

New Scientist

WEEKLY 6 July 2024

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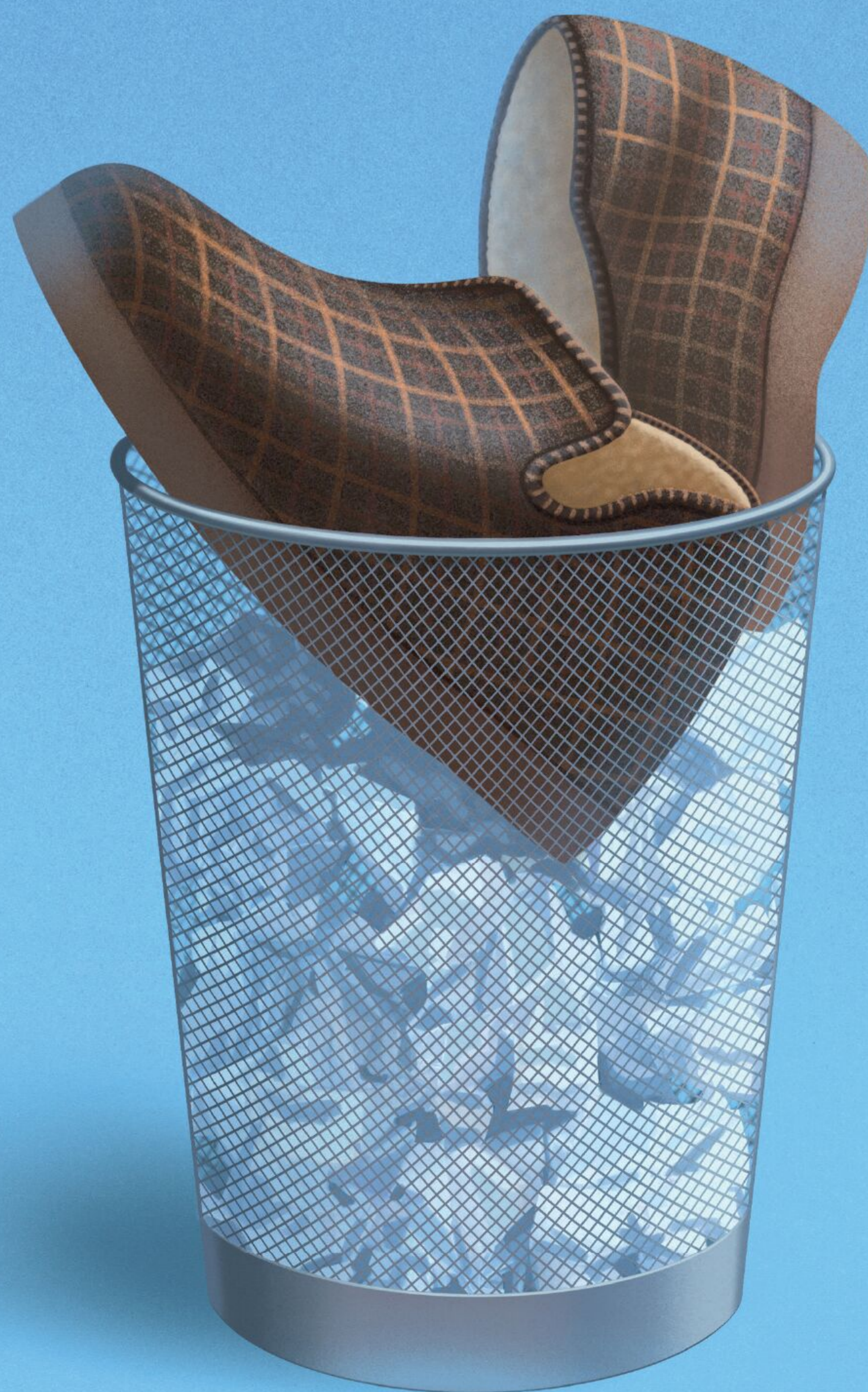
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Space

Why time ticks faster on the moon

NASA is working to define a time zone for the moon as an aid to lunar exploration

Jonathan O’Callaghan

ASTRONAUTS, set your watches. Time on the surface of the moon has been calculated to tick at a rate of 57 millionths of a second a day faster than it does on Earth, a difference that could be crucial as lunar exploration ramps up.

Later this decade, NASA hopes to return humans to the moon for the first time in more than 50 years, while in the past two years, six uncrewed spacecraft have attempted lunar landings.

“We’re looking at a sustained presence on the moon,” says Cheryl Gramling at NASA’s Goddard Space Flight Center in Maryland. “Infrastructure on Earth such as GPS provides time down to the nanosecond level. If you’re trying to navigate or land on the moon, and avoid dangerous areas, then that precision matters.”

To tackle this issue, NASA was recently tasked by the White

House to create a Coordinated Lunar Time for the moon by the end of 2026. Slava Turyshev at NASA’s Jet Propulsion Laboratory in California and his colleagues were already working on the problem, and now have an answer. “Somebody needed to sit down and work out the maths,” he says.

“If you’re trying to navigate or land on the moon, and avoid dangerous areas, then precision matters”

Time ticks faster on the moon because its gravity is one-sixth that of Earth’s, a result of time dilation, as postulated by Albert Einstein’s theory of general relativity.

Turyshev and his team have calculated the flow of time on Earth and the moon in reference to the centre of the solar system,

known as its barycentre, which moves depending on the position of the planets relative to the sun. Their calculations show that time on the moon’s surface ticks 57.5 microseconds per Earth day (0.0000575 seconds) faster than it does on Earth’s surface, so over 50 years, an astronaut on the moon would be about a second older than if they had stayed on Earth (arXiv, doi.org/m59g).

“This approach may now be used to synchronise all the assets on the moon,” says Turyshev.

Previous results for calculating lunar time have arrived at a similar number. In February, a study calculated that time on the moon’s surface ticked 56 microseconds faster than on Earth, based on the orbits of the two bodies. Having multiple results will help create an accurate time zone, says Gramling. “The mathematics behind this will

have to be synthesised together to make sure all the equations match up,” she says, noting it is likely that the moon will have just a single time zone at first.

A definition of lunar time will come from a number of bodies, including the International Bureau of Weights and Measures and the International Astronomical Union, with some discussions set to take place in August. It will be up to individual countries also interested in lunar exploration, such as China, whether they decide to follow this recommendation, though.

Defining moon time will also require us to set a “zero day” date on which we begin tracking lunar seconds compared with Earth, in the same way that international atomic time, as measured by atomic clocks, was agreed to begin on Earth on 1 January 1977. ■

Health

Baby-led weaning is as good nutritionally as spoon feeding

BABIES who hand-feed themselves solid food seem to consume the same number of calories as those given puréed food from a spoon, suggesting that such “baby-led weaning” offers no particular nutritional benefits or drawbacks.

Despite the popularity of baby-led weaning, in which babies choose what to eat, there is little scientific understanding about it, says Kinzie Matzeller at the University of Colorado. To learn more, she and her colleagues asked the parents of 100 healthy, 5-month-old babies living in the Denver, Colorado, area to report their babies’ food and milk intake for three days, as well as weighing

the food on their plate before and after meals so they could determine how much the baby had consumed.

The parents provided these food intake reports again when the babies were 9 months and 12 months old. Matzeller’s team weighed and measured the babies at each of these points.

Using the diet records, the researchers identified 35 infants who were on a baby-led weaning system, which they defined as one in which puréed food provided less than 10 per cent of their total calories. The team then selected 35 conventionally fed babies that matched those in the baby-led weaning group in terms of ethnicity, sex and whether they were breastfed or given formula.

Matzeller told the American Society for Nutrition meeting in Chicago, Illinois, on 30 June that



YAORUSHENG/GETTY IMAGES

Infants feed themselves in baby-led weaning, which can be a messy business

9-month mark, but this evened out by 12 months.

At 9 months and 12 months, the baby-led weaning infants had gained more weight with respect to their age and their height, although the differences were minor.

“If you gave me two growth charts of a baby-weaned versus conventionally weaned infant, I probably wouldn’t be able to tell you which one is which,” says Matzeller.

Baby-led weaning was, however, more common among mothers who had gone to college and had higher annual family incomes, possibly because they can afford the time and expense that baby-led weaning often requires, says Matzeller. ■
Christa Lesté-Lasserre