National Aeronautics and
Space Administration

2023 NASA SCIENCE

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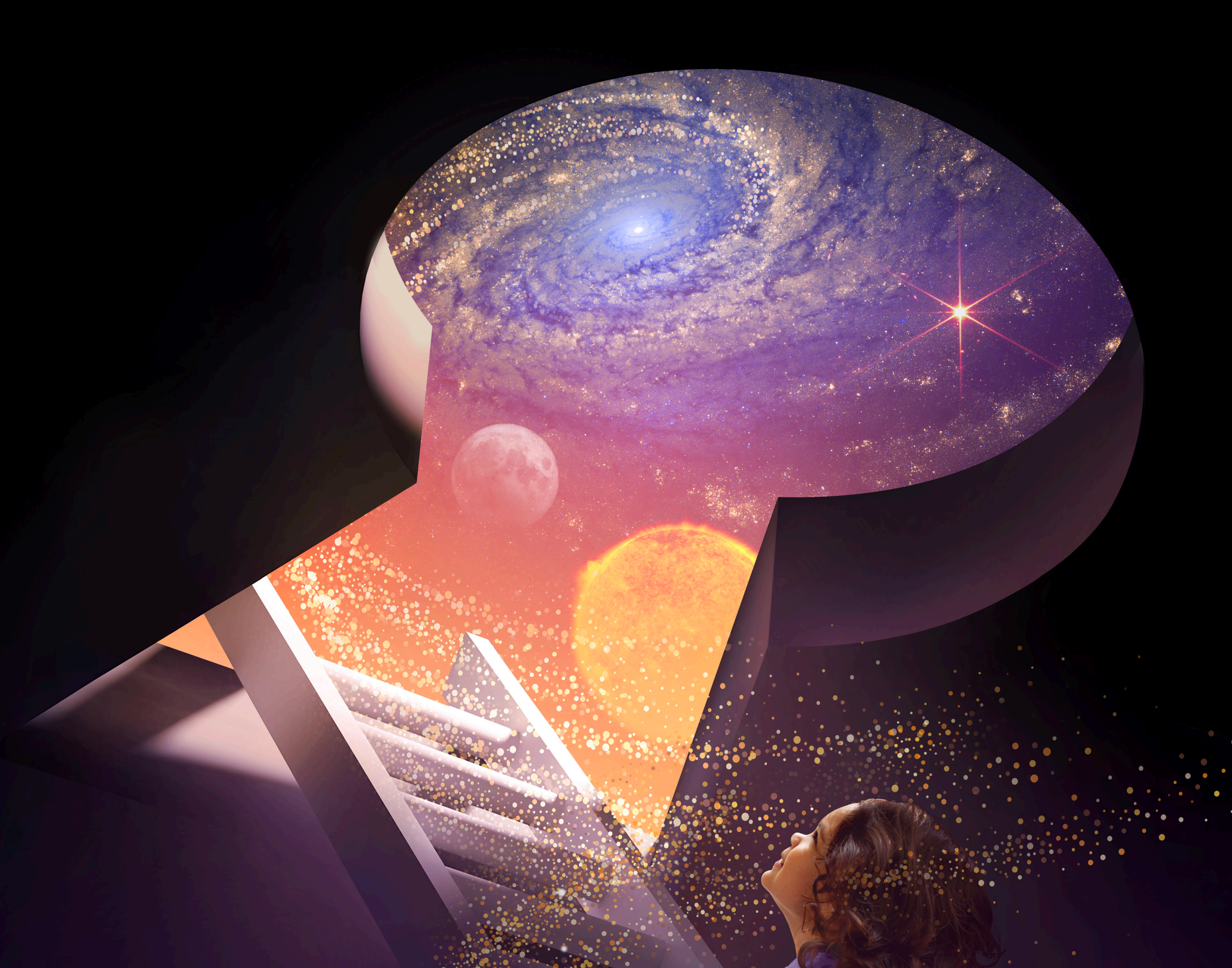

UNLOCKING THE SECRETS

Science is the key to unlocking the secrets of the universe—unifying humanity with each discovery, expanding our knowledge and igniting our imagination. As we sail the sands of time and space, science gives context and meaning to measures great and small. Did you know there are as many stars in the universe as grains of sand on Earth? The new era of NASA Science discoveries is just beginning, and you are a part of it!

In 2022, we all watched in awe as the first images from the Webb Space Telescope were revealed. These stunning observations gave us a new view into the past and the deep universe and are only a glimpse of the discoveries to come. Artemis is preparing humanity to return to the Moon and explore beyond. On Mars, we have continued searching for signs of ancient life, both microscopic and macroscopic, as the Perseverance rover collects sands and rock samples to return to Earth in 2033. While here on Earth, we are developing new missions to provide novel insights into our system of systems that is our home planet. We are also preparing for the new Earth System Observatory missions which will improve our understanding of climate change and natural hazard mitigation, enabling tangible progress at local and national levels.

Our robotic investigators are not alone in unlocking new frontiers: NASA missions continued fueling new industries and technologies and the demand for a highly skilled and diverse workforce, one that brings to the table new ideas and approaches. And looking forward, our commitment to making discoveries more accessible to all includes starting a new Open-Source Science Initiative to share data worldwide.

The NASA Science team is excited to continue our voyage together with you through time and space, discovering the universe one grain of sand at a time. Come explore with us.

Thomas H. Zurbuchen

Associate Administrator
NASA Science Mission Directorate

January 2023

Mysterious “Superbubble” Hollows Out Nebula in Hubble Image. N44 is a complex nebula filled with glowing hydrogen gas, dark lanes of dust, massive stars, and many populations of stars of different ages. One of its most distinctive features, however, is the dark, starry gap called a “superbubble,” visible in this Hubble Space Telescope image in the central region. The hole is about 250 light-years wide, and its presence is still something of a mystery. Stellar winds expelled by massive stars in the bubble’s interior may have driven away the gas, but this explanation is inconsistent with measured wind velocities in the bubble. Another possibility, since the nebula is filled with massive stars that would expire in titanic explosions, is that the expanding shells of old supernovae sculpted this cosmic cavern. **Image and text credit:** NASA, European Space Agency (ESA), V. Ksoll and D. Gouliermis (Universität Heidelberg), et al.; **processing credit:** Gladys Kober/NASA/Catholic University of America

https://go.nasa.gov/3BqEtdl

Born in 1954, **Dr. Kathryn Flanagan** is an American astrophysicist known for her senior leadership roles at the Space Telescope Science Institute in support of the science and mission operations of the James Webb Space Telescope, the Hubble Space Telescope, and the Nancy Grace Roman Space Telescope. Her prior research was in the field of X-ray astronomy, including developing instruments for the Chandra X-ray Observatory and future X-ray missions. She has held multiple astronomical community service roles and was honored by election as a fellow of the American Association for the Advancement of Science (AAAS). She is a strong advocate for science outreach to the public and the “next generation.” Photo credit: Meagan Adler

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 New Year’s Day (observed date)	3	4	5	6 Full Moon	7
8	9	10	11	12	13	14
15 Last Quarter	16 Birthday of Martin Luther King, Jr. (observed date)	17	18	19	20	21 New Moon
22	23	24	25	26	27	28 First Quarter
29	30	31				

December 2022

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February 2023

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26	27	28				

February 2023

NASA Rocket Endures Flight from Norway. On May 10, 2022, a NASA suborbital rocket called Endurance lifted off from the Svalbard Rocket Range in Norway—the northernmost launch range in the world. The rocket carried scientific instruments 475 miles (~764 kilometers) above the ground and through Earth's magnetic north pole on a brief mission to study Earth's global electric potential, or how much our planet's electric field "tugs" at electrically charged particles in our air. The European Space Agency's Venus Express mission measured the electric potential of Venus in 2016, determining that it is strong enough that it could have siphoned away ingredients of water, like the positively charged oxygen atom that gets split from water's two hydrogen atoms by intense sunlight. However, Earth's electric potential is thought to be much weaker—possibly about 25 times weaker than that of Venus, or not even as strong as a watch battery—and is so weak that previous attempts to measure it failed. Before splashing down in the Greenland Sea, Endurance took measurements that could tell us just how weak Earth's electric potential is and help explain why Earth hosts life while its planetary neighbors, Venus and Mars, do not. **Image and text credit:** NASA

https://go.nasa.gov/3OM5db0

Dr. Michael Collier (1966–2022) was the associate lab chief of the Geospace Laboratory in the Heliophysics Science Division at NASA's Goddard Space Flight Center. He fabricated, calibrated, commanded, and analyzed data from many flight hardware projects over about 30 years in the field. He launched eight instruments into space as hardware principal investigator: five low-energy neutral atom imagers, one electron spectrometer, and two soft X-ray imagers. He authored or co-authored over 110 peer-reviewed scientific articles covering solar wind, and heliospheric, terrestrial magnetospheric, and outer planets physics. Photo credit: NASA

January 2023

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March 2023

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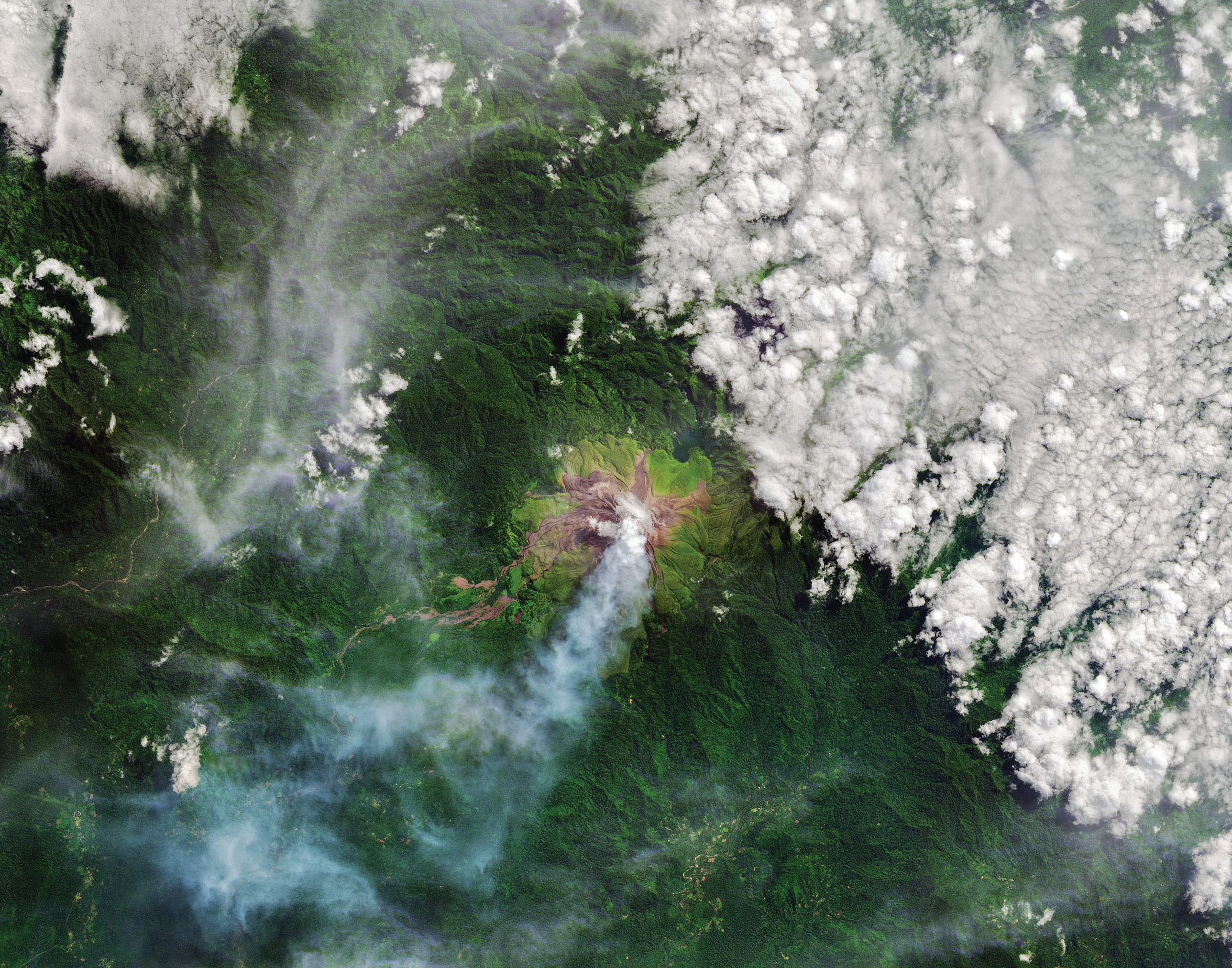
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5 Full Moon	6	7	8	9	10	11
12	13 Last Quarter	14	15	16	17	18
19	20 New Moon Washington's Birthday (observed date)	21	22	23	24	25
26	27 First Quarter	28				



March 2023

Young Volcano at Mount Bagana, Bougainville Island, Papua New Guinea. Since it was first observed by scientists in the 1840s, Mount Bagana has been erupting nearly nonstop. Of the three large volcanoes on Bougainville Island in Papua New Guinea, Mount Bagana is the only one currently active. This image—acquired May 28, 2022, by the Operational Land Imager-2 (OLI-2) on the recently launched NASA–U.S. Geological Survey (USGS) satellite Landsat 9—shows some of the more recent lava flows that helped create the large, symmetrical cone, which formed over the past 300–500 years. Fresh lava appears dark brown, while older lava flows have been covered by newer, light-green vegetation; dark-green areas are forests. Lighter brown areas are where volcanic debris or gasses have killed off vegetation. The white plume contains some of the several thousand tons of sulfur dioxide that the volcano emits each day—more than any other volcano without a lava lake. **Image and text credit:** NASA Earth Observatory image by Joshua Stevens, using Landsat data from USGS; original story by Sara E. Pratt

https://go.nasa.gov/3AxFNdj

Dr. Gail Skofronick Jackson (1963-2021) was a program manager at NASA Headquarters for Weather and Atmospheric Dynamics in the Earth Science Research & Analysis Program. Before joining the Headquarters staff, she worked at NASA's Goddard Space Flight Center (GSFC), where she started in 1997 as a postdoctoral research associate and later served as a research scientist focusing on snow. She went on to serve as the project scientist for the Global Precipitation Measurement mission and lab chief, where she earned the respect of colleagues from around the world. She was an inspirational mentor to early-career and student scientists, especially women, and helped establish the Women Mentoring Women initiative at the Institute of Electrical and Electronics Engineers Geoscience and Remote Sensing Society. An avid runner who organized group runs at science meetings and conferences, Skofronick Jackson was a graduate of Florida State University and earned her master's and doctorate degrees from the Georgia Institute of Technology. Photo credit: NASA/Bill Ingalls

February 2023

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April 2023

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7 Full Moon	8	9	10	11
12 Daylight Saving Time Begins	13	14	15 Last Quarter	16	17	18
19	20	21 New Moon	22	23	24	25
26	27	28	29 First Quarter	30	31	

April 2023

Juno Captures Moon Shadow on Jupiter. NASA's Juno spacecraft captured this view of Jupiter during the mission's 40th close pass by the giant planet on February 25, 2022. The large, dark shadow on the left side of the image was cast by Jupiter's moon Ganymede. Citizen scientist Thomas Thomopoulos created this enhanced-color image using raw data from the JunoCam instrument. At the time the raw image was taken, the Juno spacecraft was about 44,000 miles (71,000 kilometers) above Jupiter's cloud tops, at a latitude of about 55 degrees south, and 15 times closer than Ganymede, which orbits about 666,000 miles (1.1 million kilometers) away from Jupiter. An observer at Jupiter's cloud tops within the oval shadow would experience a total eclipse of the Sun. Total eclipses are more common on Jupiter than Earth for several reasons. Jupiter has four major moons (Galilean satellites) that often pass between Jupiter and the Sun: in seven days, Ganymede transits once; Europa, twice; and Io, four times. And since Jupiter's moons orbit in a plane close to Jupiter's orbital plane, the moon shadows are often cast upon the planet. JunoCam captured this image from very close to Jupiter, making Ganymede's shadow appear especially large. **Image and text credit:** NASA/Jet Propulsion Laboratory–Caltech/Southwest Research Institute/Malin Space Science Systems/Thomas Thomopoulos © CC BY

https://go.nasa.gov/3K3xEyX

Dr. Michael A'Hearn (1940–2017) was the principal investigator of NASA's Deep Impact mission, which explored beneath the surface of comet Tempel 1 by placing an impactor spacecraft in its path. He led the follow-on EPOXI mission that flew the remaining observer spacecraft by comet Hartley 2. A'Hearn advanced the field of cometary science through his foundational research on the physics, physical properties, and chemistry of comets from ground-based and space-based telescopes and from spacecraft. He established the Small Bodies Node of NASA's Planetary Data System to make mission and scientific data available to the global community. He was a distinguished professor with a 45-year career at the University of Maryland, where he taught classes and advised numerous graduate students and postdoctoral fellows. The awards for his contributions to science were many, but his humility and devotion to service made an equally deep impact on the scientific community. Photo credit: Ball Aerospace

March 2023

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May 2023

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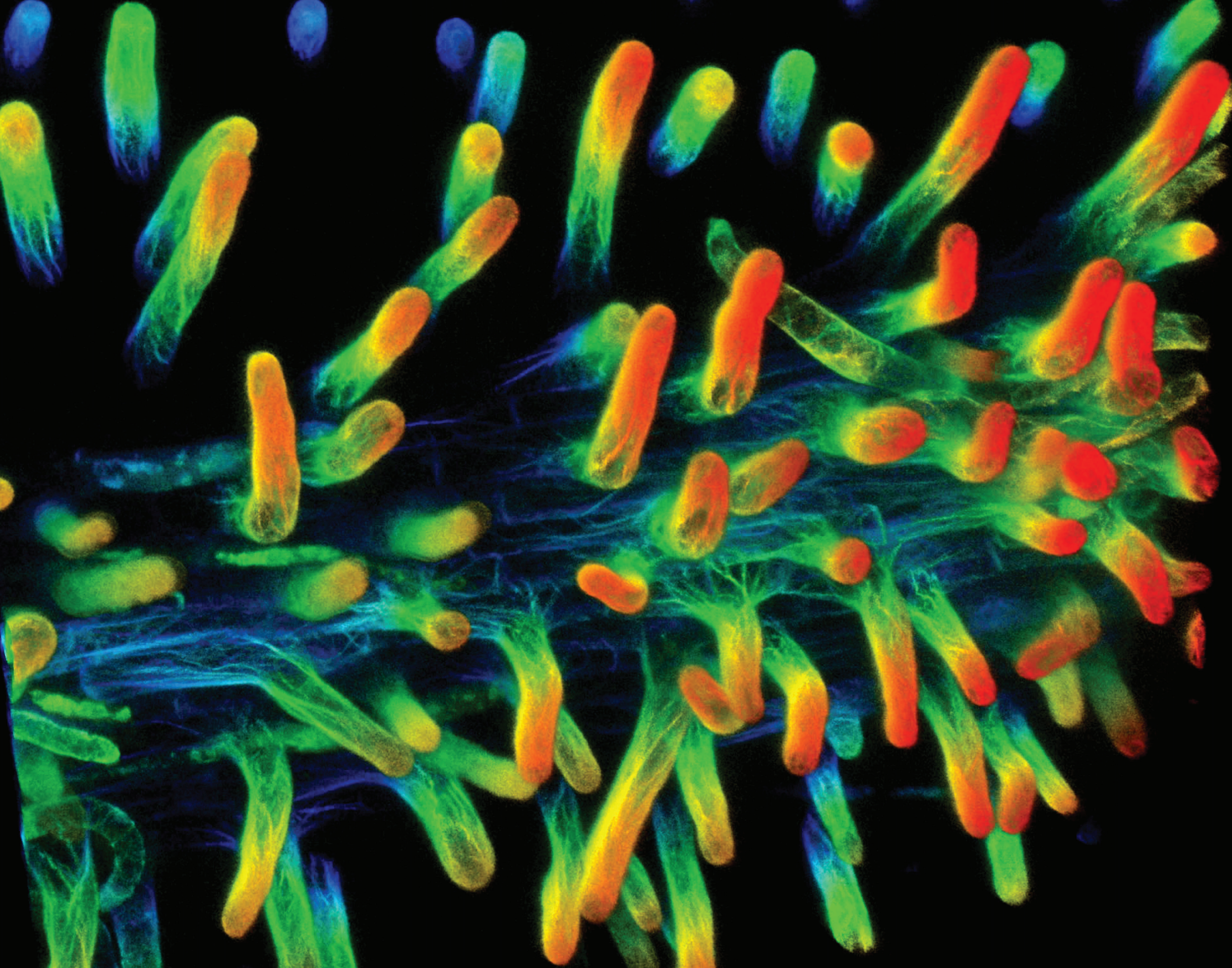
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Did you know that April is Citizen Science Month? NASA's citizen science projects are collaborations between scientists and interested members of the public. Through these collaborations, volunteers (known as citizen scientists) have helped make thousands of important scientific discoveries. Want to work on some real NASA science? NASA citizen science projects are open to everyone around the world, not limited to U.S. citizens or residents. Many projects can be done by anyone, anywhere, with just a cellphone or laptop. Visit *https://science.nasa.gov/citizenscience* or scan the QR code to get started.						1
2	3	4	5	6 Full Moon	7	8
9	10	11	12	13 Last Quarter	14	15
16	17	18	19	20 New Moon	21	22
23 30	24	25	26	27 First Quarter	28	29



May 2023

Plant Actin Cytoskeleton and Microgravity. The cytoskeleton is a network of thread-like proteins in plant and animal cells that carries out key functions in many biological processes. The cytoskeleton can sense changes in gravity and sends signals to the cells indicating these changes so they can respond accordingly. In animals, studying the cytoskeleton provides valuable information for mitigating bone and muscle loss, as well as cardiovascular dysfunction during spaceflight. This image, taken with a confocal microscope, shows a component of the cytoskeleton—called actin—in a living root of the model plant *Medicago truncatula*. Colors were assigned to highlight different features of the root. The finger-like structures (yellow-orange nodules) in the image are root hairs, which help plants absorb water and nutrients, among other essential duties. The thread-like structures (light blue and green strands) within the root hairs are actin filaments. Tools to better visualize actin filaments were developed by NASA-funded plant scientists to understand how microgravity affects plant development and plant response to stresses encountered during spaceflight. These studies aim to enable the development of plant varieties that could help support sustained human presence in space. **Image and text credit:** NASA Kennedy Space Center/Noble Research Institute, LLC

https://go.nasa.gov/3K44Aca

Dr. Robert Siegel (1927–2017) joined the NACA (NASA's predecessor) in 1955 and was a senior research scientist at NASA Lewis (now Glenn) Research Center for 44 years until he retired in 1999. Siegel authored 185 technical papers and is internationally recognized as an expert on heat transfer. A former fellow of both the American Society of Mechanical Engineers (ASME) and the American Institute of Aeronautics and Astronautics (AIAA), he received the AIAA Thermophysics Award and the Max Jakob Award. To study reduced gravity effects on heat transfer, Siegel developed the first drop tower of its kind. This pioneering work led to the design of NASA Glenn's Zero Gravity Research Facility. Siegel was inducted into the inaugural class of the NASA Glenn Research Center Hall of Fame in 2015 as one of the "Giants of Heat Transfer." Photo credit: NASA

April 2023

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June 2023

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5 Full Moon	6
7	8	9	10	11	12 Last Quarter	13
14 Mother's Day	15	16	17	18	19 New Moon	20
21	22	23	24	25	26	27 First Quarter
28	29 Memorial Day	30	31			

June 2023

Carina Nebula. This landscape of “mountains” and “valleys” speckled with glittering stars is actually the edge of a nearby, young, star-forming region called NGC 3324 in the Carina Nebula. Captured in infrared light by NASA’s new James Webb Space Telescope, this image reveals for the first time previously invisible areas of star birth. Called the “Cosmic Cliffs,” Webb’s seemingly three-dimensional picture looks like craggy mountains on a moonlit evening. In reality, it is the edge of the giant, gaseous cavity within NGC 3324, and the tallest “peaks” in this image are about 7 light-years high. The cavernous blue-colored area has been carved from the nebula by intense ultraviolet radiation and stellar winds from extremely massive, hot, young stars located in the center of the bubble, above the area shown in this image. **Image and text credit:** NASA, European Space Agency (ESA), Canadian Space Agency (CSA), and Space Telescope Science Institute (STScI)

https://go.nasa.gov/3S7xr2R

Born in 1960, **Gregory Robinson** retired as the program director of NASA’s James Webb Space Telescope. He held several senior leadership positions at NASA, including Associate Administrator for Programs, in which he provided leadership in the development and operations of 114 flight missions in the Science Mission Directorate; deputy director of NASA’s Glenn Research Center, where the scope of work spans research and technology, aeronautics, uncrewed science spaceflight, and human spaceflight; and NASA’s deputy chief engineer, in which he was engaged with the last 21 shuttle launches and numerous satellite developments and launches. His accomplishments have been recognized with several awards, including *TIME* magazine’s 100 Most Influential People of 2022, Management Excellence Medal finalist for the 2022 Samuel J. Heyman Service to America Medals (Sammies), the Presidential Distinguished Executive Rank Award (2013), and the Presidential Meritorious Executive Rank Award (2007). Photo credit: NASA/Chris Gunn

May 2023

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July 2023

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4 Full Moon	5	6	7	8	9	10 Last Quarter
11	12	13	14 Flag Day	15	16	17
18 New Moon Father’s Day	19 Juneteenth National Independence Day	20	21	22	23	24
25	26 First Quarter	27	28	29	30	

2023 YEAR AT A GLANCE

January

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February

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March

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May

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June

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SCIENCE FLEET

OPERATING & FUTURE MISSIONS

SPHEREX
GUSTO
FERMI
XRISM*
STARBURST
CHANDRA
WEBB
TESS
ASPERA
HUBBLE
ROMAN
NEW HORIZONS
IXPE
GEHRELS SWIFT
XMM-NEWTON*
VOYAGER 1
VOYAGER 2
PANDORA
ARIEL*
PUEO
EUCLID*
NUSTAR
SOLAR ORBITER*
SUNRISE
PARKER SOLAR PROBE
WIND
IMAP
THEMIS
STEREO
TIMED
GEOTAIL*
HELIOSWARM
SOHO*
HINODE*
ACE
ICON
GLIDE
AIM
EUVST*
GOLD
DRAGONFLY
EZIE
IRIS
BEPICOLOMBO*
TRACERS
SDO
JUICE*
MUSE
PUNCH
LUCY
IBEX
MMS
ENVISION*
GEOSPACE DYNAMICS CONSTELLATION
JUNO
DAVINCI
PSYCHE
EUROPA CLIPPER
VERITAS

NEO SURVEYOR

OSIRIS-REX/APEX

MSR EARTH RETURN ORBITER*

TRACE GAS ORBITER*

ESCAPADE

MMX*

NEOWISE

MAVEN

MRO

MARS EXPRESS*

SRL-SRH

SRL-MAV

ROSALIND FRANKLIN*

MARS ODYSSEY

PERSEVERANCE

INSIGHT

CURIOSITY

INCUS

CALIPSO

TEMPO

MAIA

TROPICS

SMAP

NISAR

TERRA

AQUA

PACE

BION*

RAD-SEED

OCO-2

CLOUDSAT

GPM

AURA

TSIS-2

CYGNSS

CLARREO-PF

ECOSTRESS

OCO-3

GEDI

SAGE III

DECLIC

TSIS-1

LIS

APH

PK-4

EMIT

SUBSA

EHD

MICRO

RR

SENTINEL-6 MICHAEL FREILICH*

BRIC-LED

GOES-18*

NOAA-20*

CAL

PREFIRE

RSD

BECCAL*

LIBERA

JANUS

SOFIE

MSRR

GLIMR

TIGERISS

ZBOT-NC

SENTINEL-6B*

NICER

VEGGIE

GRACE-FO

FBCE

THEMIS-ARTEMIS

ESO-1, 2, 3, 4

PFMI

HERMES

GOES-U*

AWE

PEREGRINE-1~

LANDSAT NEXT

1ST NOVA-C~

LRO

LANDSAT 7, 8, 9

BLUE GHOST~

LUNAR TRAILBLAZER

JPSS-2, 3, 4*

SERIES-2~

DSCOVR*

2ND NOVA-C~

LUNAH-MAP

GRIFFIN-1~ & VIPER

SWOT

3RD NOVA-C~

GEOCARB

LEIA

SUOMI NPP*

XL-1~

BIOEXPT-1

ICESAT-2

EARTH SCIENCE

HELIOPHYSICS

PLANETARY SCIENCE

ASTROPHYSICS

BIOLOGICAL & PHYSICAL

Future launches in bold

* Partner-led

~ Delivery contract for NASA instrument/payloads

SEPTEMBER 2022

science.nasa.gov/missions

July

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August

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September

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October

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November

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December

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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

July 2023

A Vivid Aurora Streams Over Earth. An astronaut on the International Space Station captured this photo of a vivid aurora streaming over Earth on October 13, 2021, as the station orbited 274 miles (~441 kilometers) above the southern Indian Ocean between Australia and Antarctica. Auroras are produced when particles ejected by the Sun reach Earth and travel along our planet's magnetic field lines into the upper atmosphere. There, the solar particles bombard oxygen and nitrogen atoms, which release photons of light that we see as the beautiful colors of the aurora. **Image and text credit:** NASA/Shane Kimbrough

https://go.nasa.gov/3K3JvyB

Born in 1981, **Dr. Yaireska Collado-Vega** works as the director of the Moon 2 Mars Space Weather Analysis Office, providing expert-based analysis of the space radiation environment. Her work has focused on space weather events and their impact on Earth, contributing to NASA missions such as the Magnetospheric Multiscale Mission (MMS) and the Van Allen Probes. Originally from Ponce, Puerto Rico, Collado-Vega earned degrees in theoretical physics from the University of Puerto Rico at Mayagüez and a doctorate in space physics from the Catholic University of America in Washington, D.C. She has received many awards, and her work was showcased in the first *Women of Goddard* book. Photo credit: NASA

June 2023

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August 2023

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27	28	29	30	31		

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3 Full Moon	4 Independence Day	5	6	7	8
9	10 Last Quarter	11	12	13	14	15
16	17 New Moon	18	19	20	21	22
23 30	24 31	25 First Quarter	26	27	28	29

August 2023

Lake Erie in Winter. In this February 5, 2022, image of Lake Erie—captured by the Operational Land Imager (OLI) on the NASA–U.S. Geological Survey (USGS) satellite Landsat 8—ice covers about 90% of the lake's surface. The track of a ship that made its way through the ice can be seen in the middle-left region of the image. Ice cover on the lake can change quickly, even day-to-day. Just two days earlier, on February 3, ice cover was only about 62%, and the day after the image was taken, February 6, it had fallen from 90% to 82%. Air temperature and wind affect the extent and thickness of ice on all the Great Lakes. As the shallowest of the Great Lakes, Lake Erie regularly sees annual maximum ice cover of more than 80%, compared to about 53% annual average ice cover for the Great Lakes overall. Over the past 50 years, Lake Erie has seen 100% ice cover three times: in 1978, 1979, and 1996. **Image and text credit:** NASA Earth Observatory image by Joshua Stevens, using Landsat data from USGS; original story by Sara E. Pratt

https://go.nasa.gov/3PFs0Wl

Dr. Shelby Tilford (1937–2022) played a significant role in growing NASA's Earth Science Division from a small program to a major agency initiative. Tilford joined NASA's solar physics program in 1976. By the time he retired from the Agency in 1994 as acting Associate Administrator of Mission to Planet Earth, Tilford had overseen NASA's adoption of Earth System Science as an integrative approach, as well as the creation of the Earth Observing System of satellites and the effort to ensure wide access to their data. He played a key role in the development of the interagency U.S. Global Change Research Program (USGCRP), and he received numerous awards, including the Presidential Rank Awards' Distinguished Executive Award (1993), the William T. Pecora Award (1992), and the Lifetime Achievement Award from the National Council for Science and the Environment (2014). A graduate of Western Kentucky University, Tilford was awarded his Ph.D. in physical chemistry from Vanderbilt University before beginning his career at the U.S. Naval Research Laboratory. Photo credit: Courtesy of the Tilford family

July 2023

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30	31					

September 2023

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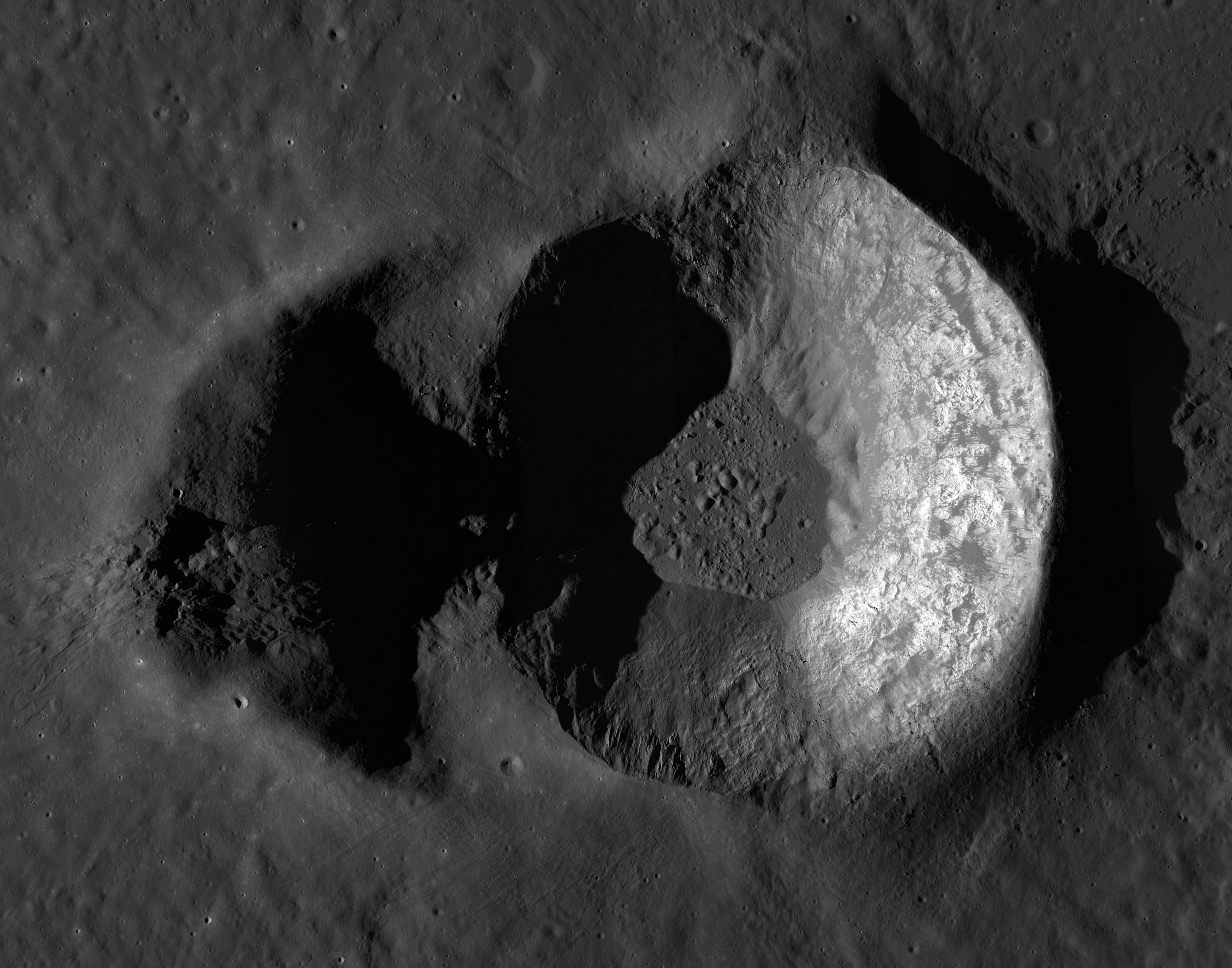
24	25	26	27	28	29	30

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 Full Moon	2	3	4	5
6	7	8 Last Quarter	9	10	11	12
13	14	15	16 New Moon	17	18	19
20	21	22	23	24 First Quarter	25	26
27	28	29	30	31 Full Moon		



September 2023

Double Trouble: Messier A. This feature mosaic of Messier A crater, located in Mare Fecunditatis on the Moon, was captured by NASA's Lunar Reconnaissance Orbiter (LRO). Three Narrow Angle Camera (NAC) images make up the mosaic. Messier A crater presents an interesting puzzle. The main crater is beautifully preserved, with a solidified pond of impact melt resting in its floor. But there is another impact crater beneath and just to the west of Messier A (the shadowed crescent shape that appears on the left side of the scene). This more subdued and degraded impact crater clearly formed first, with Messier A following as a second impact. But what interval of time separated these two impact events? Perhaps the first impact occurred thousands of years or more before the second and was just unlucky to have a similarly sized impact crater form almost directly on top of it. It is also possible that these two craters formed just seconds apart. **Image and text credit:** NASA/Goddard Space Flight Center/Arizona State University

https://www.lroc.asu.edu/posts/1136

Dr. Marilyn Fogel (1952–2022) was a world-leading isotope biogeochemist and pioneering astrobiologist. Fogel was an outstanding scientist, at home in the laboratory or in the field, focusing on the uses of isotopes to examine and characterize the fields of ecology and biogeosciences. She was a leading light in the nascent field of astrobiology and was elected to the National Academy of Sciences. She was a fellow of the American Geophysical Union, the American Association for the Advancement of Science, and the Geochemical Society—which awarded her its Treibs and Goldschmidt medals. Fogel spent 30 years at the Carnegie Institute of Washington before moving to a professorship at the University of California, Merced, in 2013 and to a distinguished chair in geoecology at the University of California, Riverside, in 2016. Her last years of research included one of the most vexing environmental problems in the United States—the shrinking of the Salton Sea. Fogel showed a joie de vivre for all aspects of life and supervised many of the leading isotope geochemists in the country. In addition to several seminal isotope papers, she wrote three books on her career and the challenges faced by women in the sciences. Photo credit: Steele, Eigenbrode, and Lyons

August 2023

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20	21	22	23	24	25	26
27	28	29	30	31		

October 2023

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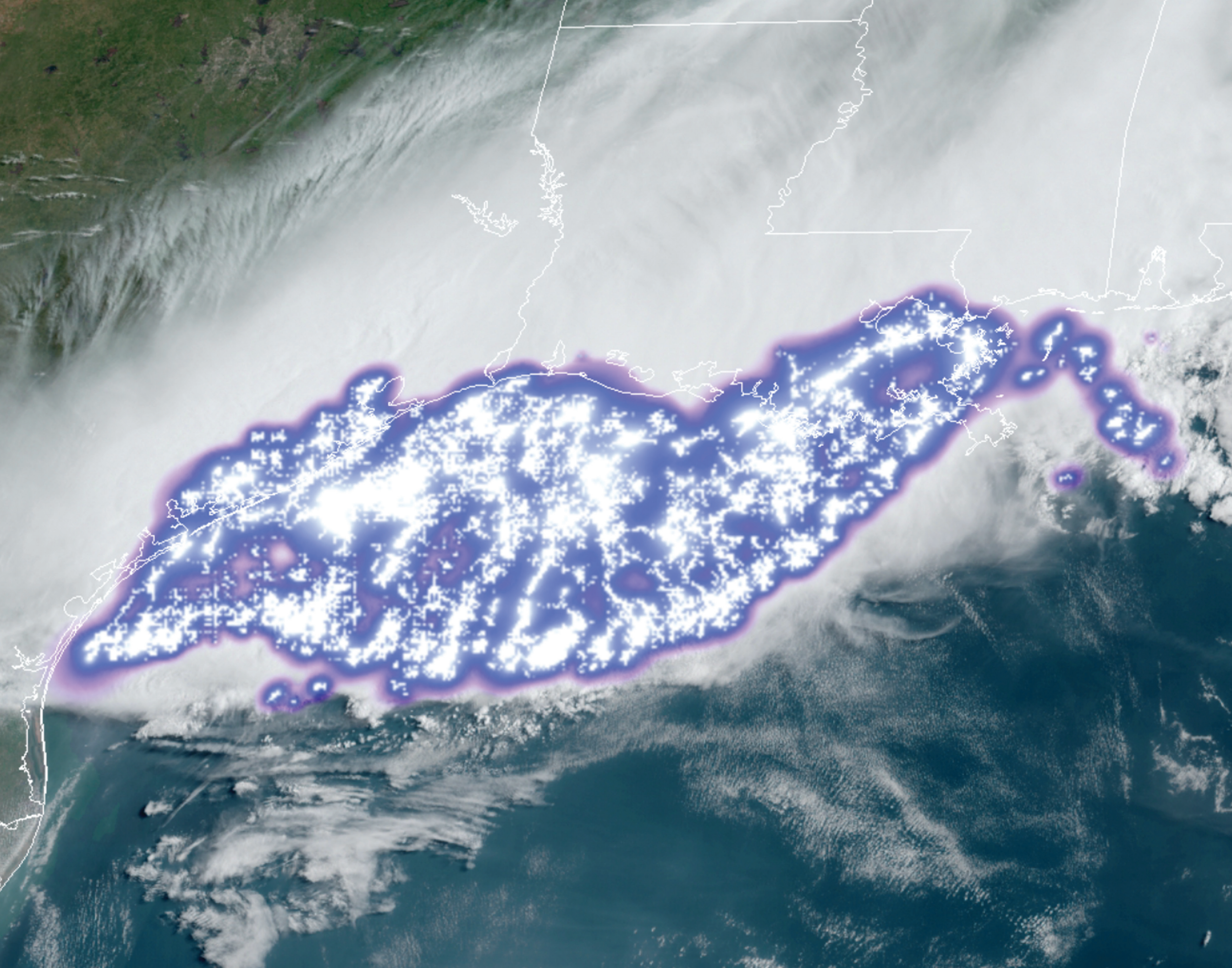
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4 Labor Day	5	6 Last Quarter	7	8	9
10	11	12	13	14	15 New Moon	16
17 Constitution Day	18	19	20	21	22 First Quarter	23
24	25	26	27	28	29 Full Moon	30



October 2023

World's Longest Lightning Flash on Record Captured by NOAA Satellites. Within this cluster of storms, a single lightning bolt captured by the Geostationary Lightning Mapper (GLM) instrument on the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite-16 was certified by the World Meteorological Organization (WMO) as the world's longest flash on record. The horizontal distance of the bolt stretched 477 miles (~768 kilometers), from the central coast of Texas to southern Mississippi, when it flashed on April 29, 2020. The flash generated millions of joules over its approximately 8-second duration. This beats the previous record of 440.6 miles (~709 kilometers) for a lightning strike across southern Brazil in 2018. **Image and text credit:** NOAA

https://www.nesdis.noaa.gov/news/longest-lightning-flash-ever

Margaret Davidson (1950–2017) was a visionary leader in coastal management and sustainability. Davidson spent most of her career at the National Oceanic and Atmospheric Administration (NOAA), where she focused on environmentally sustainable coastal development practices, the reduction of risk associated with extreme events, and climate adaptation. She held advanced degrees in law, marine policy, and resource economics. She served as executive director of the South Carolina Sea Grant Consortium for 13 years before joining NOAA as the founding director of the Coastal Services Center. During her NOAA career, she held many key leadership positions, most notably serving as NOAA's senior scientific advisor on coastal inundation and resilience. Davidson was a Fulbright Fellow, American Meteorological Society Fellow, Gilbert White Fellow, and Zurich Fellow for Climate Adaptation, and was awarded the Nobel Prize in 2007 jointly with the Intergovernmental Panel on Climate Change and Albert Gore, Jr. Photo credit: NOAA

September 2023

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24	25	26	27	28	29	30

November 2023

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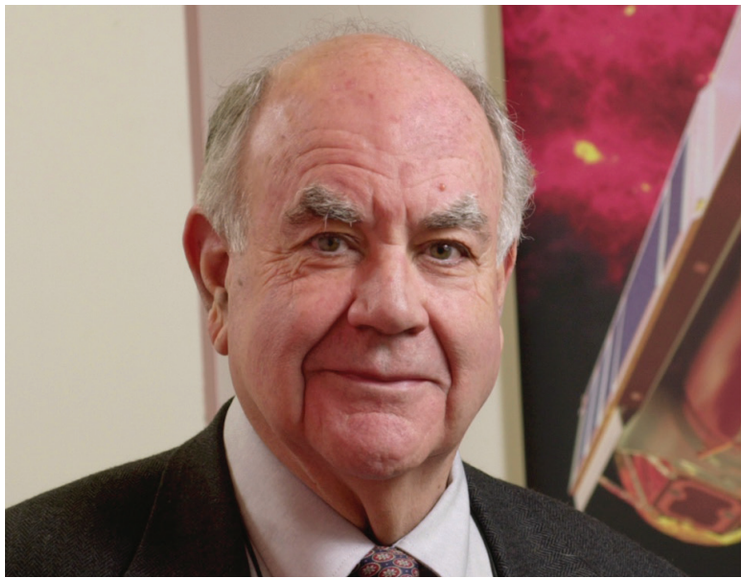
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6 Last Quarter	7
8	9 Columbus Day	10	11	12	13	14 New Moon
15	16	17	18	19	20	21
22 First Quarter	23	24	25	26	27	28 Full Moon
29	30	31				

November 2023

Stephan's Quintet. A visual grouping of five galaxies, called Stephan's Quintet, is best known for being prominently featured in the holiday classic film *It's a Wonderful Life*. Today, NASA's James Webb Space Telescope reveals Stephan's Quintet in a new light. This enormous mosaic covers about one-fifth of the Moon's diameter. It contains over 150 million pixels and is constructed from almost 1,000 separate image files. The information from Webb provides new insights into how galactic interactions may have driven galaxy evolution in the early universe. With its powerful infrared vision and extremely high spatial resolution, Webb shows never-before-seen details in this galaxy group. Sparkling clusters of millions of young stars and starburst regions of fresh star birth grace the image. Sweeping tails of gas, dust, and stars are being pulled from several of the galaxies due to gravitational interactions. Most dramatically, Webb captures huge shock waves as one of the galaxies, NGC 7318B, smashes through the cluster. **Image and text credit:** NASA, European Space Agency (ESA), Canadian Space Agency (CSA), and Space Telescope Science Institute (STScI)

https://go.nasa.gov/3zcZwNL



Born in 1933, **Dr. Giovanni Fazio** is currently senior physicist at the Center for Astrophysics | Harvard & Smithsonian; faculty emeritus at the International Space University, Strasbourg, France; and for many years a lecturer within the Astronomy Department at Harvard University. He received his undergraduate degree from St. Mary's College, Texas, and his Ph.D. in physics from the Massachusetts Institute of Technology (MIT), and he has performed research in the area of space astronomy for more than 60 years. He has been the principal investigator for cameras on three of NASA's space telescope missions and co-investigator on a fourth space mission. He was recently the principal investigator for the Infrared Array Camera (IRAC) on the Spitzer Space Telescope, one of NASA's Great Observatories, which viewed the universe for more than 16 years. He has served on numerous NASA advisory committees and is the recipient of many national and international awards. Photo credit: Smithsonian Institution

October 2023

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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

December 2023

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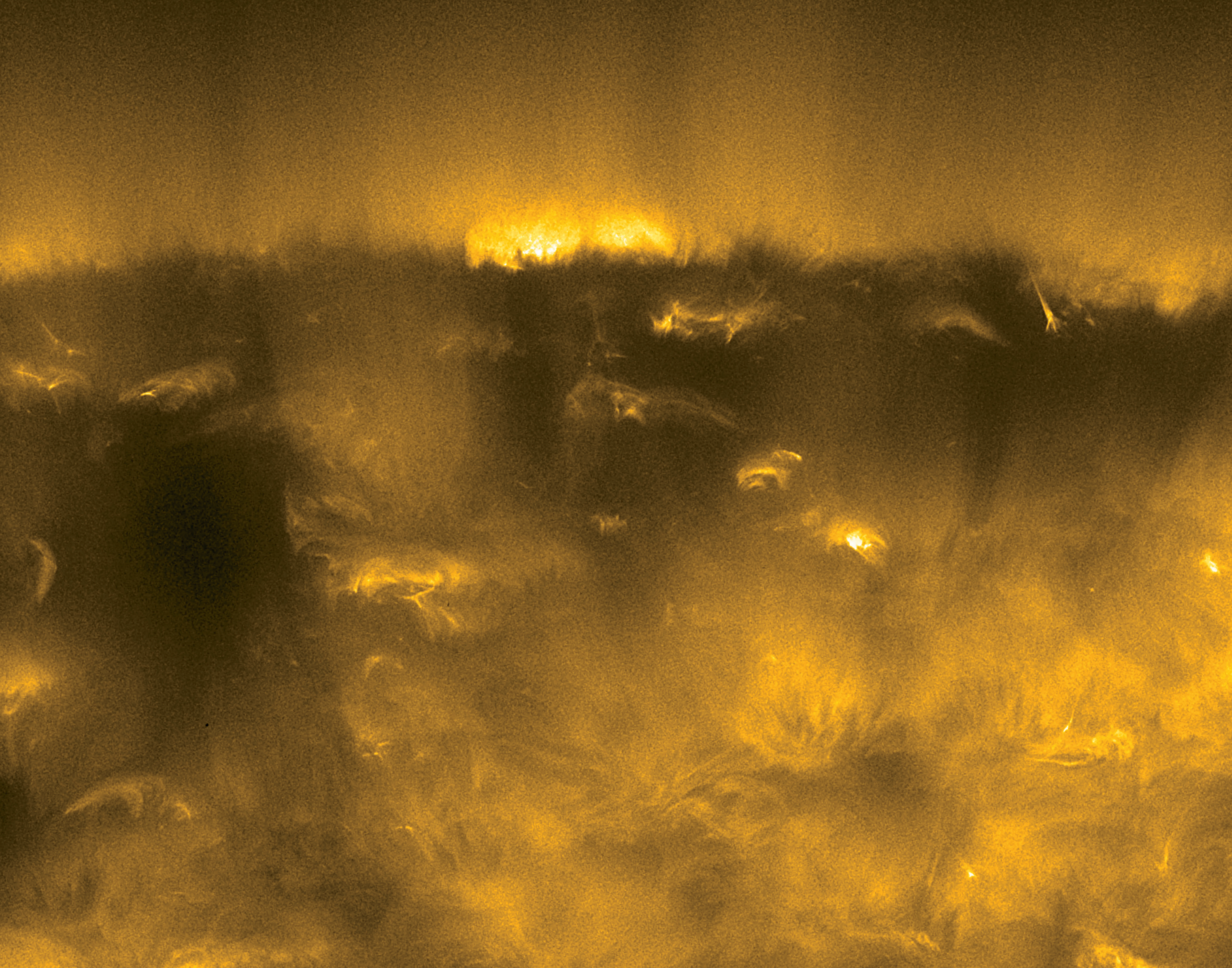
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5 Last Quarter Daylight Saving Time Ends	6	7 Election Day	8	9	10 Veterans Day (observed date)	11
12	13 New Moon	14	15	16	17	18
19	20 First Quarter	21	22	23 Thanksgiving Day	24	25
26	27 Full Moon	28	29	30		



December 2023

The Sun As You've Never Seen It Before. The European Space Agency (ESA)/NASA Solar Orbiter spacecraft captured this view of the Sun's south pole on March 30, 2022, just four days after the spacecraft made its closest-yet pass to the Sun, traveling inside the orbit of Mercury, about one-third the distance from the Sun to Earth. The highest-resolution image of the Sun's south pole taken by Solar Orbiter up to that date was recorded at a wavelength of 17 nanometers by the mission's Extreme Ultraviolet Imager (EUI) and colored yellow, as that wavelength of light is invisible to the human eye. The lighter areas of the image are mostly created by loops of magnetism that rise upward from the solar interior and trap particles that emit the extreme-ultraviolet radiation detected here. The darker areas are regions where the Sun's magnetic field lines open, allowing gases to escape into space and creating the solar wind, a constant stream of solar material that travels through the solar system. **Image and text credit:** ESA & NASA/Solar Orbiter/EUI Team

https://www.esa.int/Science_Exploration/Space_Science/Solar_Orbiter/The_Sun_as_you_ve_never_seen_it_before

Born in 1943, **Dr. Jay Pasachoff** has been observing solar eclipses since he was 16 years old. He has experienced 75 so far, including 36 total eclipses. An astronomy professor at Williams College in Massachusetts for 50 years, he has brought his students on many eclipse expeditions, striving to both teach and learn more about the Sun with each eclipse. Pasachoff earned his doctorate from Harvard University while studying the solar chromosphere, the layer above the visible "surface" of the Sun. He has used several NASA satellites to study the Sun, and one of his photographs is included on the Golden Record carried by NASA's two Voyager spacecraft. Photo credit: Courtesy of Jay Pasachoff

November 2023

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26	27	28	29	30		

January 2024

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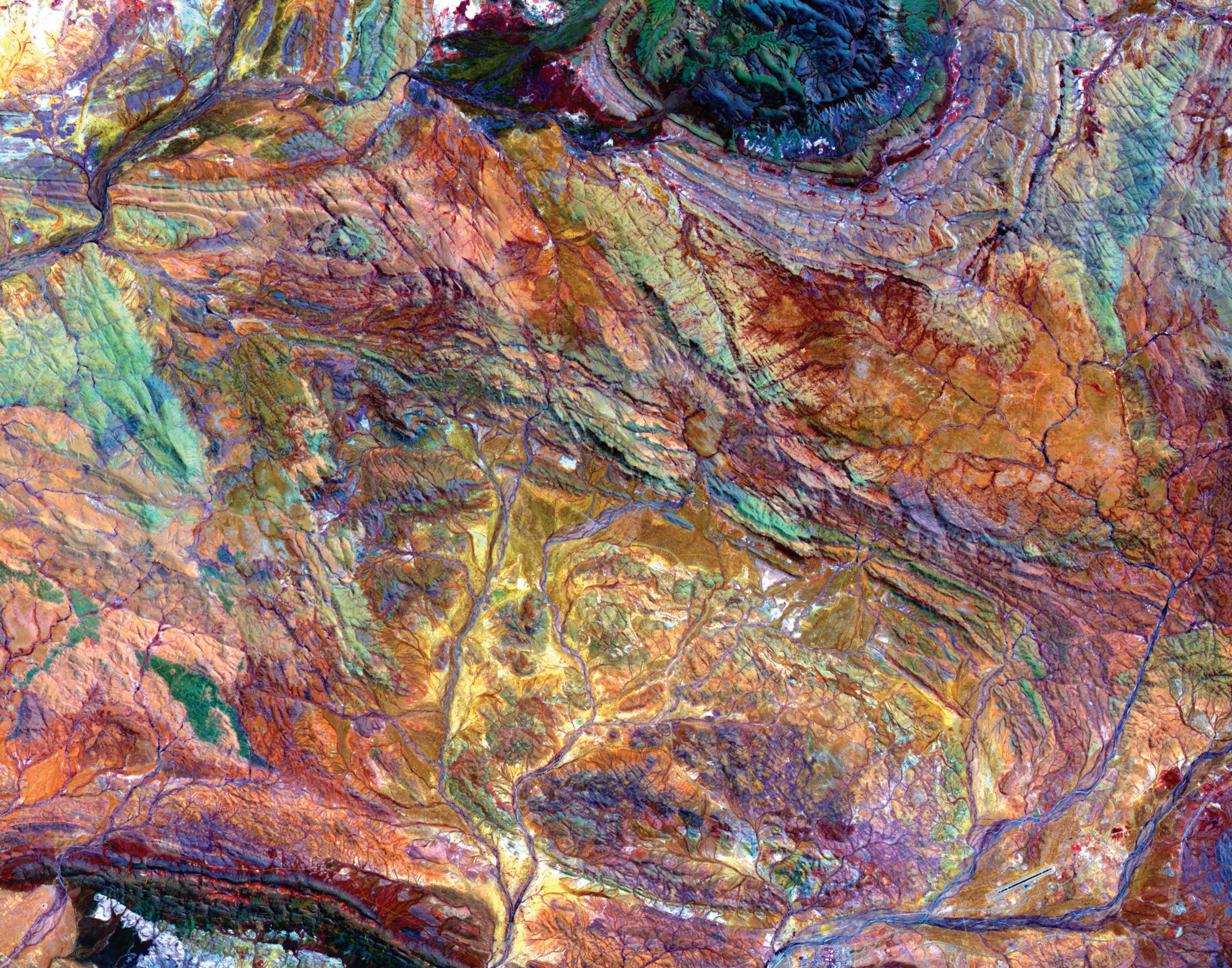
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5 Last Quarter	6	7	8	9
10	11	12 New Moon	13	14	15	16
17	18	19 First Quarter	20	21	22	23
24 31	25 Christmas Day	26	27 Full Moon	28	29	30



January 2024

Assembling Australia. In northwestern Australia, the Pilbara Craton is home to some of the oldest fossilized lifeforms on Earth, 3.45-billion-year-old microbial cyanobacteria called stromatolites. This visible and infrared image showing part of the Hamersley Basin was captured October 12, 2004, by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument built by Japan's Ministry of Economy, Trade, and Industry (METI), which flies on NASA's Terra satellite. To distinguish between bands that detect shortwave-infrared light, near-infrared and visible red light, and green light, researchers assigned the colors red, green, and and blue, respectively, to assemble the image shown. Using these color bands, researchers can distinguish characteristics of the Craton, such as iron-rich areas (yellow-green) or vegetation (dark red). In addition to holding an incredibly preserved record of the Great Oxidation Event—when oxygen became a major component of Earth's atmosphere some 2.5 billion years ago—the iron-rich rocks also provide a significant economic contribution to the iron-ore mining industry in the region. **Image and text credit:** NASA Earth Observatory image by Joshua Stevens, using data from NASA/METI/Advanced Information Systems Technology (AIST)/Japan Space Systems and the U.S.–Japan ASTER Science Team; original story by Sara E. Pratt

https://go.nasa.gov/3PujeKU

Born in 1944, **Dr. Jagadish Shukla**, learned his early school lessons under a tree, as his small village in India had no primary school. Although his high school did not teach science, Shukla's father gave him science textbooks to study, and Shukla went on to earn degrees from Banaras Hindu University and the Massachusetts Institute of Technology. Shukla has advanced the field of meteorology worldwide, notably as a senior scientist at NASA's Goddard Space Flight Center (1979-83), where he showed how satellite measurements can be used to predict seasonal mean climate and demonstrated the importance of retrospective data analysis in climate studies. Among his many awards are the International Meteorological Organization Prize from the World Meteorological Organization (2007) and NASA's Exceptional Scientific Achievement Award (1982). A distinguished professor and founding chairman of the Department of Atmospheric, Oceanic and Earth Sciences at George Mason University, Shukla helped establish Gandhi College in his home village for the education of girls. Photo credit: Courtesy of Jagadish Shukla

December 2023

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31						

February 2024

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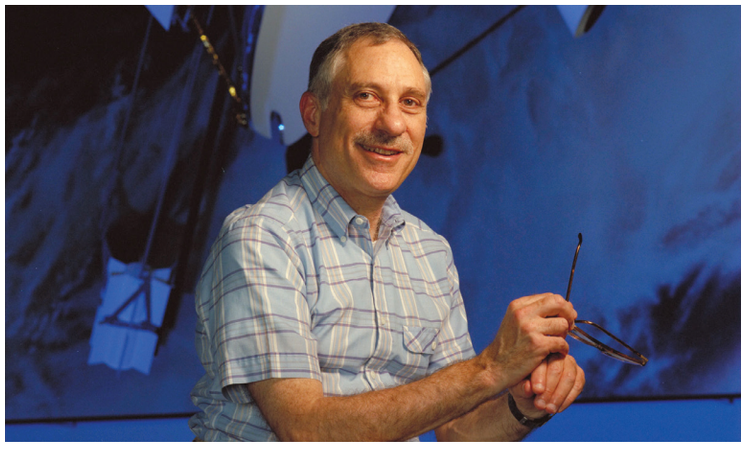
18	19	20	21	22	23	24
25	26	27	28	29		

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 New Year's Day	2	3	4 Last Quarter	5	6
7	8	9	10	11 New Moon	12	13
14	15 Birthday of Martin Luther King, Jr.	16	17	18 First Quarter	19	20
21	22	23	24	25 Full Moon	26	27
28	29	30	31			

February 2024

Mars Rocks at Jezero Delta. The Mars Perseverance Rover took this stunning image of the rocks at the top of the Jezero Delta formation on June 12, 2022—Sol 466 of the mission. This layered unit was called “Rocky Top” by the science team and inspired much speculation as to its origin. To learn about this distinctive unit, Rocky Top was sampled twice and placed in the Rover’s onboard caching system for later return to Earth on the Mars Sample Return mission. NASA and the European Space Agency (ESA) are planning ways to bring the first samples of Mars material back to Earth for detailed study, including a Sample Return Lander that would land near or in Jezero Crater, bringing a small rocket on which the samples collected by Perseverance would be loaded. Two Ingenuity-like helicopters would provide a secondary capability to retrieve samples on the surface of Mars. Once the sample cache is launched off the Red Planet, another spacecraft would capture it in Mars orbit and then bring it back to Earth in the early to mid-2030s. **Image and text credit:** NASA/Jet Propulsion Laboratory–Caltech/Arizona State University

https://go.nasa.gov/3vn262k



Dr. James Pollack (1938–1994) was a world-renowned planetary scientist at NASA Ames Research Center who worked on every major NASA planetary mission mounted between 1971 and his death, including Mariner 9, Viking, Voyager, Pioneer Venus, Mars Observer, Galileo, and Cassini. Radiative transfer theory was one of Pollack’s specialties, and he applied it to analyzing spacecraft data and developing models of the energy balance in planetary atmospheres—including that of our home planet—and protoplanetary nebulae. Pollack pioneered models of the early formation stages of the giant planets due to gas accretion onto solid cores, and he played the leading role in establishing NASA’s Mars general circulation modeling program—an essential tool for NASA and the planetary science community. In fact, it was Pollack who determined that the sky on Mars was pink, not blue, when the first images came back from Viking. He was one of the first NASA scientists to think about Earth as a system, highlighting atmosphere-biosphere interactions and their evolution over time, and he was also a key part of the Nuclear Winter study with both scientific and societal implications. Although Pollack spent his life exploring our solar system, he also helped show humanity the complexity of Earth and the fragility of its life-sustaining ecosystem. Pollack’s supportive and equitable approach to science continues to inspire many today in the scientific community. Photo credit: NASA

January 2024

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28	29	30	31			

March 2024

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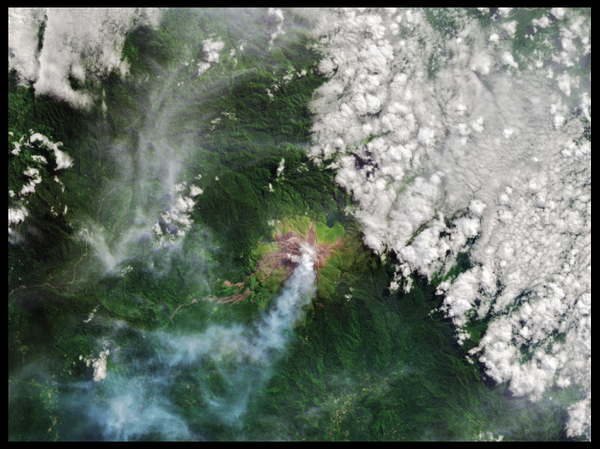
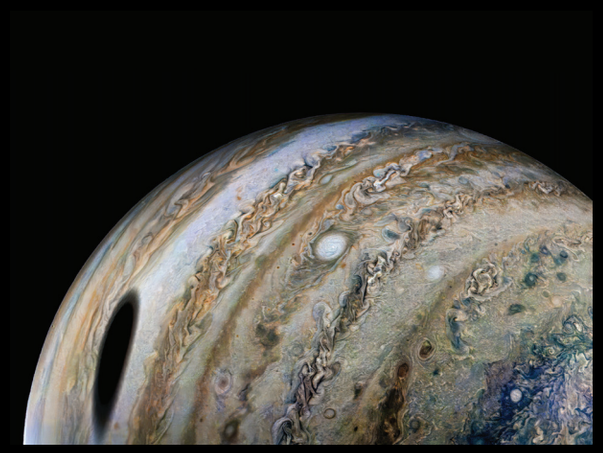
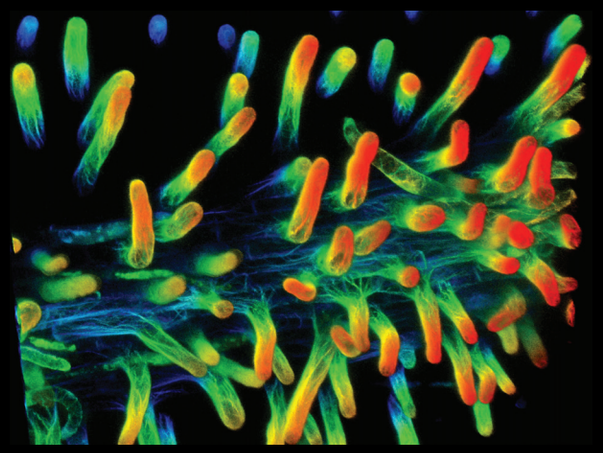
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

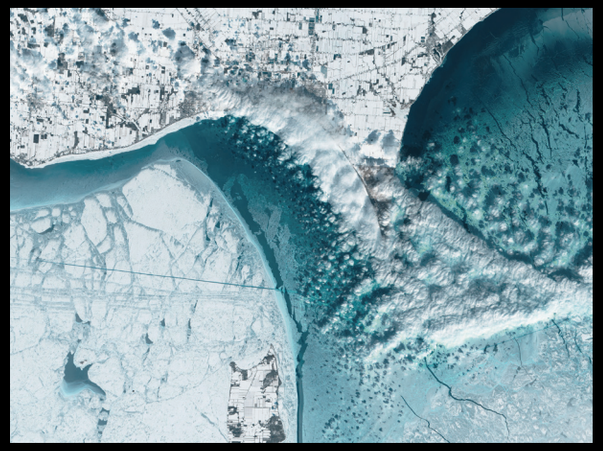
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2 Last Quarter	3
4	5	6	7	8	9 New Moon	10
11	12	13	14	15	16 First Quarter	17
18	19 Washington’s Birthday (observed date)	20	21	22	23	24 Full Moon
25	26	27	28	29		

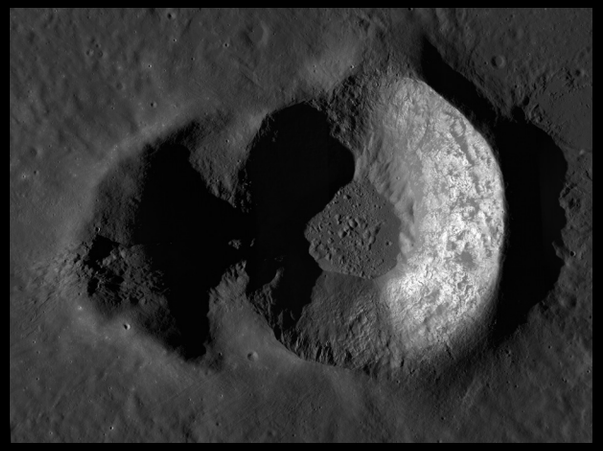
National Aeronautics and
Space Administration

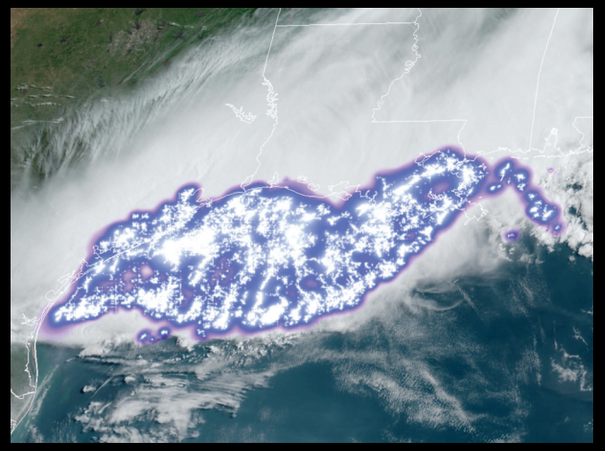


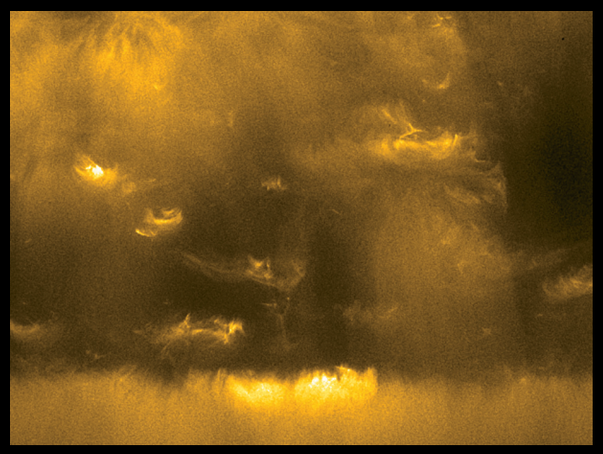


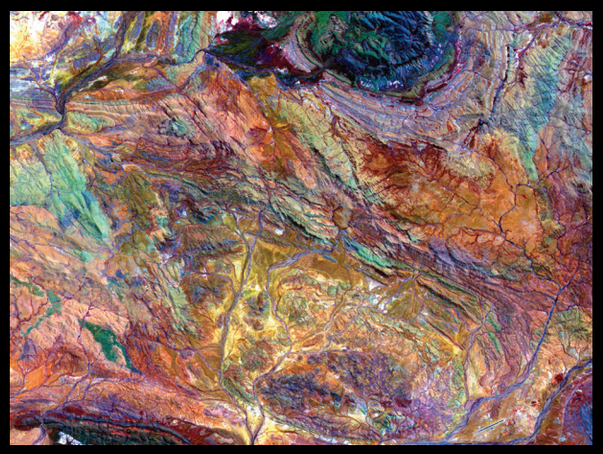












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