets orbiting closer to their stars than Mercury. Today, powerful observatories like NASA's Kepler space telescope, will continue the hunt of distant planets.

www.nasa.gov

NASA's Exoplanet Exploration Program. Jet Propulsion Laboratory, Pasadena CA.
exep.jpl.nasa.gov

National Aeronautics and Space Administration

Exoplanet Travel Bureau



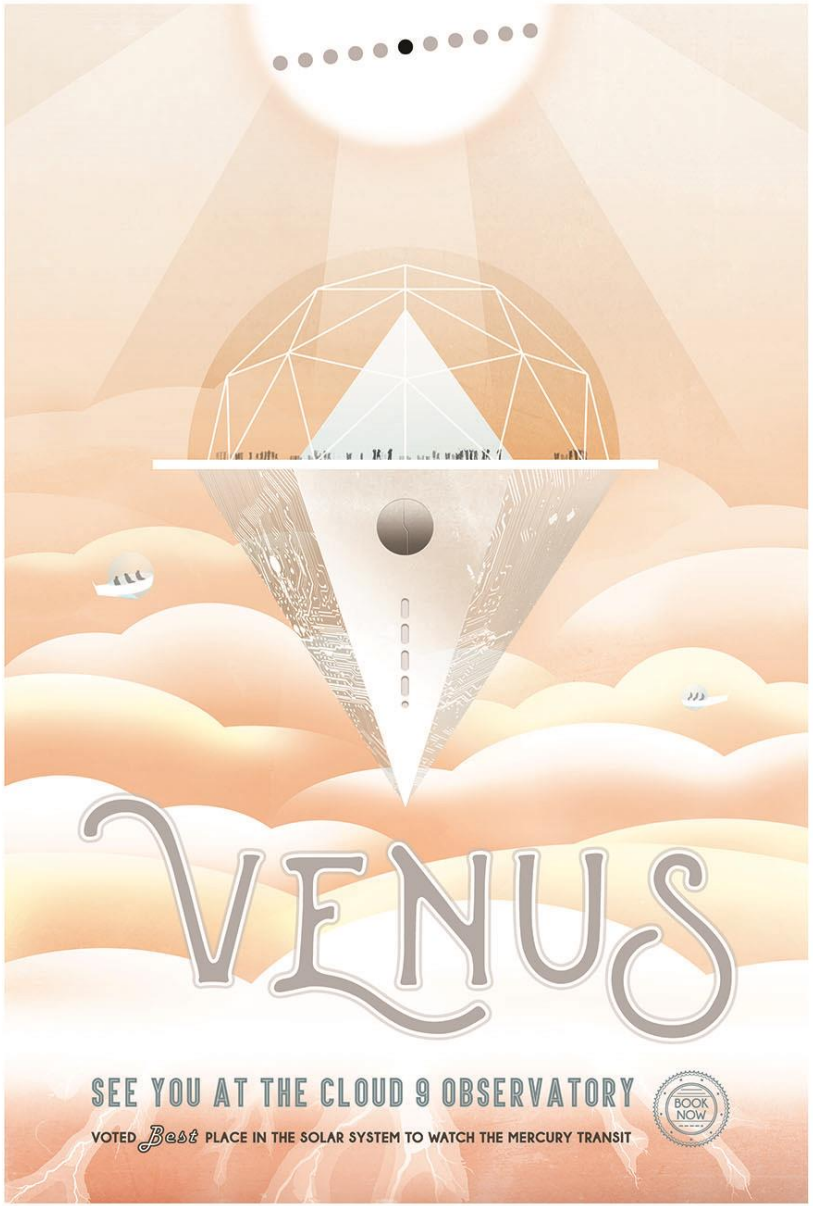
Discovered in October 2013 using direct imaging, PSO J318.5-22 belongs to a special class of planets called rogue, or free-floating, planets. Wandering alone in the galaxy, they do not orbit a parent star. Not much is known about how these planets come to exist, but scientists theorize that they may be either failed stars or planets ejected from very young systems after an encounter with another planet. These rogue planets glow faintly from the heat of their formation. Once they cool down, they will be dancing in the dark. Confirmed and candidate exoplanets and all available data are listed in the NASA Exoplanet Archive.

NASA's Exoplanet Exploration Program. Jet Propulsion Laboratory, Pasadena CA.
exep.jpl.nasa.gov

www.nasa.gov

Frigid and alien, yet similar to our own planet billions of years ago, Saturn's largest moon, Titan, has a thick atmosphere, organic-rich chemistry and a surface shaped by rivers and lakes of liquid ethane and methane. Cold winds sculpt vast regions of hydrocarbon-rich dunes. There may even be cryovolcanoes of cold liquid water. NASA's Cassini orbiter was designed to peer through Titan's perpetual haze and unravel the mysteries of this planet-like moon.

NASA Jet Propulsion Laboratory
www.jpl.nasa.gov



The rare science opportunity of planetary transits has long inspired bold voyages to exotic vantage points – journeys such as James Cook's trek to the South Pacific to watch Venus and Mercury cross the face of the Sun in 1769. Spacecraft now allow us the luxury to study these cosmic crossings at times of our choosing from unique locales across our solar system.

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www.jpl.nasa.gov