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π IN THE SKY 6

Can you weather through the math needed to size up this killer dust storm on Mars? It's not rocket science when you've got pi to guide you.

Explore the full NASA Pi Day Challenge at:
jpl.nasa.gov/edu/nasapidaychallenge

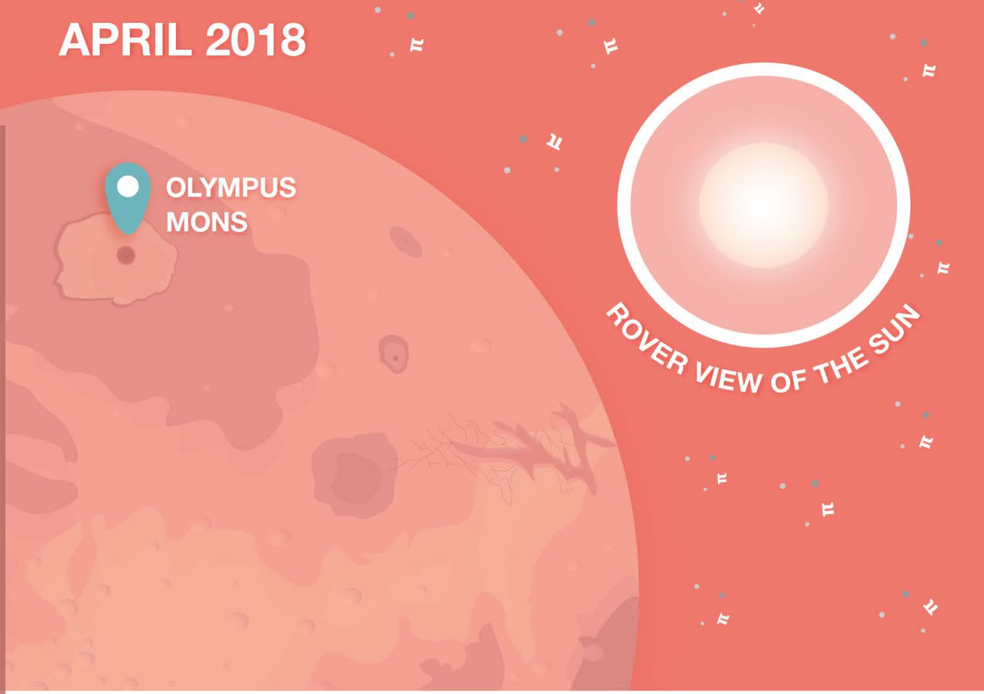
DEADLY DUST

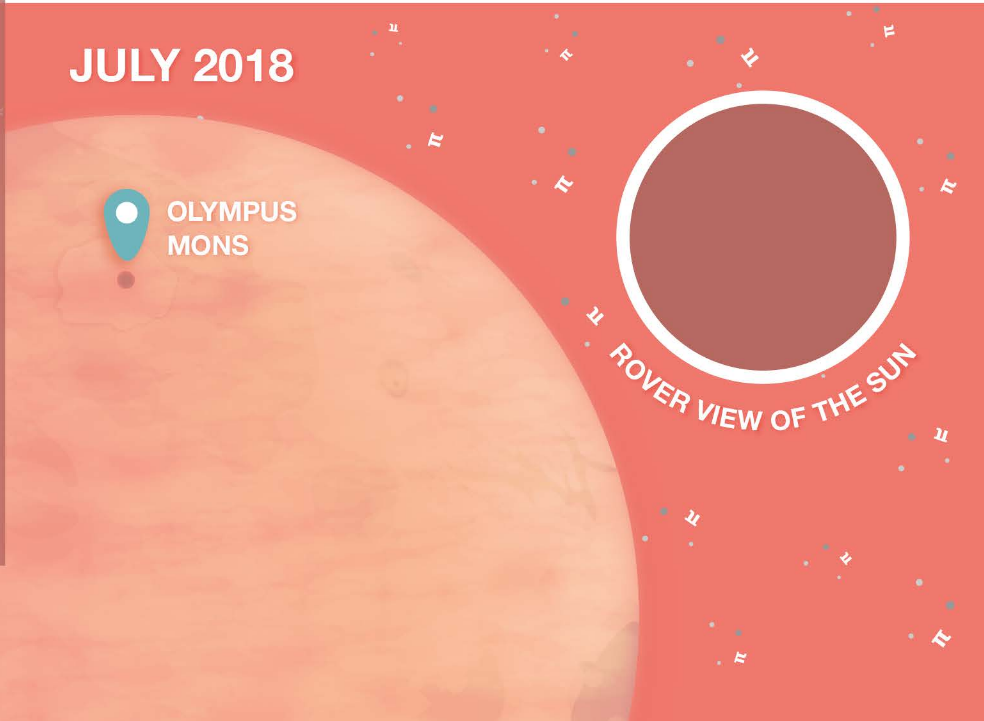
In the summer of 2018, a large dust storm enshrouded Mars, blocking visibility over a large portion of the planet. The thick dust covered almost all of the Mars surface, blocking the vital sunlight that NASA's solar-powered Opportunity rover needed to survive. In fact, the storm was so intense and lasted for so long that Opportunity, which had spent 14.5 years traveling around the Red Planet, never managed to regain consciousness and the mission had to come to an end.

During the height of the storm, only the upper caldera of one of the solar system's largest volcanos, Olympus Mons, peeked out above the dust cloud. The diameter of Olympus Mons' caldera is approximately 70 km.

What percent of the Mars surface was covered in dust at that time?

LEARN MORE
mars.nasa.gov/mer





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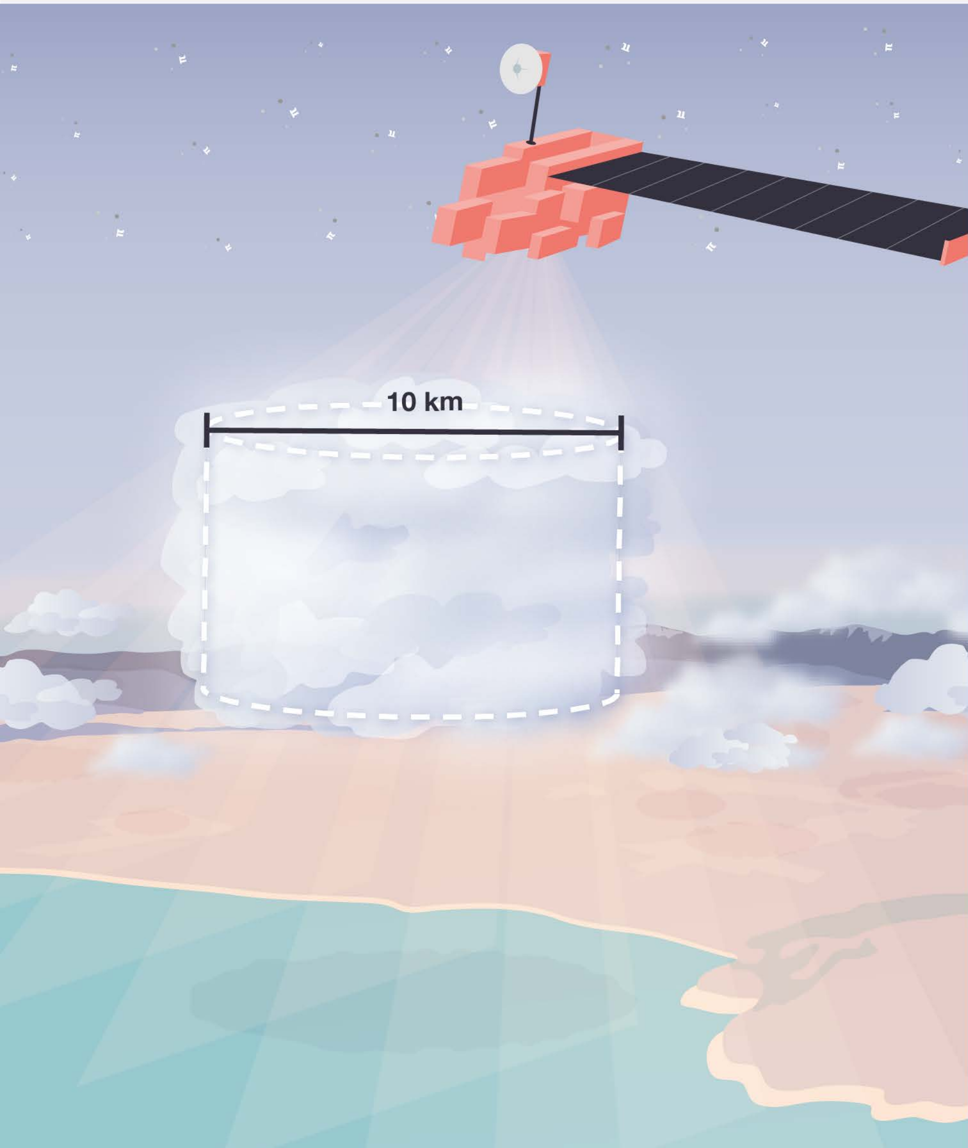

CLOUD COMPUTING

The MISR instrument on NASA's Terra satellite has nine cameras that view Earth from different angles to study features on the surface and in the atmosphere in 3D. One of MISR's tasks is to collect measurements of clouds, which are full of liquid water or ice. Scientists can use the measurements to estimate how much water is in a cloud.

Imagine MISR flies over a cloud that from directly overhead looks like a circle, 10 km across. From the side, it looks like a soup can, indicating it's roughly the shape of a right cylinder. Given that the cloud's top and height measure 16 km combined, calculate the approximate volume of the cloud in cubic kilometers.

Given the liquid water content of a typical, puffy cumulus cloud (see graphic for figures), calculate the total amount of water in the cloud.

If all the water in the cloud fell as rain, how many Olympic size swimming pools could it fill? (See graphic for figures.)

LEARN MORE
misr.jpl.nasa.gov

CUMULUS CLOUD LIQUID WATER CONTENT = 500,000 kg/km^3

OLYMPIC SWIMMING POOL VOLUME = 2,500 m^3

WATER DENSITY = 1,000 kg/m^3

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Can you spot the math needed to measure this shrinking storm on Jupiter? It's not rocket science when you've got pi to guide you.

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STORM SPOTTER

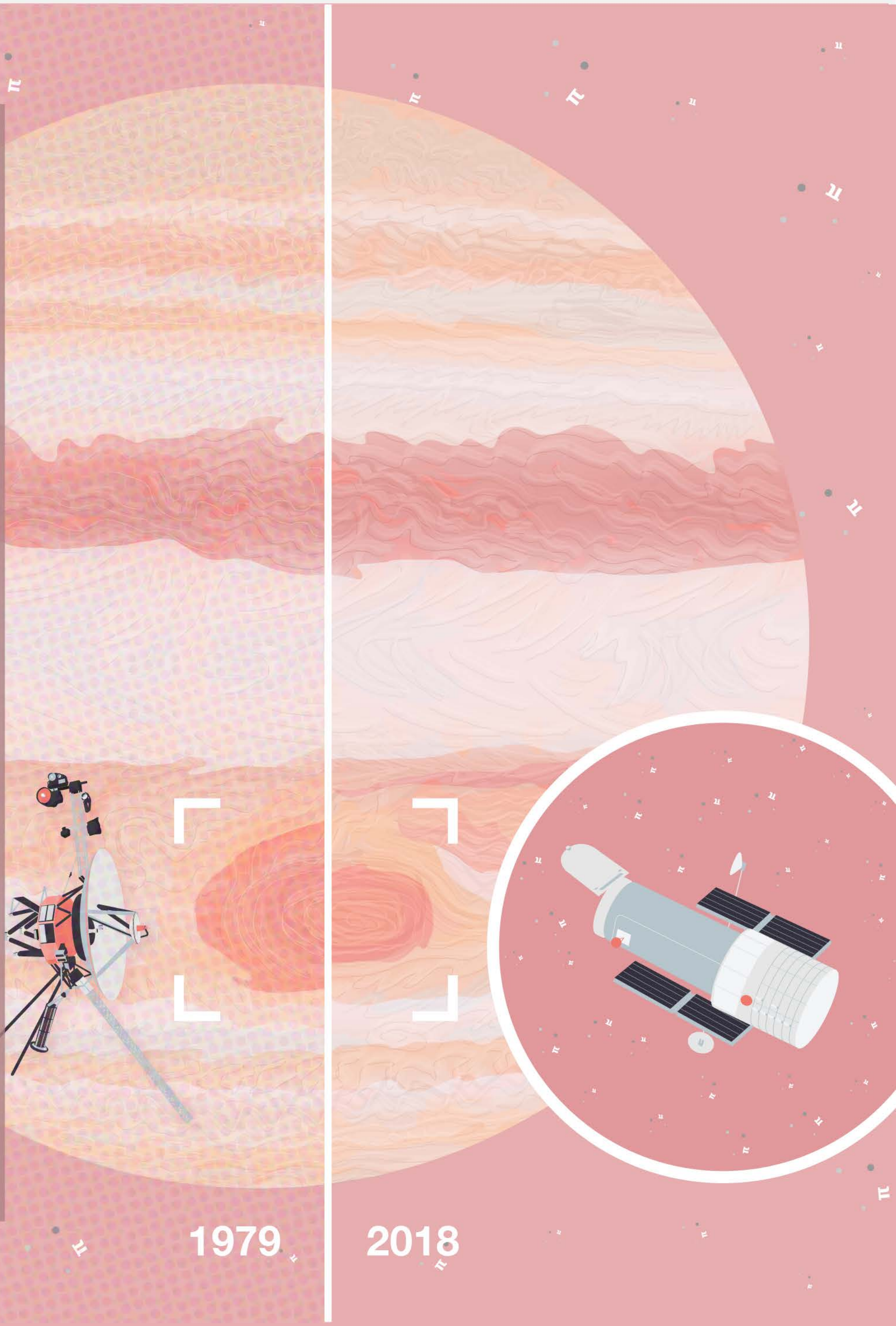
Jupiter's well known Great Red Spot is shrinking and someday may disappear entirely. Continuously observed since the 1830s, this massive storm was once more than three times the diameter of Earth.

When the twin Voyager spacecraft flew by Jupiter in 1979, they sent back images of the Great Red Spot. At that time, the storm measured 24,700 km wide by 13,300 km tall. When scientists measured the storm again in 2018, using images from the Hubble Space Telescope, their estimates were 16,500 km wide by 11,400 km tall.

Given these measurements, how does the current width of the Great Red Spot compare to the diameter of Earth?

By what percent did the area of the Great Red Spot shrink from 1979 to 2018? The formula for the area of an ellipse is πab.

LEARN MORE
nasa.gov/juno



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ICY INTEL

Scientists at JPL study ices found in space to understand what they're made of and how chemical processes unfold in cold environments. To find out what molecules are produced when sunlight or solar wind hits a comet, scientists place a piece of simulated comet ice in a vacuum to expose it to conditions that exist in space. Then, they aim an infrared laser at the sample to produce a plume that can be analyzed. Through this process, scientists have found that when simple molecules are exposed to light or electrons, they can transform into more complex molecules – even ones considered key to life's formation!

Scientists need to know how much energy is hitting the sample in a given area. This is called "fluence." Enough of it will explode the ice so the sample can be analyzed. Peak fluence is found by dividing the laser's total optical pulse energy by $\pi w^2 / 2$, where w is the radius of the beam. **Using a beam that has a radius of 125.0 μm and a total optical pulse energy of 0.30 mJ, what is the laser's peak fluence in J/cm^2?**

If the optics used to aim and focus the laser reduce its energy by 27% before it hits the sample, **will this beam be sufficient to examine a sample that needs a peak fluence of 1.0 J/cm^2 to explode?**