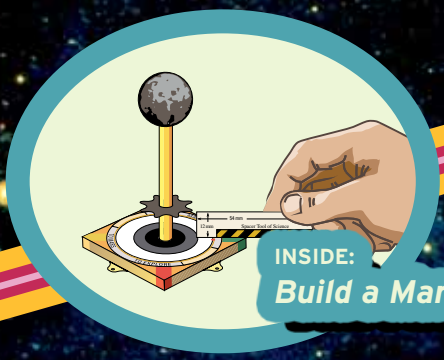
VOLUME 2, ISSUE 2 | JUNE SOLSTICE 2012

PLANETARY SOCIETY KIDS

MARS' TWO MOONS
Phobos & Deimos
ON THE BACK



INSIDE:
Build a MarsDial!

MarsDials and EarthDials

Next time you have a sunny day with plenty of blue sky, go outside with a clean white piece of paper or one of your clean white T-shirts. Cast a shadow on the white surface. Try a pencil, your finger, or your kid brother's head. You'll see that the shadow is gray—well, yeah . . . But if you look closely, you'll see the shadow is just slightly light blue—just a little bit. The blue color comes from the Earth's sky.

Most of us can tell right away whether a picture was taken inside or outside with just a glance, but most of us cannot quite say why we can tell which is which. Well, part of it is this blue from our sky. You see it in the shadow.

On Mars, they (if there are any "them") have an orange sky. The Martian orange is quite a bit more noticeable than our own Earth's blue. This orange color made the earliest *Viking* spacecraft camera pictures from Mars, back in 1976, turn out too pink. The camera setup was all done electronically, with the colors of the spacecraft cameras set in labs back here on Earth. It wasn't until the cameras were actually sitting on Mars that scientists could figure out the sky's contribution to the color in the pictures. To keep this pink business from happening again, engineers set up a photometric calibration (cal) target, a test pattern for the cameras. It has precisely known rubber color "coupons" and a metal post to cast a small shadow so that we can have a look at the color of the Martian sky as it falls on the cal target. Not bad.

Years ago, I was in a meeting about the *Spirit* and *Opportunity* rovers, which are on Mars right now. I saw the target and suggested it could be used as a sundial (actually, I was kind of jumping out of my chair and waving my arms). We made three of them and called them MarsDials. One is on *Spirit*, one on *Opportunity*, and the third on the *Curiosity* rover flying through space right now as I write this.

Sundials often have a motto, something to think about. The first two MarsDials say "Two Worlds One Sun." The one aboard *Curiosity* says "To Mars To Explore." Maybe you can make up your own motto. I like "To Know Worlds." It's fun.

You can build your own MarsDial and cast your own shadows and observe the color of the sky, or the color of lights in rooms. Try the color of a flashlight or candle.

If you want to take this one step further, think about setting up an EarthDial. It's a sundial ten times as big as the MarsDials. Because the Earth is tilted in its

continued inside...

DID YOU KNOW THAT... The Sun contains 99.86% of the mass in our solar system?

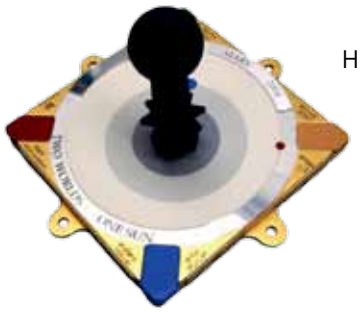
continued from front...

orbit and its orbit is not quite a perfect circle, the shadow will make a figure-eight pattern, if you mark its length every day at the same time. By long tradition, that figure eight is called the "analemma."

It is this deep understanding of the motion of the Sun in the sky (as seen from our Earth) that convinced early astronomers that the Earth is round, its orbit is out-of-round (an ellipse), and the seasons are brought on by its tilt. You can make the same discoveries for yourself! With two EarthDials far enough apart, a few hundred kilometers or so, you can measure the diameter of our world! Wild.

Check out *planetary.org/kids* for more information about MarsDials and EarthDials.

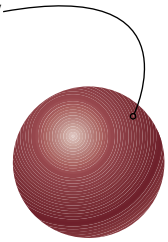
Make Your Own MarsDial

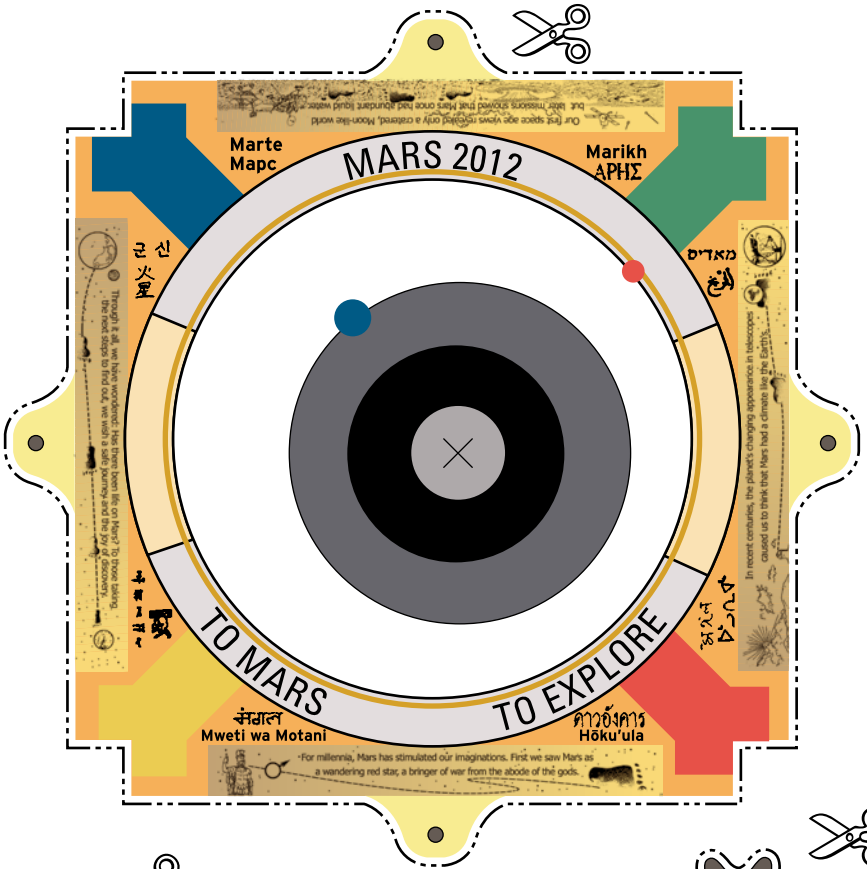


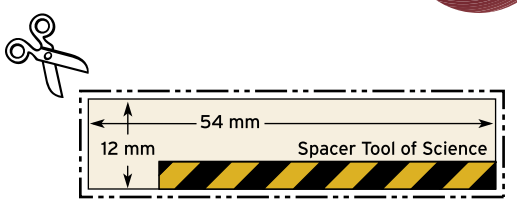
This is the same size as the MarsDials on Mars!

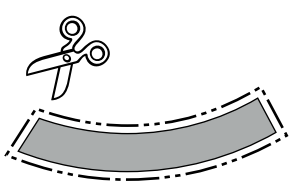
Here's what you'll need:

- scissors
- glue
- some cardboard
- a short pencil
- some foil (optional)
- a bit of clay

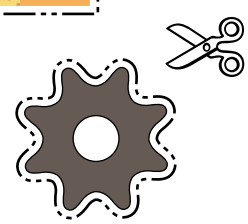




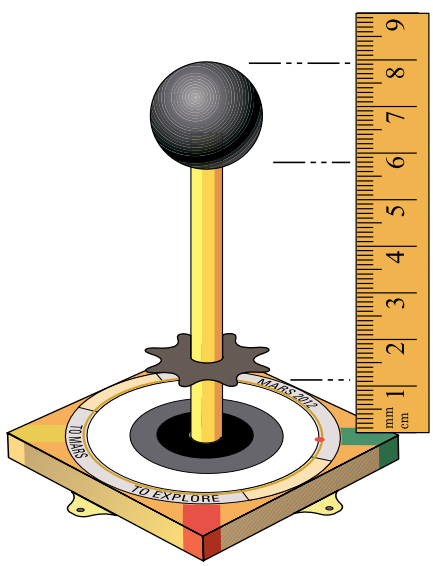




Foil Mini-Mirror Pattern (Optional)



Lower Nodus



Assembled View

Don't forget! Report your findings at planetary.org/kids

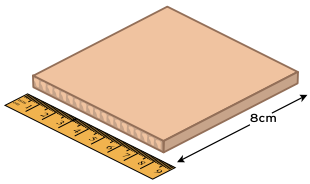
Thank you to the Clarence Foster Stanback Donor Advised Fund of Foundation For The Carolinas for its generous gift to create this publication.

1

Cut the pattern out from the facing page. It's the same size and shape as the sundials on Mars! For thousands of years, humans have been measuring time with sundials. You can, too. North of the equators of both Earth and Mars, the spins of the planets make the shadows cast by sundials go in the same direction as the hands on a clock ... clockwise.

2

Glue the pattern to two pieces of cardboard 80 mm (3.15 inches) square.



3

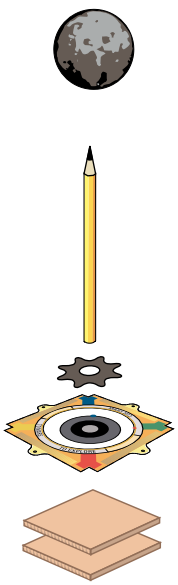
On a sundial, the post that casts the shadow is called the "gnomon" [NOE-munn]. It has two features that help you find the center of the shadow. Each one is called a "nodus" [NOE-duss], more than one, "nodi" [NOE-dee]. The upper one is a ball. The lower one is a flower shape. You can make your gnomon and nodi out of anything you'd like. Try a pencil, a ball of clay, and the daisy-shaped pattern here.

4

Poke a hole in the cross-mark big enough for a pencil.

5

Cut a pencil (You may need an adult to help you...) so that it sticks through the cardboard, then sticks up 45 mm (1.75 inches).



6

Make a ball of clay that is 20 mm (0.79 inch) in diameter. Color it black, if you like.

7

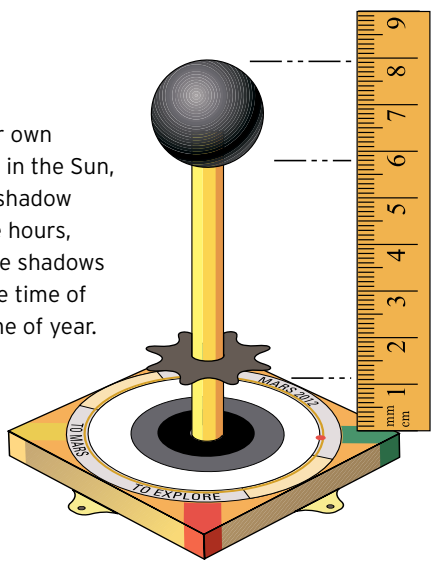
Cut out the Lower Nodus and the Lower Nodus Spacer Tool of Science. Mount the Lower Nodus 12 mm above the dial face using the Spacer Tool. Glue it in place.

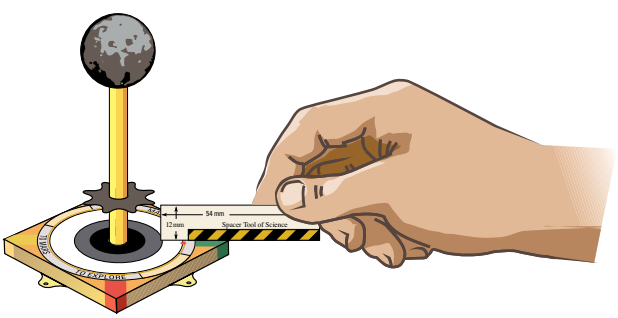
8

Use the ruler on the edge of page 2 to make your gnomon (clay ball and all) 54 mm high, just like the ones on Mars! You can add mini-mirrors like the ones on the real MarsDials. Cut out the mini-mirror pattern. Trace the pattern twice on foil. Cut out the foil pieces, and glue them onto the matching curved areas. The mini-mirrors let us see up at the sky, while we look down at the dial.

9

You've got your own MarsDial. Put it in the Sun, and watch the shadow move. Mark the hours, and see how the shadows change with the time of day and the time of year.





You can see hour lines and learn a lot more about MarsDials at *jpl.nasa.gov/missions/mer*, *nyelabs.com*, and *planetary.org*!

MarsDial created by: J. Bell, L. Friedman, J. Lomberg, T. Nordgren, W. Nye, S. Squyres, & W. Sullivan. Illustration by Dave Merrill.

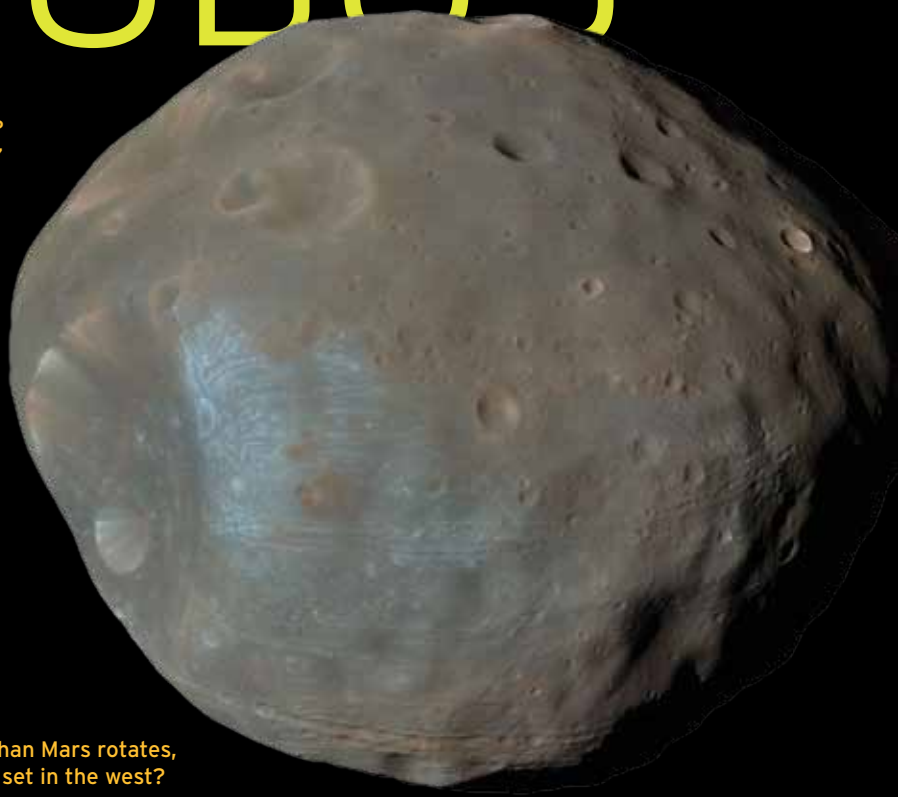
Pass It On!

"Our special **PLANETARY SOCIETY KIDS** insert in each issue of our magazine is shareable! I want everyone—young and old—to know and appreciate our place in space!"

BILL NYE, CEO

DEIMOS & PHOBOS

Mars' itty-bitty moons



DID YOU KNOW THAT...

- Mars' two moons are tiny and aren't round? Phobos is 27 × 22 × 18 kilometers (about 17 × 14 × 11 miles) across; Deimos is 15 × 12 × 10 kilometers (about 9 × 7 × 6 miles).
- Phobos and Deimos might have started out as asteroids and later been captured into Mars' orbit?
- Mars' moons orbit very close to their planet? Phobos is only 6,000 kilometers (3,700 miles) above the surface; Deimos is at 20,000 kilometers (12,000 miles). (For comparison, our Moon orbits Earth at a distance of about 380,000 kilometers, or about 228,000 miles.)
- Phobos orbits Mars faster than Mars rotates on its axis (that is, it circles once around Mars in less than a Martian day)?
- If you stood on the surface of Mars, you'd see Phobos rise in the west and set in the east more than once a day?
- But Deimos orbits Mars just a little faster than Mars rotates, so it rises in the east and takes 2.7 days to set in the west?
- Phobos and Deimos both keep the same face pointed to Mars all the time, just like our own Moon does Earth?
- Most spacecraft orbit closer to Mars than Phobos or Deimos, so they can see only the Mars-facing sides of the moons?
- ESA's *Mars Express* is the only Mars mission with a high enough orbit to see the far side of Phobos?
- The only spacecraft ever to see the far side of Deimos were the two *Viking* orbiters?
- Phobos has lots of grooves in its surface, and scientists aren't sure how they formed?
- Deimos seems to be covered in dust?
- Phobos is slowly moving toward Mars and probably will crash into it in about 10 million years?
- But that it will probably break into pieces first, forming a ring around Mars?

Images: NASA/JPL/University of Arizona