

<

Ads by Google

[Stop seeing this ad](#)[Why this ad? ⓘ](#)

TRENDING

[Artemis 1 updates](#)[Best Telescopes](#)[Nov. 8 Blood Moon lunar eclipse](#)[Best Star Projectors](#)[Best Binoculars](#)

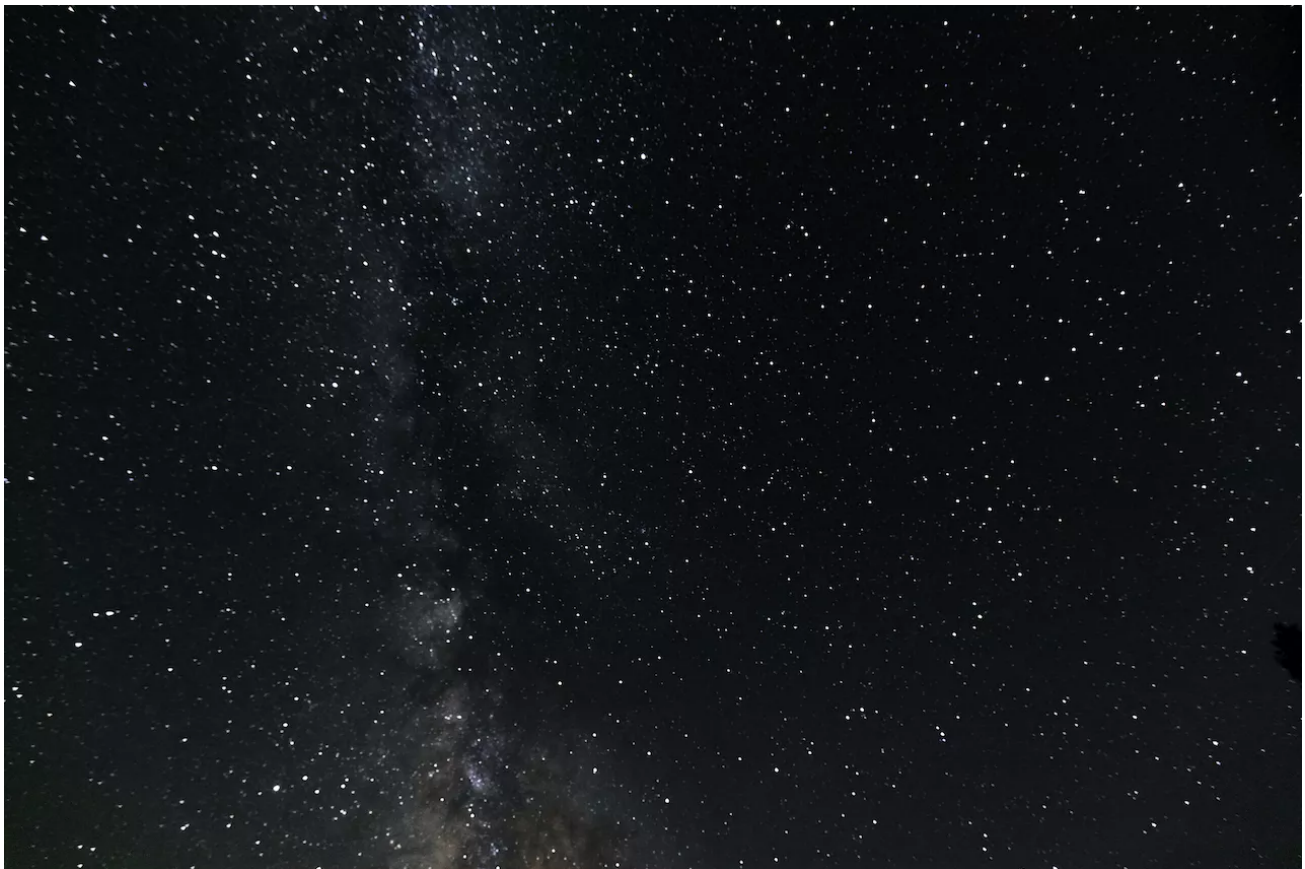
F

Space is supported by its audience. When you purchase through links on our site, we may earn an affiliate commission. [Here's why you can trust us.](#)

How many stars are in the universe?

By [Ailsa Harvey](#), [Elizabeth Howell](#) published February 11, 2022

Can we estimate the total number of stars?



(Image credit: Getty Images)

Jump to: [Observable universe](#) | [Galaxy observations](#) | [Additional resources](#) | [Bibliography](#)

challenging enough for an amateur astronomer to
come visible, making counting a lengthy

process. So how do [astronomers](#) figure out how many stars are in the [universe](#)?

The first sticky part is trying to define what "universe" means, said David Kornreich, an assistant professor at Ithaca College in New York State. He was the founder of the "Ask An Astronomer" service at Cornell University.

"I don't know [the answer] because I don't know if the universe is [infinitely large](#) or not," he said. The [observable universe](#) appears to go back in time by about 13.8 billion years, but beyond what we could see there could be much, much more. Some astronomers also think that we may live in a "[multiverse](#)" where there would be other universes like ours contained in some sort of larger entity.

The simplest answer may be to estimate the number of stars in a typical [galaxy](#), and then multiply that by the estimated [number of galaxies](#) in the universe, according to the [European Space Agency \(ESA\)](#). But even that is tricky, as some galaxies shine better in visible or some in infrared, for example. There also are estimation hurdles that must be overcome.

In October 2016, deep-field images from the Hubble Space Telescope suggested that there are about 2 trillion galaxies in the observable universe, or about 10 times more galaxies than previously suggested, according to the journal [Nature](#). In an email with Live Science, lead author Christopher Conselice, a professor of astrophysics at the University of Nottingham in the United Kingdom, said there were about [100 million stars in the average galaxy](#).



Galaxies are vast collections of stars that populate our universe. (Image credit: ESA/Hubble & NASA, F. Pacaud, D. Coe)

[Telescopes](#) may not be able to view all the stars in a galaxy, however. A 2008 estimate by the [Sloan Digital Sky Survey](#) (which catalogs all the observable objects in a third of the sky) found about 48 million stars, roughly half of what astronomers expected to see. A star like our own sun may not even show up in such a catalog. So, many astronomers estimate the number of stars in a galaxy based on its mass — which has its own difficulties, since [dark matter](#) and galactic rotation must be filtered out before making an estimate.

RELATED ARTICLES

[How many black holes are there in the universe?](#)
[What is the biggest thing in the universe?](#)

Missions such as the [Gaia mission](#), a European Space Agency space probe that launched in 2013, may provide further answers. Gaia aims to precisely map about 1 billion stars in the [Milky Way](#). It builds on the previous Hippararchus mission, which precisely located 100,000 stars and also mapped 1 million stars to a lesser precision. Data from the mission is due to be released in June 2022, according to [ESA](#).

"Gaia will monitor each of its 1 billion target stars 70 times during a five-year period, precisely charting their positions, distances, movements and changes in brightness," [ESA said on its website](#). "Combined, these measurements will build an unprecedented picture of the structure and evolution of our galaxy. Thanks to missions like these, we are one step closer to providing a more reliable estimate to that question asked so often: 'How many stars are there in the universe?'"

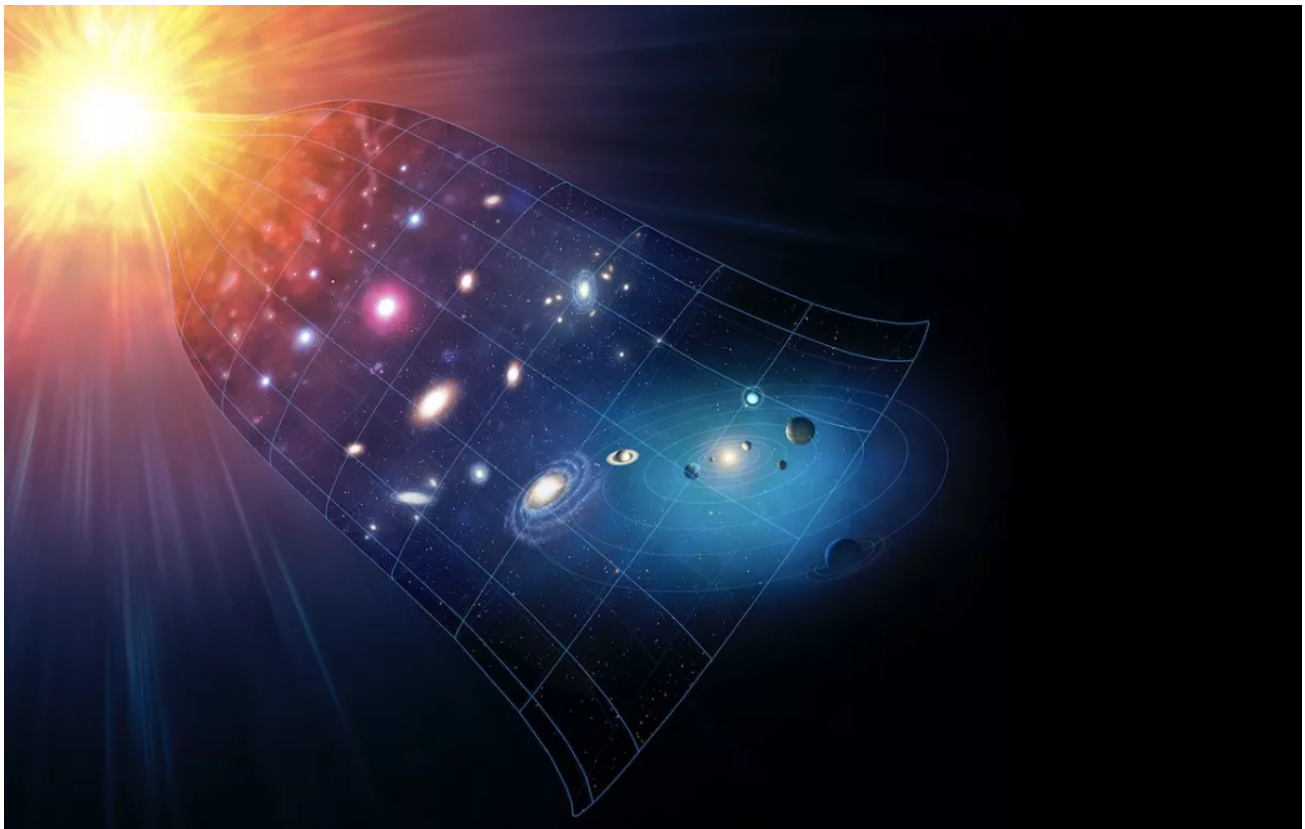
OBSERVABLE UNIVERSE

Even if we narrow down the definition to the "observable" universe — what we can see — estimating the number of stars within it requires knowing just how big the universe is. The first complication is that the universe itself is expanding, and the second complication is that [space-time](#) can curve.

To take a simple example, light from the objects farthest away from us would take approximately 13.8 billion light-years to travel to [Earth](#), taking into account that the very youngest objects would be shrouded because light couldn't carry in the early universe. So the radius of the observable universe should be 13.8 billion light-years since light only has that long to reach us.

Or should it? "It's a logical way to define distance, but not how a relativist defines distance," Kornreich said. A relativist would use a device such as a meter stick, measuring the distance along that device and then extending it as long as needed.

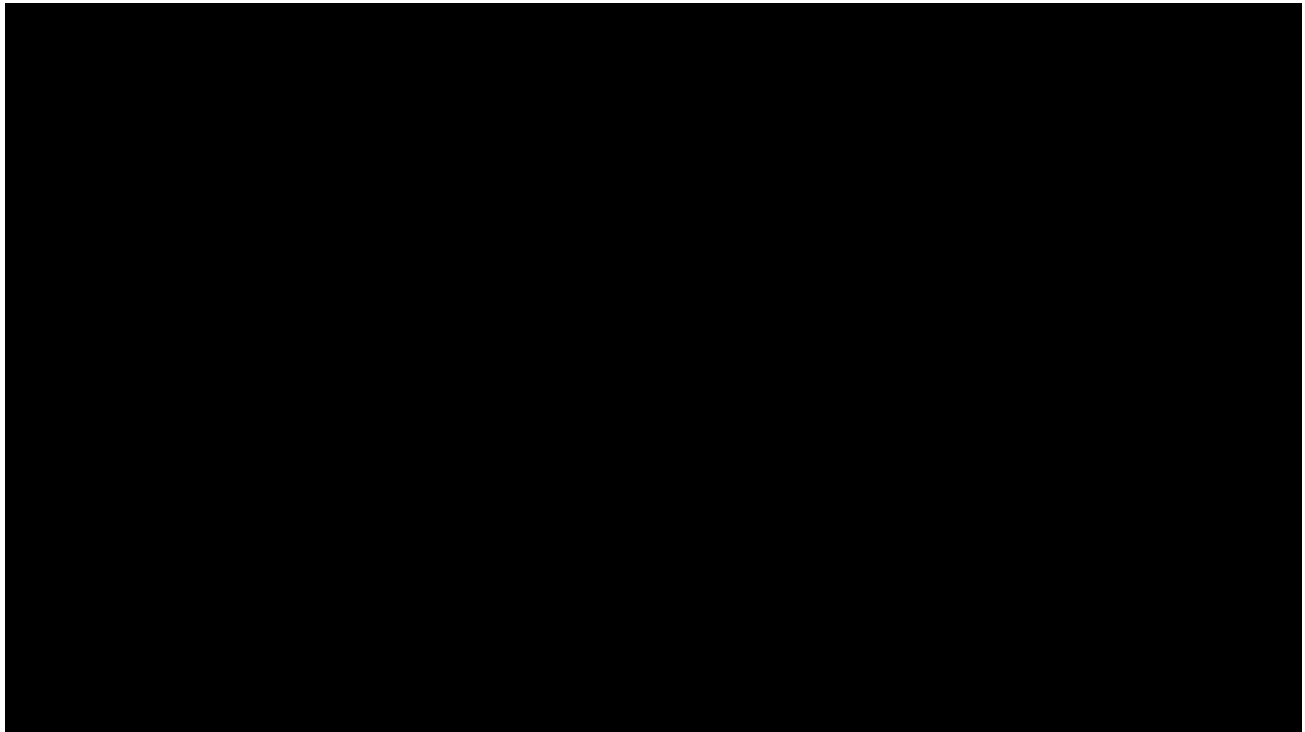
This produces a different answer, which some sources define as 48 billion light-years in radius. Sources vary on this number, however. That's because space-time can curve. As the observer does the measurement with the meter sticks, light travels at the same time and influences the measurements.



Star number estimation is made more difficult by the fact that the universe is expanding. (Image credit: Getty)

It's easier to count stars when they are inside galaxies, since that's where they tend to [cluster](#), according to the [Harvard and Smithsonian Center for Astrophysics](#). To even begin to estimate the number of stars, then you would need to estimate the number of galaxies and come up with some sort of an average.

Some estimates peg the Milky Way's star mass as having 100 billion "[solar masses](#)," or 100 billion times the mass of [the sun](#). Averaging out the types of stars within our galaxy, this would produce an answer of about [100 billion stars in the galaxy](#). This is subject to change, however, depending on how many stars are bigger and smaller than our own sun. Also, other estimates say the Milky Way could have 200 billion stars or more.



The [number of galaxies](#) is an astonishing number, however, as shown by some imaging experiments performed by the [Hubble Space Telescope](#). Several times over the years, the telescope has pointed a detector at a tiny spot in the sky to count galaxies, performing the work again after the telescope was upgraded by astronauts during the [shuttle](#) era.

A 1995 exposure of a small spot in Ursa Major revealed about 3,000 faint galaxies. In 2003-4, using upgraded instruments, scientists looked at a smaller spot in the [constellation](#) Fornax and found 10,000 galaxies. An even more detailed investigation in Fornax in 2012, with even better instruments, showed about 5,500 galaxies.

Kornreich used a very rough estimate of 10 trillion galaxies in the universe. Multiplying that by the Milky Way's estimated 100 billion stars results in a large number indeed: 1,000,000,000,000,000,000,000,000 stars, or a "1" with 24 zeros after it (1 septillion in the American numbering system; 1 quadrillion in the European system). Kornreich emphasized that number is likely a gross underestimation, as more detailed looks at the universe will show even more galaxies.

ADDITIONAL RESOURCES

Read more about estimating the number of stars in the Milky Way in this article by [NASA](#). Additionally, you can see some of the best images of stars taken by Hubble in [ESA's image archive](#).

BIBLIOGRAPHY

"Universe has ten times more galaxies than researchers thought". Nature (2016). <https://www.nature.com/articles/nature.2016.20809.pdf?origin=ppub>

≡

SPACE

Subscribe ▼

Q

"Star Clusters". Harvard and Smithsonian Center for Astrophysics. <https://pweb.cfa.harvard.edu/research/topic/star-clusters>

"Oases in the Dark: Galaxies as probes of the Cosmos". Utah State University (2007). <https://digitalcommons.usu.edu>

Join our [Space Forums](#) to keep talking space on the latest missions, night sky and more! And if you have a news tip, correction or comment, let us know at: community@space.com.

SPACE

Ailsa Harvey




Ailsa is a staff writer for [How It Works](#) magazine, where she writes science, technology, space, history and environment features. Based in the U.K., she graduated from the [University of Stirling](#) with a BA (Hons) journalism degree. Previously, Ailsa has written for Cardiff Times magazine, Psychology Now and numerous science bookazines.

MORE ABOUT SCIENCE ASTRONOMY



Antares rocket launches ovarian cells and other wild experiments to space station for NASA ►



Alien planets keep their parent stars young by forcing them to 'exercise' ►

LATEST



Best Budget Cameras: Picks from Canon, Olympus, Sony and more ►

SEE MORE LATEST ►

Taboola Feed

Dead Spacecraft on Mars Spotted in New Photos

A NASA spacecraft in orbit around Mars has captured fascinating color images of the remains of two defunct spacecraft in their final resting places on the surface of the Red Planet.

Space

If you own a mouse, you have to try this game. No Install. Play for free.

Combat Siege | Sponsored

This Idea Everyone Should To Know

Rupa-News | Sponsored

 **SPACE**
UNIVERSE

Subscribe ▼



≡

SPACE

11/10/22

Subscribe ▾

Q

≡

SPACE

WIRE

Subscribe ▾

Q



SIGN UP FOR E-MAIL NEWSLETTERS

Get breaking space news and the latest updates on rocket launches, skywatching events and more!

- ☐ Contact me with news and offers from other Future brands
- ☐ Receive email from us on behalf of our trusted partners or sponsors

SIGN ME UP

By submitting your information you agree to the [Terms & Conditions](#) and [Privacy Policy](#) and are aged 16 or over.

Advertisement

IHG ONE REWARDS



InterContinental Maldives Maafushigau Resort

จองตอนนี้

MORE FROM SPACE...

SPACE.com

1 **Best Budget Cameras: Picks from Canon, Olympus, Sony and more**

2 **On This Day In Space: Nov. 7, 1996: Mars Global Surveyor launches to the Red Planet**

3 **Antares rocket launches ovarian cells and other wild experiments to space station for NASA**

4 **Alien planets keep their parent stars young by forcing them to 'exercise'**

5 **James Webb Space Telescope could help hunt for habitable alien worlds**

Advertisement



 **SPACE**
UNIVERSE

Subscribe ▾



 **SPACE**
UNIVERSE

Subscribe ▼



Space is part of Future US Inc, an international media group and leading digital publisher. **Visit our corporate site.**

[About Us](#)

[Terms and conditions](#)

[Privacy policy](#)

[Cookies policy](#)

[Accessibility Statement](#)

[Topics](#)

[Advertise with us](#)

[Web notifications](#)

[Careers](#)

© Future US, Inc. Full 7th Floor, 130 West 42nd Street, New York, NY 10036.