



NASANE**XT**

EMPOWERING THE NEXT GENERATION OF SPACE EXPLORERS

EARTH'S EXTREMES

YOUR RAINY DAY MIGHT BE
SOMEONE ELSE'S HEAT WAVE

PAGE 5



Attendees take a virtual tour of Mars during Sneak Peak Friday at the USA Science and Engineering Festival in Washington, D.C. on April 15, 2016. NASA/Joel Kowsky

DEAR READER,

You may not know it but NASA is doing some pretty awesome things. We're sending astronauts into space. We're building rockets and launching satellites. We're studying both the world beneath our feet and worlds lightyears away. With so much science taking place, it might be hard to keep up with it all. But with NASA Next, you have all of the top news right at your fingertips.

NASA Next is a news magazine made entirely for kids and teens — our next generation of space scientists and explorers. We break down the complex science and bring you the latest news on what our scientists are doing at [NASA's Goddard Space Flight Center](#) in Greenbelt, Maryland. Goddard is just one of NASA's 10 centers. It is home to the [Hubble](#) and [James Webb](#) space telescopes and serves as the control center for numerous NASA satellites. Our scientists and engineers build spacecraft and develop new technology to study [Earth](#), the [sun](#), our solar system and the universe.

The feature story of our first issue takes a closer look at how NASA studies global weather. In just the first half of 2016, our planet has undergone extreme weather events such as flooding, droughts and record-breaking temperatures. NASA studies these weather patterns to help keep us safe and predict what our future weather will be.

Let your curiosity take over as you read through each story. Take note of the things that excite you and the things that make you want to learn more. These are just the stepping stones you will take to expand our understanding of space and help us explore our universe further than ever before.

Sarah Schlieder
NASA Next editor

NASANEXT

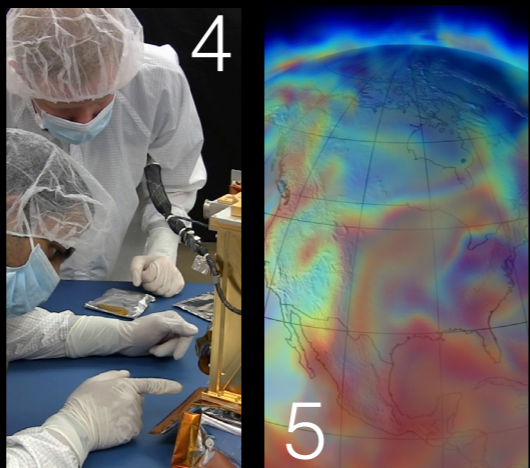
EMPOWERING THE NEXT GENERATION OF SPACE EXPLORERS

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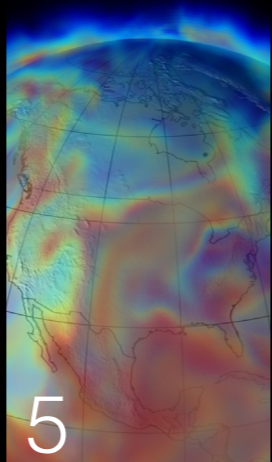
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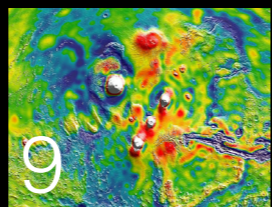
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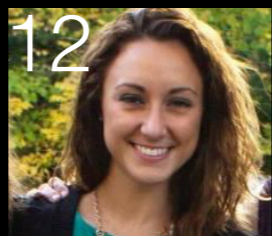
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MAY 2016
NASANEXT



The first six of 18 gold segments that will form NASA's James Webb Space Telescope's primary mirror undergo cryogenic testing. Webb will be the premier observatory for exploring the first luminous glows after the Big Bang and the formation of our own solar system. NASA/MSFC/David Higginbotham

the next-generation space telescope

NASA's James Webb Space Telescope will investigate the origins of the earliest stars and galaxies

How do you see stars and galaxies that are so far away we haven't been able to see them yet? With a giant space telescope! Unlike telescopes you might have at home or in your classroom, a space telescope is launched into space to look at stars and planets far beyond our solar system.

NASA is currently building the most powerful space telescope in history — the [James Webb Space Telescope](#). It will look across vast distances to find the earliest stars and galaxies. It will also investigate objects in Earth's own neighborhood — planets, moons, comets

and asteroids in our solar system. These studies will help scientists learn more about the formation of the solar system and how Earth became capable of supporting life.

"The James Webb Space Telescope will be an innovative tool for studying objects in the solar system and can help take planetary science to a new level," said Stefanie Milam, Webb's Deputy Project Scientist for Planetary Science at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

But before Webb can go to space, it needs all the essential pieces and instruments to do its job. Two things engineers can check off the to-do list:

Webb's primary and secondary mirrors.

The first of Webb's 18 primary mirrors was installed November 2015. Over the next few months, engineers at Goddard worked to complete the mirrors' installation using a robotic arm to lift and lower each hexagonal-shaped mirror segment. The final mirror segment was installed February 2016.

Engineers installed the sole secondary mirror in March 2016.

Webb uses its mirrors to direct incoming light into its instruments. The primary mirror will gather the faint

WEBB continues on page 4.

exploring asteroids

Student-built instrument integrated with NASA'S OSIRIS-REx mission

Imagine helping NASA build a spacecraft in your science class. Well, a group of college students got to do just that!

Students and teachers from Massachusetts Institute of Technology and Harvard University designed and built an instrument for NASA's OSIRIS-REx spacecraft.

OSIRIS-REx, which stands for Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer, will launch in September 2016. The spacecraft will travel to an asteroid known as Bennu to retrieve a surface sample and return it to Earth for study.

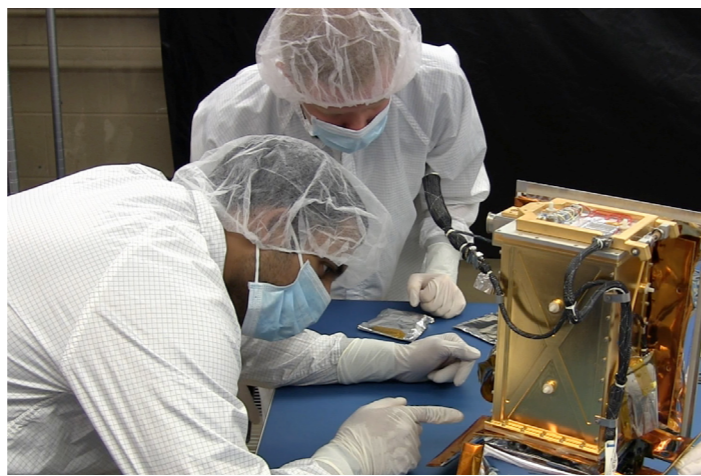
The student-built instru-

ment, known as the Regolith X-ray Imaging Spectrometer, or REXIS, will help scientists determine what elements are present on the asteroid's surface and how abundant they are.

Using this information, the science team will construct maps identifying where to find the elements on Bennu's surface.

REXIS will involve more than 100 college students throughout the mission. The students will analyze data as part of their coursework. That's one homework assignment we wouldn't mind.

Want to know more about OSIRIS-REx? Check out nasa.gov/mission_pages/osiris-rex/index.html.



MIT Graduate students prepare the REXIS instrument for flight. Courtesy of William Litant/MIT. Top image: NASA/GSFC/Conceptual Image Lab

LET'S GO TO AN ASTEROID!

Build your own rocket: Construct a rocket powered by an antacid tablet and water.

<http://go.nasa.gov/1S674XU>

For more information about asteroids, as well as fun activities and homework help, search "asteroids":

<http://solarsystem.nasa.gov/kids/index.cfm#>

WEBB continues from page 3.

light from distant galaxies. The light then hits the secondary mirror before being directed into the black "cone" in the center of the primary mirror. Small mirrors inside direct the light to the science instruments.

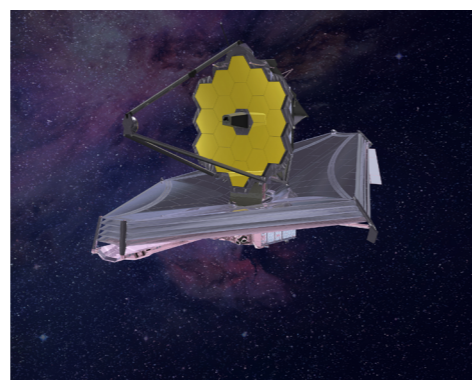
"Completing the assembly of the mirrors is a very significant milestone after more than a decade of design, manufacturing, testing and now assembly of the mirror system," said

Lee Feinberg, Optical Telescope Element Manager at Goddard.

Webb is set to launch in 2018. It is an international project led by NASA, the European Space Agency and the Canadian Space Agency.



Learn more about James Webb Space Telescope and check out videos, photos and more at jwst.nasa.gov.



The James Webb Space Telescope will launch in 2018. Illustration by Northrop Grumman.

sunny and dry with a chance of rain

Earth is a large, dynamic planet. While you look forward to summer vacation, students in another part of the world may be skiing to school.

Sometimes, these differences may be more extreme. Severe floods and record droughts may strike the planet — at the same time. And this year is no exception.

Just a few months into the new year, people around the world have seen record-breaking weather.

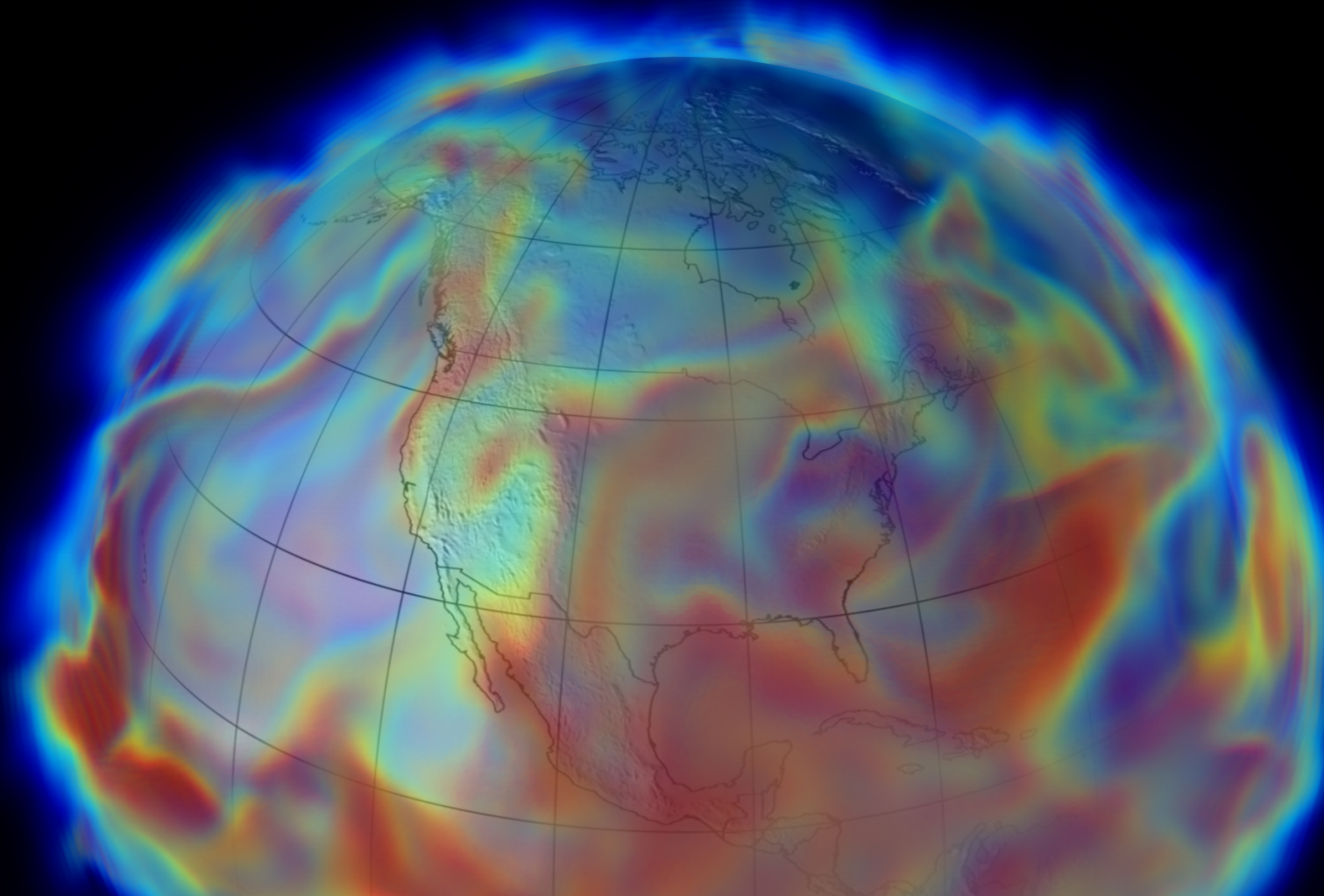
These extremes directly impact our

day-to-day lives. Floods can wash away homes and droughts can threaten Earth's food supply.

NASA researchers keep a close eye on changing weather patterns. Satellite images and data from research sites help us predict and prepare for future weather extremes.

Our planet is constantly evolving. By studying changes in weather patterns and Earth's water cycle over time, we can be ready for what lies ahead.

EARTH continues on page 6.





flooding

Rain is **essential** for our planet and us. It waters our plants, supplies us with drinking water and even helps us generate energy. But too much rain can wash away crops and homes.

Heavy rain drenched the southern United States throughout February and March, with rainfall totals nearing 24 inches over the space of a week in some states.

An unusually strong low pressure weather system pulled in atmospheric water vapor from the Caribbean and areas in the Eastern Pacific and paused over the southern United States, dumping its rain on states from Texas to Tennessee.

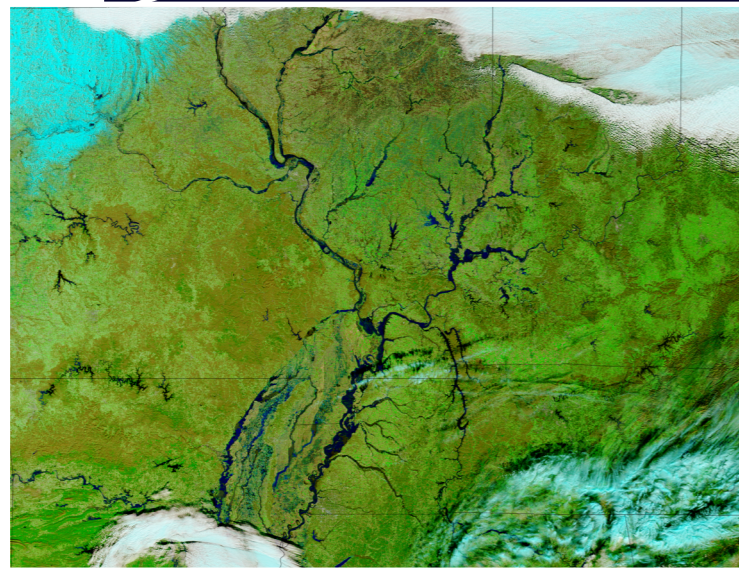
As a result, floodwaters rose in several areas along rivers such as the Mississippi River and the White River in Arkansas. Flooding in Louisiana alone damaged nearly 5,000 homes.

NASA scientists track heavy rains and flooding using satellites from the **Global Precipitation Measurement** (GPM) mission. These satellites orbit Earth and measure precipitation rates around the world every three hours. NASA scientists then compile the data and create visuals and 3-D animations to give us a global picture of rainfall totals.

By monitoring precipitation levels of a storm, NASA scientists and meteorologists can more accurately determine how much rain a certain area received as the storm moved across the country.

Studying changes in precipitation and Earth's water cycle over time is also important for agriculture.

If a certain area has experienced a steady and consistent increase in flooding, farmers may want to look somewhere else to plant their crops.



droughts

While too much rain can harm crops, not enough rain can be just as damaging. Farmers need a steady supply of water to grow crops and raise livestock to provide us with the food we need. But when droughts hit, farmers can't grow crops without extra water.

Rainfall from October through December 2015 in South Africa's croplands, for example, was the lowest measured since 1981.

South African farmers typically begin to plant maize (corn) in early October and sow the crops in Spring. Maize is an important crop for this region. But the hot and dry conditions have delayed sowing and plant growth.

Scientists can see the impact of the drought on plants with data from NASA's **Terra** satellite. The satellite measures how plants absorb visible light and reflect infrared light. Plants in drought-stricken areas reflect more visible light and less infrared light than healthy plants where water is abundant. Knowing where crops are not

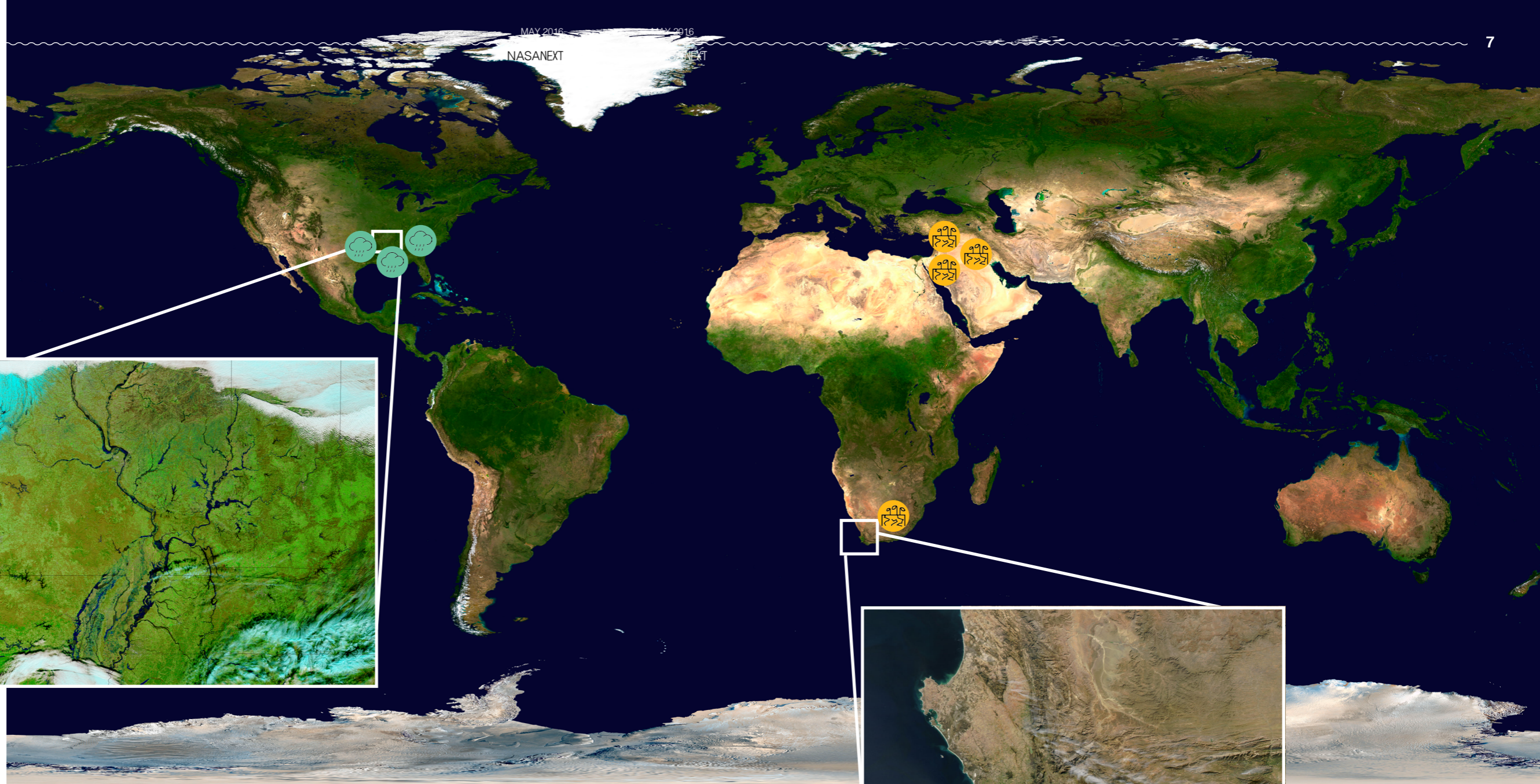
healthy can tell farmers where to water or help governments plan to import extra food where crops will fail.

Droughts can last from a few months to many years. An area known as the eastern Mediterranean Levant region has been dealing with a drought since 1998. That's 18 years with below-average rains! The region includes countries such as Cyprus, Israel, Jordan, Lebanon, Palestine, Syria and Turkey. Scientists are calling the drought the worst of the past 900 years.

NASA researchers studied the drought history by analyzing tree ring measurements recorded in the Old World Drought Atlas. Thin tree rings indicate dry years while thick rings show years with plentiful water. The scientists used the data to construct a timeline of drought patterns over the past millennium. It remains unclear as to when or if the region will find relief with an

end to the drought. We need plenty of water for the things we do in our day-to-day lives. From brushing your teeth to the farmers who grow the food you eat, water plays an essential role. But too much water or too little can change the way we live. More often than not, the weather is average. But sometimes, record-breaking weather patterns occur. NASA continues to study weather patterns and precipitation levels, better than ever before, to help us prepare for the weather to come.

All images: NASA Earth Observatory





Above: NASA GSFC. Below: Wikimedia Commons

SCIENCE ON FOUR LEGS

Sled dogs help NASA scientists reach distant study sites

The **Arctic Boreal Vulnerability Experiment** investigates some of the most distant areas of North America. Scientists use satellites and aircraft to study how a 2.5 million square mile stretch of tundra, forests and lakes in Alaska and Northwestern Canada is changing as a result of a warming climate.

Satellite data isn't always enough to monitor changes in the region. Teams of researchers also go out into the field to make observations and take measurements. But getting out to the study site requires an unusual form of transportation. The scientists often turn to sled dogs to reach their wintry destination. Some of these dogs have retired from competitive sled dog racing and are now assisting scientists with important climate research — a great example that science needs all hands (and paws!) on deck.



DID YOU KNOW?

NASA has enlisted the help of our furry friends for a variety of science projects. Before there were astronauts, several animals were launched into space, paving the way for human space travel.

TRIVIA QUESTION: Do you know what kind of animal was the first to go into space?

Fruit flies!

MAPPING MARS

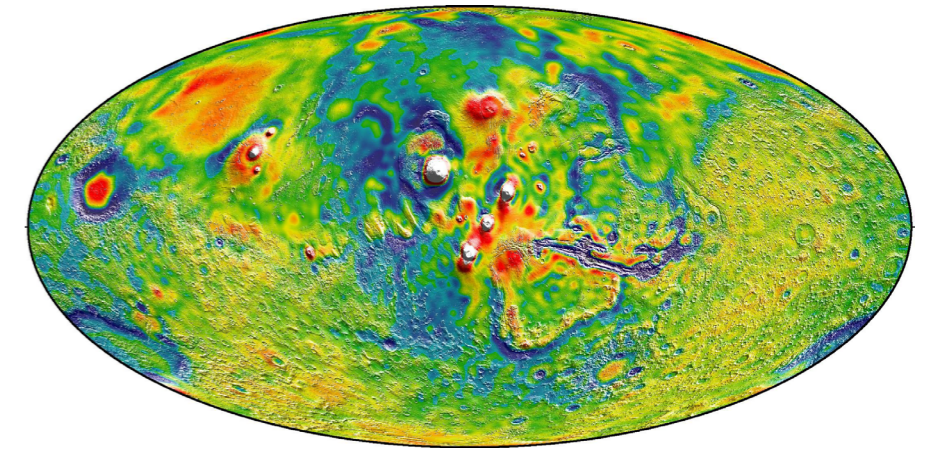
NEW GRAVITY MAP LETS SCIENTISTS PEER INSIDE MARS

How do you study the interior of Mars without physically being there? Make a gravity map!

Scientists have created a new map of Mars' gravity that is the most detailed to date, providing a revealing glimpse into the hidden interior of the Red Planet.

Gravity maps allow us to see inside a planet, just as a doctor uses an X-ray to see inside a patient. The new gravity map will be helpful for future Mars exploration, because better knowledge of changes in the planet's gravity helps mission controllers insert spacecraft more precisely into Mars' orbit. It will also help scientists understand the still-mysterious formation of certain regions of the planet.

The map was made using data from three NASA spacecraft in orbit around Mars: Mars Global Surveyor, Mars Odyssey and the Mars Reconnaissance Orbiter.



Gravity maps, like this one of Mars (above), work just like an X-ray and allow us to see inside a planet. MIT/UMBC-CRESS/ GSFC.

DID YOU KNOW?

The surface gravity on Mars is only about 38 percent of the surface gravity on Earth. So, if you weighed 100 pounds on Earth, you would weigh 38 pounds on Mars!

My weight on Mars is:

{YOUR WEIGHT} X 0.38 = LBS.

NASA SPINOFF bringing space technology down to Earth

Did you know that technology developed for space exploration often ends up benefitting life on Earth? From the digital image sensor in your cell phone to memory foam mattresses, you might be using NASA technology every day.

NASA highlights these "spinoffs" — commercial products or services that began as or have benefited from the agency's technologies — in an annual publication called Spinoff.

"Space is a bigger part of our lives than we realize. People don't always realize that when we pursue these noble things like going to space, there are side benefits that come out of it," said Daniel Coleman, current Spinoff editor at NASA's Goddard Space Flight Center. "We're not going into space just to get spinoffs, but there are all sorts of great things that come about when you try and dare to do difficult things."



Discover other ways NASA technology is used on Earth at spinoff.nasa.gov.

AN EPIC ECLIPSE OF THE SUN

NASA's Earth Polychromatic Imaging Camera (EPIC), a camera aboard the DSCOVR satellite, snapped this image of the solar eclipse on March 9, 2016.

NASA image courtesy of the DSCOVR EPIC team.



MARK YOUR CALENDAR: A total solar eclipse will pass across the United States in **2017**. A solar eclipse occurs when the moon passes directly between Earth and the sun. NASA/Goddard Space Flight Center Scientific Visualization Studio

Where did the sun go? Residents of islands and nations in the Western Pacific Ocean might have been asking themselves this very question during a total solar eclipse March 9. A **total solar eclipse** occurs when the moon passes between the Earth and the sun, casting a shadow over the earth. The moon's shadow masks the sun's surface and blocks sunlight from reaching Earth directly, creating what looks like a dark disk in the sky surrounded by a halo of light.

But while we caught a glimpse of the total eclipse of the sun, the **Deep Space Climate Observatory (DSCOVR)** looked down from space and captured the shadow of the moon creeping across Earth's sunlit face.

From its position about one million miles from Earth, DSCOVR maintains a constant view of the sunlit planet. DSCOVR watched as the moon's shadow crossed the Indian Ocean and travelled past Indonesia and Australia into the open waters and islands of Oceania, including Melanesia, Micronesia and Polynesia, and on to the Pacific Ocean. The shadow moved in the same direction as Earth's rotation.

Not only are eclipses incredible sights, but they also provide scientists with unique science opportunities. One particular topic of interest during a total solar eclipse is the solar corona, or the sun's atmosphere.

The corona is thought to hold the keys to several solar mysteries, including the acceleration of the solar wind and the origin of explosive

clouds of solar material known as coronal mass ejections.

Though it is about as bright as the full moon, the corona is ordinarily drowned out by the sun's much brighter face.

But total solar eclipses block the entire disk of the sun so the faint solar corona is visible.

For times outside of a total solar eclipse, scientists use instruments called coronagraphs, which create artificial eclipses by using solid disks to block the sun's bright face and reveal the faint corona.

But because of a phenomenon known as diffraction — the bending of light around sharp objects — coronagraph disks obscure the inner corona. Total solar eclipses give researchers a more accurate, closer view of the sun's surface corona.

Q&A

GINA DiBRACCIO

SPACE RESEARCH SCIENTIST

Dr. Gina DiBraccio is a space research scientist in the **Solar System Exploration Division** at NASA's Goddard Space Flight Center in Greenbelt, Maryland. She works on the science team for MAVEN, a satellite that orbits Mars and studies its upper atmosphere and ionosphere. Her work focuses on how the sun affects the space environment of Mars.

DiBraccio's interest in space began when she was young. Her parents encouraged this interest by sharing NASA news articles and bringing her to the local planetarium. She took her first astronomy course in high school and immediately fell in love. Her interest has since grown into a passion.

We spoke with DiBraccio about her work at NASA, her early interest in STEM (Science, Technology, Mathematics and Engineering) and her advice to you — the next generation of space explorers.

Tell us a little bit about your role at NASA Goddard.

As a space research scientist, my primary task is to analyze data that has been collected by spacecraft orbiting other planets. I am currently a science team member of NASA's **MAVEN mission** at Mars. I am interested in learning how changes in the sun can affect the Martian space environment and contribute to that fact that Mars is losing its atmosphere over time. To understand



Image courtesy of Gina DiBraccio.

this, I analyze **plasma** and **magnetic field** data that is being collected by MAVEN. In addition to data analysis, a large part of my job includes communicating my science results to fellow scientists and the public. I give presentations at science conferences around the world — I was just in the Arctic Circle in January! I also publish scientific journal articles and visit local schools or career fairs. My job is different every day and is always exciting!

How did you get to where you are now — working in the Solar System Exploration Division at Goddard?

I have been interested in space. I went to college at the University of Pittsburgh and decided to major in Physics and Astronomy, as well as

Business Administration, because I wanted to learn the managerial side of organizing research groups and space missions. During my undergraduate education, I landed an internship at the NASA Glenn Research Center in Cleveland, Ohio, which really set the ball in motion for my career path.

After my summer of interning, I transitioned into NASA's Co-op program, allowing me to rotate semesters between working at NASA Glenn and taking classes at my university. After I graduated, I decided to transfer to NASA Goddard because I was interested in the research being done in the Heliophysics Division, in which scientists study the sun and its effects on bodies in our solar system. At the same time, I started graduate school at the University of Michigan, where I acquired a Master's degree and Ph.D. in Atmospheric and Space Sciences. Following my Ph.D., I was selected for the NASA Postdoctoral Program Fellowship and started working full time at Goddard in the **Planetary Magnetospheres Laboratory** of the Solar System Exploration Division.

Did you always want to work in STEM?

Yes, I always knew that I was interested in STEM-related fields. I loved math and science growing up. What I did not know, however, was the type of job that I would actually

DiBRACCIO continues on page 13.

DiBRACCIO continues from page 12.

.....
want. I knew that I wanted to be involved with NASA in some capacity but I had no idea what my options were. I slowly figured this out by trying different roles through my internship and co-op opportunities. From there, I talked to my professors, advisors and mentors to understand how I could apply my skills. It was a process of trial and error until I found what I enjoyed the most. Hands-on experience is the key to really determining what you like and dislike.

How did your mentors or advisors help lead you to where you are today?

Having supportive and passionate mentors were, and are still, the key to my success. From an early age, my parents acted as mentors. They are not scientists themselves, but they saw my excitement and urged me to learn more. In graduate

school, my Ph.D. advisors guided me through research but also provided mentorship on many levels that contributed to my success. In my current role at Goddard, there are many senior scientists that I look to as role models. No matter what

“
It's OK to be wrong. My goal is to always keep learning, even if I ask a question that I think is silly.

-GINA DiBRACCIO

stage you're at, it's always great to have a mentor — they motivate you to learn more and offer a support system as well.

What advice would you give to our readers who may be considering a STEM career in the future?

Do not be afraid to challenge yourself or ask questions! The point of research is asking questions because we don't have all of the answers. More importantly, it's okay to be wrong. My goal is to always keep learning, even if I ask a question that I think is silly.

Also, take advantage of any resources around you: enroll in STEM classes offered by your school, read articles online, visit museums and more! You really can do anything you set your mind to. The key is to stay motivated and work hard.

GLOSSARY

plasma: heated gas made of charged particles

magnetic field: an area where an object exhibits a magnetic influence.

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FOR EDUCATORS

WANT TO INCORPORATE NEXT ARTICLES INTO YOUR CLASSROOM? WE HAVE LESSON PLANS TO HELP YOU GET STARTED!

JAMES WEBB SPACE TELESCOPE (page 3)

“The Astronomer’s Toolbox: Telescopes”

<http://go.nasa.gov/1rQt1QD>

EXTREME WEATHER (page 5)

Precipitation Towers

<http://go.nasa.gov/1TZv3EM>

Exploring the Water Cycle

<http://go.nasa.gov/1TZv0sv>

Exploring the Environment: Drought Problem

<http://go.nasa.gov/1TZuR8h>

MAPPING MARS (page 9)

Mars Image Analysis

<http://go.nasa.gov/1TZvjn2>

On the cover: “Blue Marble” image of Earth. NASA Goddard Space Flight Center

This page: NASA’s Hubble Space Telescope has unveiled in stunning detail a small section of the Veil Nebula — expanding remains of a massive star that exploded about 8,000 years ago. NASA/ESA/Hubble Heritage Team

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