Keene Amateur Astronomers

The Newsletter for Keene Amateur Astronomers

Vol. 2026 No. 11 November 2026

# The Seagull Nebula



See the Seagull Nebula through the Eyes of NSF–DOE Vera C. Rubin's Observatory's engineering test camera, the Commissioning Camera (ComCam). Captured in 2024, this is one of the many images that led to the success of Rubin First Look in June 2025 and helped to document the observatory's excellent performance! Credit**:** NOIRLab

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## Editor's Message

The weather has been unusually mild for this time of year, and hopefully you've had a chance to get outside and enjoy the night sky.

Saturn is currently the only planet visible to the naked eye before midnight, while Neptune remains visible in the evening with a telescope. Uranus is an easier target to locate this month, appearing in the Pleiades star cluster. In the predawn sky, Venus will pass close to Spica on the 10th. Mars and Jupiter will also put on a show in the early morning sky as they appear near Regulus. The two planets will reach their closest apparent approach on the 15th and 16th.

The Leonid meteor shower will be active throughout most of the month, reaching its peak on November 17th and 18th. The best viewing is expected during the early morning hours of the 18th, before dawn. Look toward the constellation Leo, where the meteors appear to originate, as you watch for these annual visitors.

Great objects to view this month:

- **Messier 34** an open star cluster located in Perseus. It is a little larger than the full Moon. With a magnitude of 5.5 it can be seen with the naked eye under dark sky conditions. It resolves into a scattering of stars with a pair of binoculars.

- **NGC 869 and NGC 884 - Double Cluster** a pair of open star clusters that appear side by side located between Cassiopeia and Perseus. This can pair can also be seen with the naked eye and is a great binocular target. They are visible in the early evening and reach their highest point around midnight.

- **M31 Andromeda Galaxy** a spiral galaxy. It is a great object to view this month and like the prior objects mentioned, this one can be seen with the naked eye and is a great object to look at with binoculars and a telescope.

I hope you are able to find time to step outside this month and enjoy the beauty and wonder of the night sky.

- Susan Rolke

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# Monthly Business Meeting

The business meeting in November has been canceled. The next meeting will be in December 4th at 7 pm at Bruce Norlund's house.

## Club Happenings

An observing session is scheduled for Saturday November 14th at 7pm at the Sullivan observatory, weather permitting.

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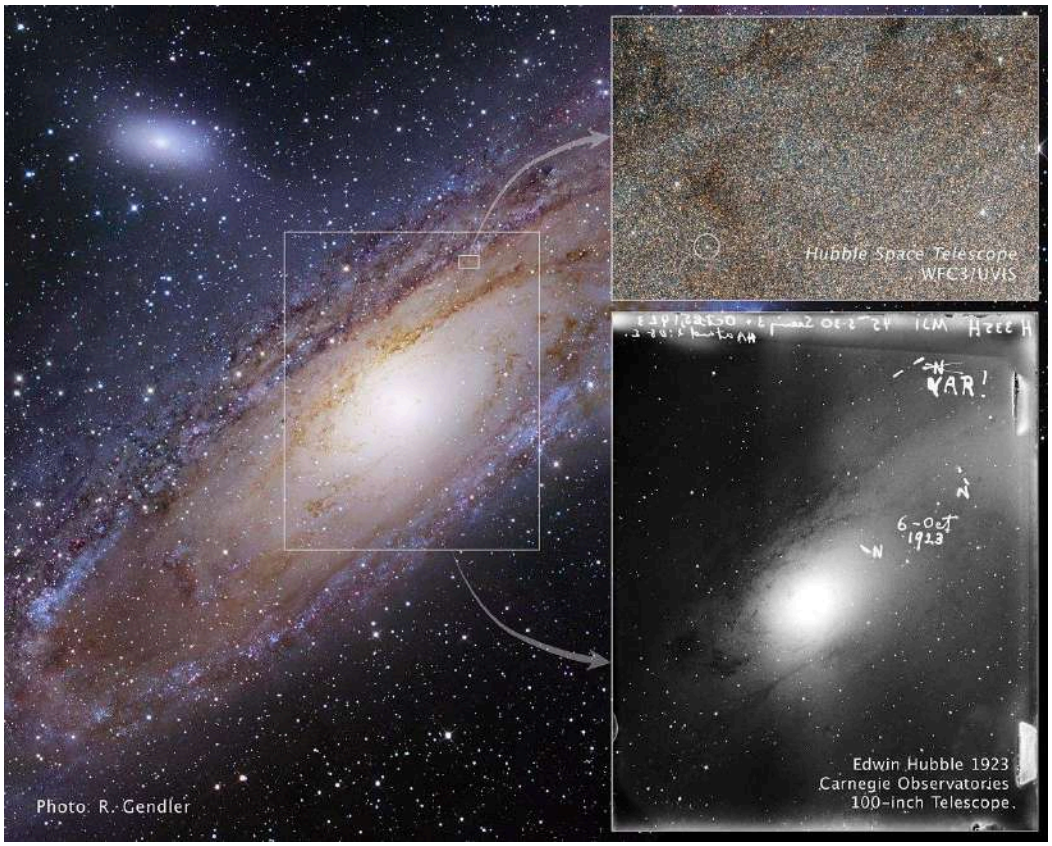
# Was the Big Bang Really the Beginning?
# Exploring Cosmic Inflation

## By Susan Rolke

Each month I put these articles together, I learn something new. Sometimes I expand on topics I know well and have taught several times. Other times, I dive into new research. And sometimes, like this month, I find myself going down an unexpected rabbit hole.

What I thought would be a relatively quick article about the sheer size of our Universe took an unexpected turn. Instead, I found myself exploring developments in cosmic inflation and some intriguing questions about the origins of the Universe. In astronomy and cosmology, our understanding is continually evolving as new observations challenge existing ideas and researchers develop models to better explain what we see. This month, I'd like to take you along on that journey and explore a particularly fascinating question: What came before the Big Bang?

Our modern understanding of the Big Bang has changed considerably over the past century. In the 1920s, astronomers discovered that distant galaxies were moving away from us, with more distant galaxies generally receding faster than closer ones. This became known as the expansion of the Universe.




Hubble's discovery of a Cepheid variable in the Andromeda galaxy, M31, provided evidence that the Universe was expanding. Credits: NASA, ESA and the Hubble Heritage Team (STScI/AURA); Illustration via NASA, ESA, and Z. Levay (STScI)

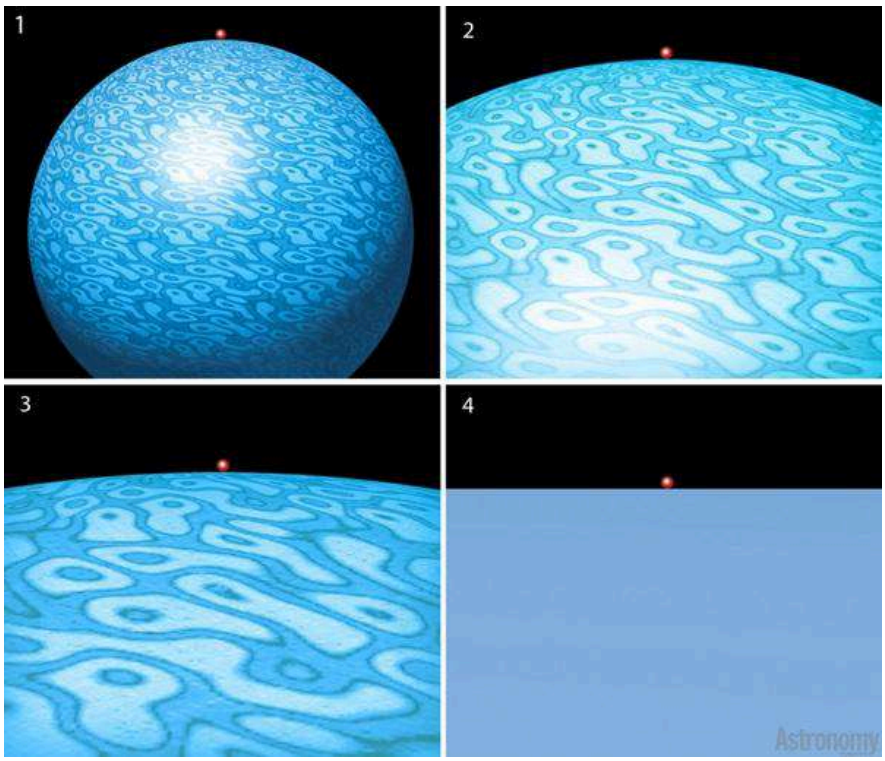
The reasoning was relatively straightforward. If galaxies are moving farther apart today, they must have been closer together in the past. By tracing this expansion backward in time, astronomers arrived at a picture of an increasingly hot and dense early Universe. Using measurements of the expansion rate and other cosmological parameters, scientists can estimate how long this expansion has been taking place. Today, the age of the Universe is generally accepted to be about 13.8 billion years.

The Big Bang model has been remarkably successful in explaining many of the observations we make today. It describes how the Universe expanded and cooled, allowing the first atoms to form, followed much later by stars, galaxies, and the large-scale structures we see throughout the cosmos.

But there is a fundamental limitation to this picture. When we trace the expansion backward far enough, our equations lead us toward what is called a *singularity*. In this mathematical description, density and temperature become infinitely large, and our current understanding of physics breaks down. We cannot reliably describe what happened at that point, or even whether such a singularity actually existed.

In other words, the Big Bang model does a remarkably good job of describing the evolution of our Universe, but it does not tell us what caused it to begin expanding or what, if anything, came before.

That unanswered question helped motivate one of the most important developments in modern cosmology: cosmic inflation.



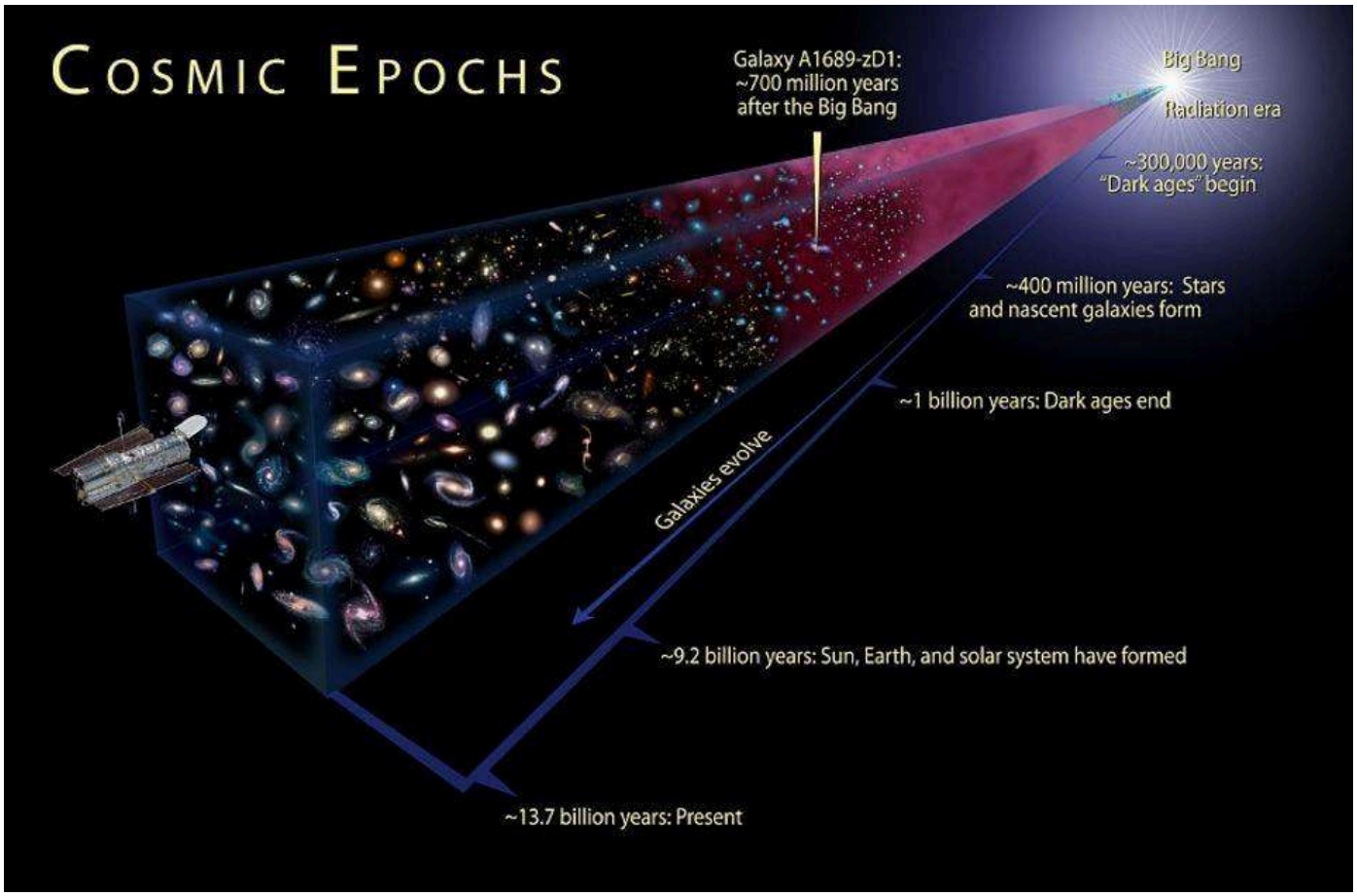

**INFLATIONARY STEP.** Inflation made the universe flat. Here, a curved surface expands by a factor of three in each panel, appearing nearly flat by the end. To relive cosmic inflation, repeat this expansion 87 more times. Credit: *Astronomy*, Roen Kelly

In 1981, physicist Alan Guth published a paper proposing that the very early Universe underwent an extraordinarily brief period of rapid expansion. This period, called *inflation*, would have stretched space at an enormous rate, smoothing out irregularities and helping explain several puzzling features of the Universe we observe today.

Why was this necessary? Astronomers had identified some properties of the Universe that were difficult to explain using the original Big Bang picture alone. For example, the Universe appears remarkably uniform on large scales, even in regions that are too far apart to have exchanged information through ordinary physical processes since the beginning of the expansion. The geometry of space also appears remarkably close to flat.

Inflation offered a possible solution. An extremely rapid expansion in the earliest moments of the Universe could have stretched space so dramatically that any initial irregularities or curvature became much less noticeable.

Over time, researchers refined Guth's original proposal, and inflation became an important part of the broader framework used to explain the early Universe. Combined with the standard model of cosmology, known as Lambda-CDM, it helps explain many of the observations astronomers have made.




The stars and galaxies we see today didn't always exist, and the farther back we go, the closer to an apparent singularity the Universe gets, as we go to hotter, denser, and more uniform states. However, there is a limit to that extrapolation, as going all the way back to a singularity creates puzzles we cannot answer. Credit:NASA, ESA, and A. Feild (STScI)

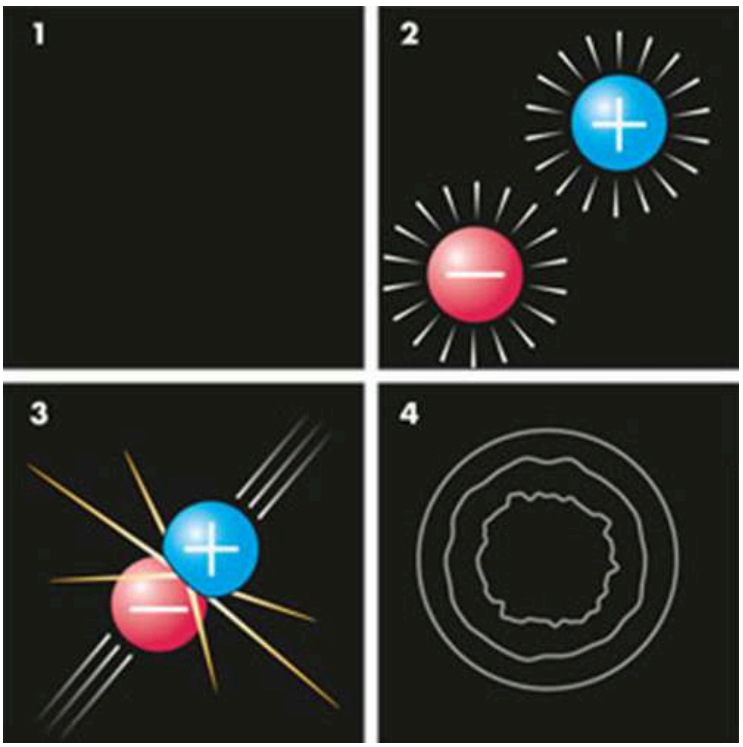
This brings us back to our original question: What came before the Big Bang?

However, inflation also introduced a fascinating possibility. What if the rapid expansion did not begin with the Big Bang? What if the inflationary process itself was part of a much larger structure, one that existed before our particular Universe took shape?

To explore this possibility, we need to distinguish between two ideas that are sometimes treated as though they mean the same thing: the hot Big Bang and cosmic inflation.

The hot Big Bang describes the early period in which our Universe was extremely hot and dense and began expanding and cooling. Inflation describes a proposed period of extraordinarily rapid expansion that may have occurred before that hot, dense phase.

In some inflationary models, the process begins in a state dominated by energy associated with empty space, sometimes called vacuum energy. Rather than our Universe emerging from an infinitely dense point, it could have developed within a much larger region of space that was already expanding.

4. 

An illustration of vacuum energy. 1. Empty space. 2. Two particles suddenly appear. 3. Particles ram together and annihilate each other. They leave ripples of energy through space. Credit: Tim Jones

Even more intriguing, some versions of inflation suggest that this process may never completely stop.

This idea is called *eternal inflation*. In these models, inflation ends in certain regions of space, allowing individual universes to form, while the larger inflationary process continues elsewhere. These regions are sometimes called *pocket universes*.

Think of bubbles forming in a glass of beer. Each bubble is separate from the others, while the surrounding liquid continues to expand. In this analogy, each bubble represents a universe, and the expanding space between them represents the larger inflationary structure.

The analogy is imperfect, of course, but it gives us a way to imagine how our Universe might be just one region within something much larger.

If this model is correct, other universes could exist beyond our observable Universe, separated from us by regions of space that continue to inflate. They would not simply be distant galaxies waiting to be discovered. They would be separate regions of spacetime, potentially forever beyond our ability to observe or communicate with.

This is a remarkable shift in perspective. Instead of thinking of the Big Bang as the beginning of everything, we begin to consider whether it marked the beginning of our particular Universe within a much larger cosmic structure.

This brings us to another important question. If inflation occurred before the hot Big Bang, how did the matter and energy that make up our Universe come into existence?

The answer involves a process called *reheating*.

In inflationary models, the rapid expansion is driven by energy associated with a field that fills space, often called the inflaton field. When inflation ends in a particular region, that energy can be converted into ordinary particles and radiation. The result is an extremely hot, dense environment that begins the familiar evolution of the early Universe.

This process does not require us to imagine matter appearing from nowhere. Rather, it describes how the energy driving inflation could be transformed into the particles and radiation that make up our Universe.

From that point, the familiar Big Bang story unfolds. The Universe continues to expand and cool. Particles combine to form atoms, gravity gradually draws matter together, and eventually the first stars and galaxies emerge.

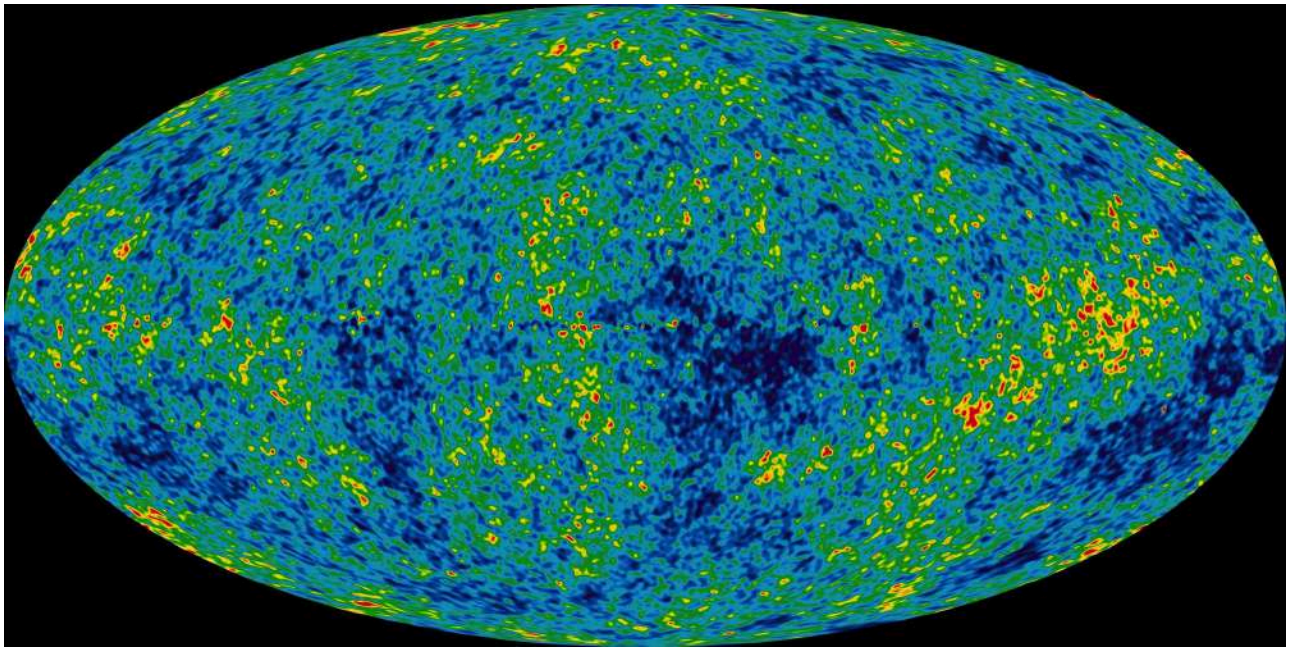
In this picture, inflation is not replacing the Big Bang. It is providing a possible explanation for what happened before the hot, dense phase that we commonly associate with the Big Bang.

An important question remains: Is there evidence to support inflation?

One of the most compelling reasons scientists take inflation seriously is that it helps explain several features of the Universe we observe today.

Consider the Cosmic Microwave Background (CMB), the faint radiation left over from the early Universe. First detected in 1965, it provides us with a remarkable snapshot of the Universe when it was about 380,000 years old.

Measurements from NASA's WMAP mission and the European Space Agency's Planck satellite have revealed extraordinarily small variations in the temperature of this radiation. These tiny differences reflect slight variations in the density of matter in the early Universe.



A view of temperature differences in the cosmic microwave background, when the galaxy was less than 400,000 years old, made from nine years of observations from the Wilkinson Microwave Anisotropy Probe (WMAP). Credit: NASA

Cosmic inflation provides a possible explanation for these variations. During the rapid expansion, tiny quantum fluctuations could have been stretched to enormous cosmic scales. These small differences in density eventually became the seeds from which galaxies and large-scale cosmic structures developed.

Inflation also helps explain why the Universe appears so uniform and nearly flat on the largest scales. By stretching space enormously in a very short period, inflation could have smoothed out irregularities that might otherwise have remained.

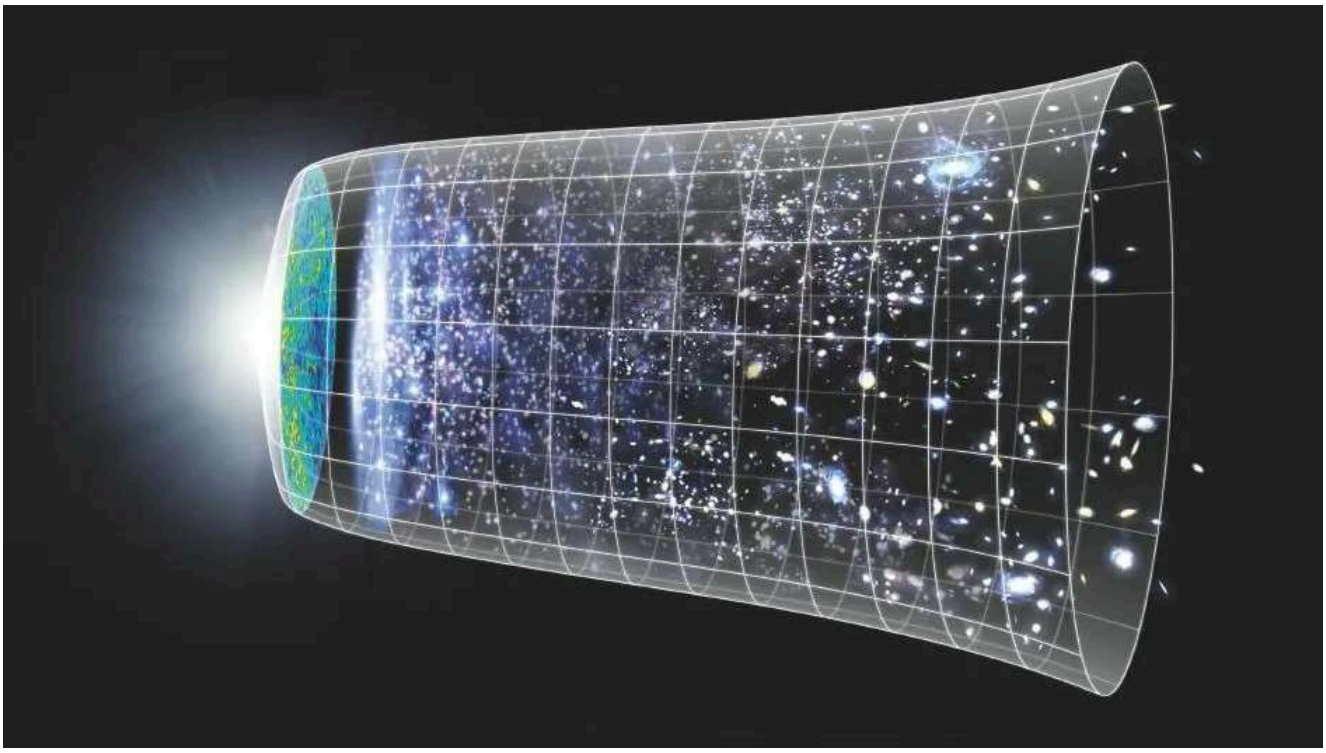
Another important consideration is the energy and temperature of the early Universe. Some inflationary models place an upper limit on the energy reached during this period. This is significant because a Universe that began at arbitrarily high temperatures could have produced other effects or relics that we would expect to observe today. The absence of certain predicted features helps place constraints on possible models of the early Universe.

These observations do not prove that inflation happened, nor do they establish that other universes exist. However, they provide important reasons for continuing to investigate inflationary models.

We have come full circle to the question that started this journey.

In some inflationary models, the process that created our Universe began in a state very different from the hot, dense conditions traditionally associated with the Big Bang. Rather than starting with all matter and

energy compressed into an extraordinarily small region, our Universe could have emerged from a much larger, expanding region of space dominated by vacuum-like energy.



The modern cosmic picture of our universe's history begins not with a singularity that we identify with the Big Bang, but rather with a period of cosmic inflation that stretches the universe to enormous scales, with uniform properties and spatial flatness. The end of inflation signifies the onset of the hot Big Bang, and our Universe has expanded and evolved ever since. Credit: NASA/WMAP science team

This gives us a possible way to think about what preceded the hot Big Bang, but it does not answer every question. We still do not know what caused inflation to begin, what physical conditions existed before it, or whether the larger structure in which our Universe formed has always existed.

In fact, if eternal inflation is correct, we may never be able to observe the other pocket universes or obtain direct information about the larger structure. The rapid expansion between these regions would place them beyond our ability to observe or communicate with.

Cosmic inflation is an intriguing part of modern cosmology because it offers possible answers to some longstanding questions about the early Universe while raising entirely new ones. It challenges us to think beyond the familiar picture of the Big Bang as the beginning of everything.

Perhaps the Big Bang was not the beginning of all existence, but rather the beginning of our particular cosmic story. Perhaps our Universe is one small region in a much larger cosmic landscape.

For now, these ideas remain theoretical. Time, observation, and continued research will determine whether inflation provides the right explanation for the Universe's earliest moments and whether the possibility of other universes has any basis in reality.

But perhaps the most fascinating thing about cosmology is that the more we learn about our Universe, the more questions we uncover. And sometimes, the most interesting question isn't how big the Universe is, but what came before it.

Resources to Investigate Further:

- Big Think, How did the Universe truly begin?
- Medium, Starts With A Bang
- Astronomy.com, Does Inflation Theory Govern the Universe?
- Forbes, How Small Was the Universe At The Start Of The Big Bang?
- Video - CHATS With Will Kinney, An Infinity Of Worlds
- Book, Will Kinney, *An Infinity of Worlds, Cosmic Inflation and the Beginning of the Universe*

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# Night Sky Network Online Webinar

Join the NASA Night Sky Network will host 50 Years of Voyager on November 4th at 9 PM EST. Dr Jeffrey Hayes will discuss 50 years of science with Voyager as it approaches its first Light-Day on November 18th.

In case you missed the program in October, you can find the presentation at this link for NASA's next flagship space telescope, the Nancy Grace Roman Space Telescope.

# McDonald Observatory

Join the McDonald Observatory will have a program to learn about backyard astronomy on November 18th at 8:30 PM EST. They will discuss how to navigate by the constellations as well as using a telescope. Weather permitting, there will be views from their 16 inch telescope. Past topics can be accessed on this site if you missed a prior program.

# Observing

To find skywatching tips for this month, click on the following link to learn more.

Video: What's Up November 2026 Sky Watching Tips from NASA

You can find past pdfs of the Astronomical League charts **here.** Turn to the end of the Newsletter to see what is up this month.

**NASA Night Sky Notes**

**This article is distributed by NASA's Night Sky Network (NSN).**
The NSN program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!

# November's Night Sky Notes: Light-Day Away

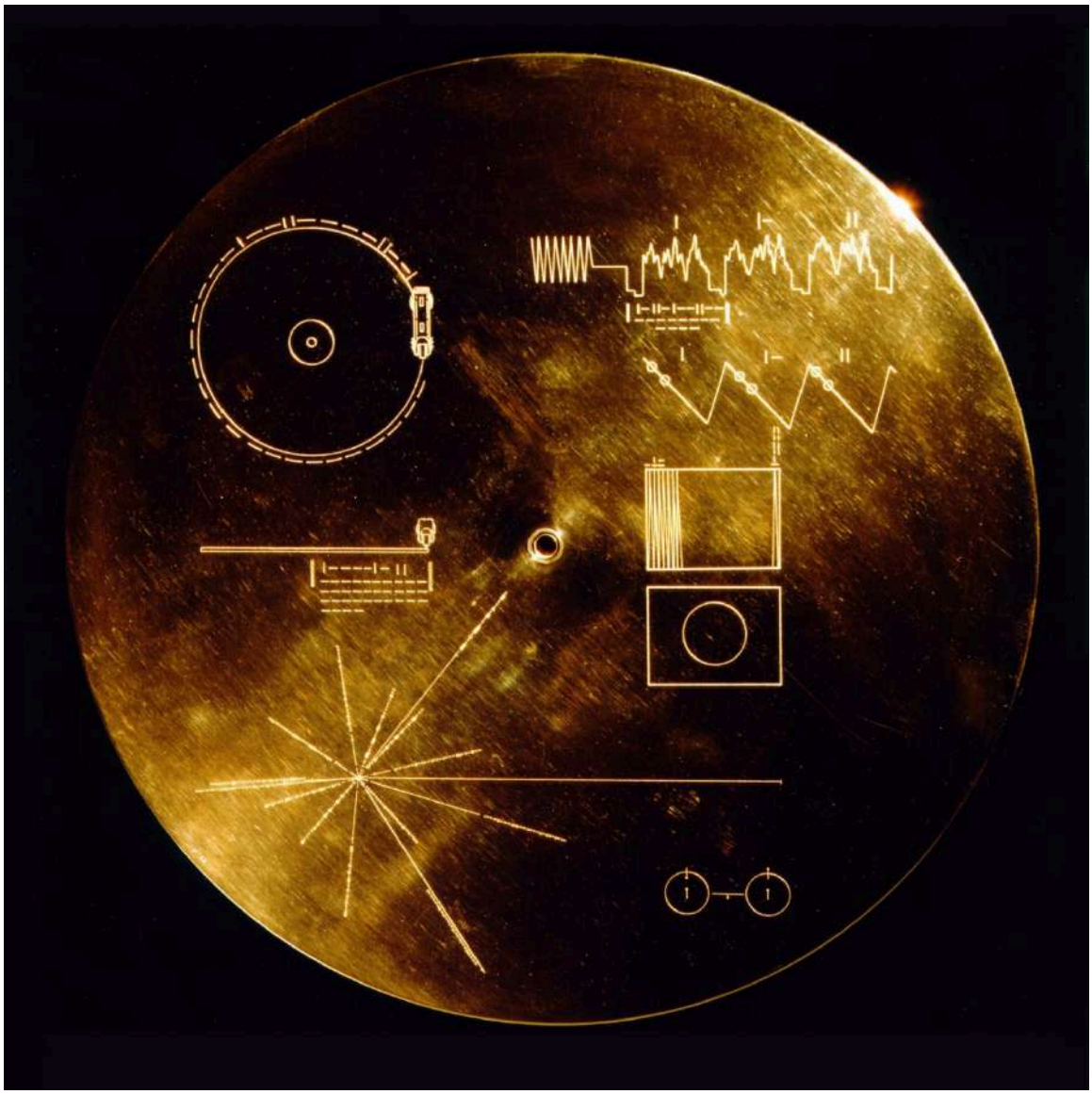
## By Kat Troche



A travel poster of The Grand Tour. Credit: NASA/JPL

## Twin Travelers

In 1977, NASA launched twin spacecraft Voyager 1 and 2, taking advantage of a once-every-175-year planetary alignment of the four largest planets in our solar system: Jupiter, Saturn, Uranus, and Neptune. Using six gravity assists between them, this Grand Tour gave us up-close views of the gas and ice giants, including several moons. By the 1980s, the two probes went their separate ways at Saturn. As Voyager 2 continued toward Uranus and Neptune, Voyager 1 grabbed one more portrait of the solar system (excluding Mercury and Mars), including a final image of the pale blue dot we call home.



The Golden Record cover shown with its extraterrestrial instructions. Credit: NASA/JPL-Caltech

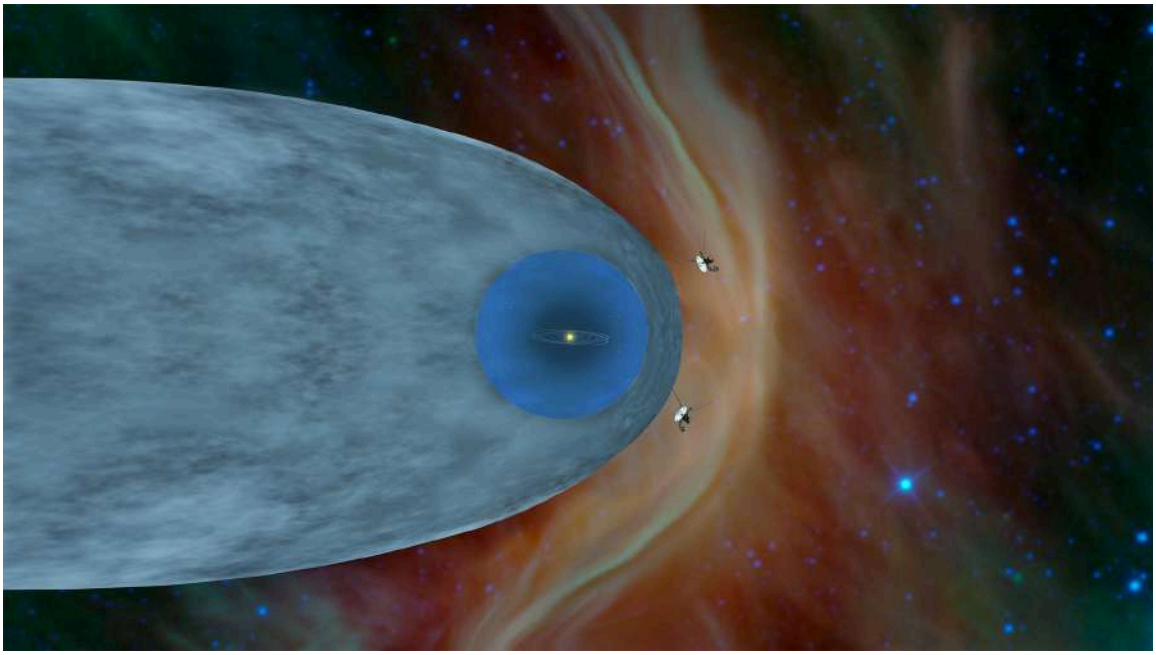
## Playlist

*“Hello from the children of planet Earth.”*

Every good road trip needs some music to match. In this case, each craft carries the Golden Record, a 12-inch phonograph record with spoken greetings in 55 languages, 27 musical tracks, 116 images, and other sounds from Earth. Each record is protected by an outer cover featuring etchings showing our Sun's location relative to 14 pulsars, along with instructions on how to play it. The design used various metals to protect the information encoded from space radiation: the record used copper and gold plating, and the cover used aluminum. The cover was electroplated with an ultra-pure sample of the isotope uranium-238. Uranium-238 has a half-life of 4.468 billion years.

# Are We There Yet?

Did you know that a light-minute is a measure of distance, not time? In August 2012 and November 2018, Voyager 1 and 2 crossed the heliopause, the boundary where the Sun's solar wind meets the interstellar medium. Using NASA's Deep Space Network, Earth communicates with both spacecraft and tracks each on its journey. At the time of this article, the Canberra antenna tracked Voyager 1 at 25.80 billion km, or just over 16 billion miles.



This illustration shows the positions of NASA's Voyager 1 and Voyager 2 probes outside the heliosphere, a protective bubble created by the Sun that extends well past Pluto's orbit. The red wave in front of the light blue heliopause is the bow shock. Credit: NASA/JPL-Caltech.

On November 18, 2026, 49 years after its launch, Voyager 1 will cross the one-light-day mark, 16.1 billion miles from the Sun. You may have heard the term *light-year* in your favorite sci-fi movie or show, or when stargazing and referring to an object outside of our solar system. This video best demonstrates the different distances between the inner solar system, outer solar system, and beyond, using light measurements. Additionally, track each Voyager spacecraft here.

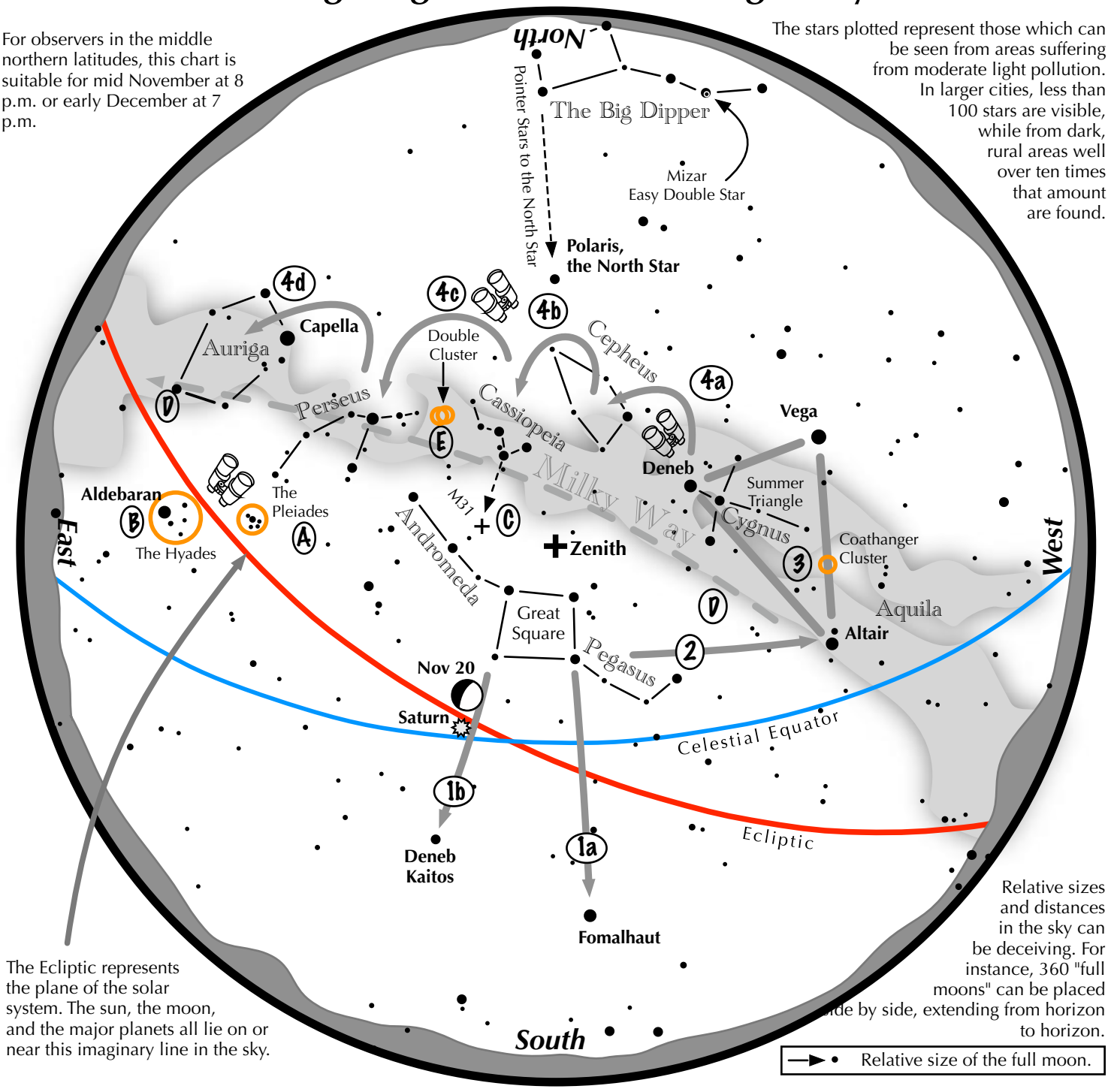
You can get a real understanding of what a gravity assist might be like with our Gravity Assist activity and learn what it's like to measure a "light minute" with our Measuring a Kid Minute activity guide!

# Navigating the November Night Sky

2026

For observers in the middle northern latitudes, this chart is suitable for mid November at 8 p.m. or early December at 7 p.m.

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.




The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

Relative size of the full moon.

## Navigating the November night sky: Simply start with what you know or with what you can easily find.

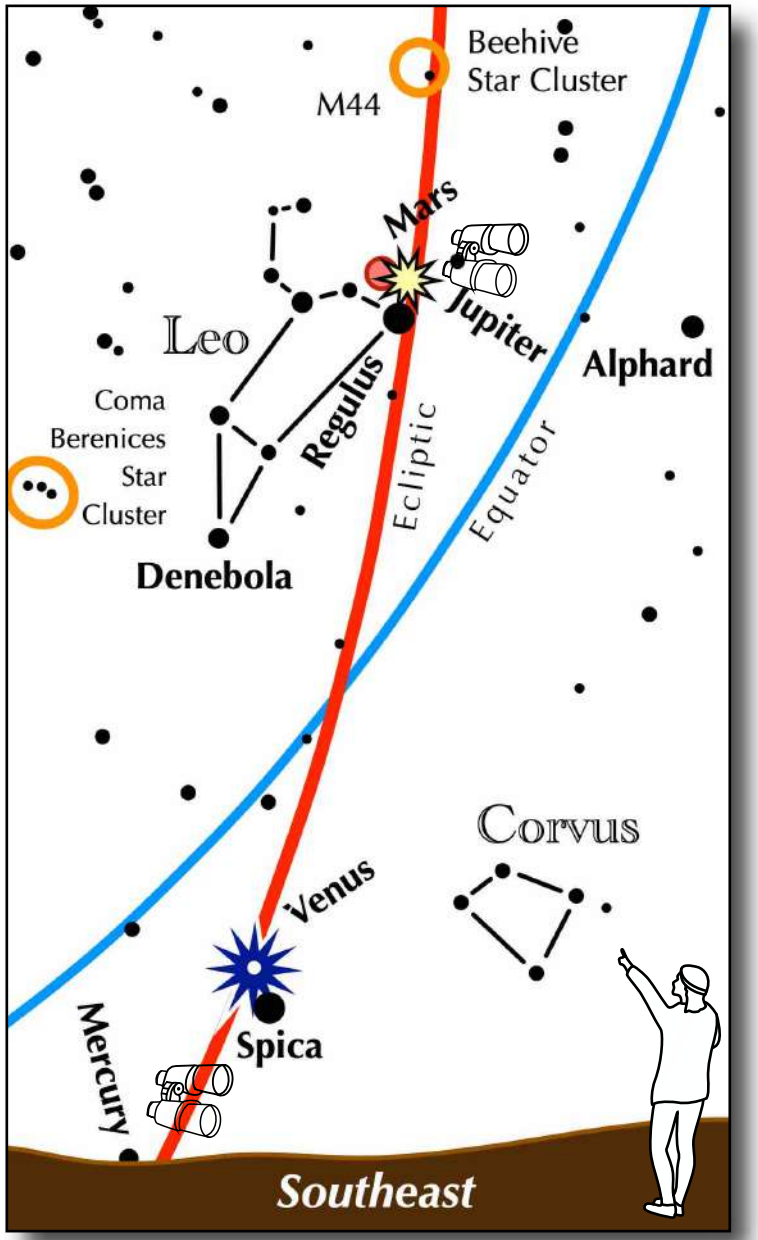
1. Face south. Almost overhead lies the "Great Square" with four stars about the same brightness as those of the Big Dipper. Extend a line southward following the Square's two westernmost stars. The line strikes Fomalhaut, the brightest star in the south. A line extending southward from the two easternmost stars, passes Deneb Kaitos, the second brighest star in the south.
2. Draw a line westward following the southern edge of the Square until it strikes Altair, part of the "Summer Triangle."
3. Locate Vega and Deneb, the other two stars of the Summer Triangle. Vega is its brightest member, while Deneb sits in the middle of the Milky Way.
4. Jump along the Milky Way from Deneb to Cepheus, which resembles the outline of a house. Continue jumping to the "W" of Cassiopeia, then to Perseus, and finally to Auriga with its bright star Capella.

### Binocular Highlights

**A and B:** Examine the stars of the Pleiades and Hyades, two naked eye star clusters. **C:** The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval. **D:** Sweep along the Milky Way from Altair, past Deneb, through Cepheus, Cassiopeia and Perseus, then to Auriga for many intriguing star clusters and nebulous areas. **E.** The Double Cluster.

**Astronomical League** *www.astroleague.org/outreach; duplication is allowed and encouraged for all free distribution.*

# In the early mornings around November 15-18, try this activity:



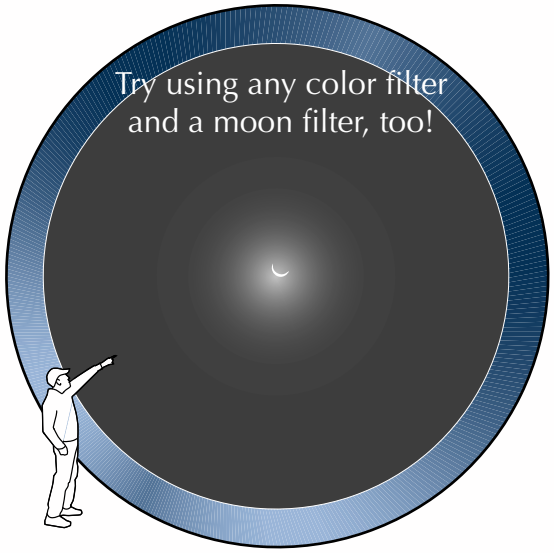

## Count the bright celestial wonders strung along the ecliptic

1. Red Mars meets bright Jupiter high in the southeast ninety minutes before sunrise. Grouped with them is the brightest star in Leo, Regulus.

2. Much nearer the southeastern horizon shines brilliant Venus sitting just above the bright star Spica.

3. 40 minutes before sunrise, little Mercury pops above the horizon, far below Venus. Binoculars help spot it in the bright twilight.

Grab a quick look at **Venus** through any telescope. Its beautiful, thin, and brilliant crescent awaits! As the mornings pass, the crescent grows smaller, but thicker.

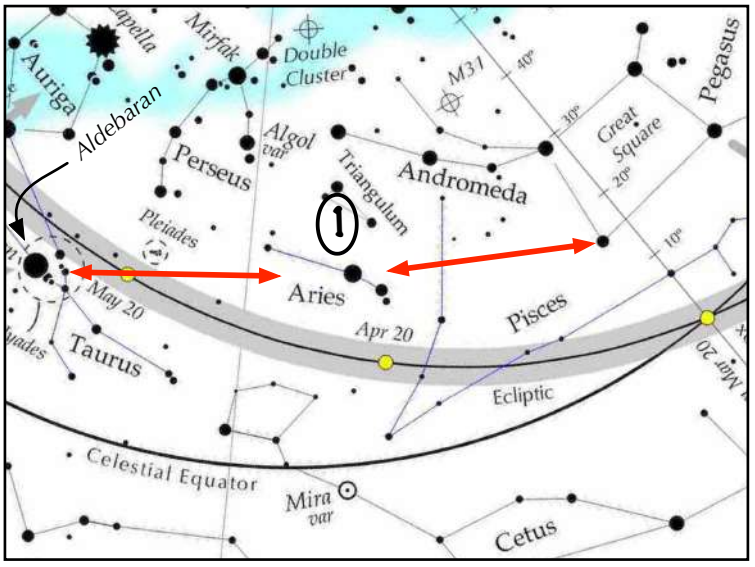


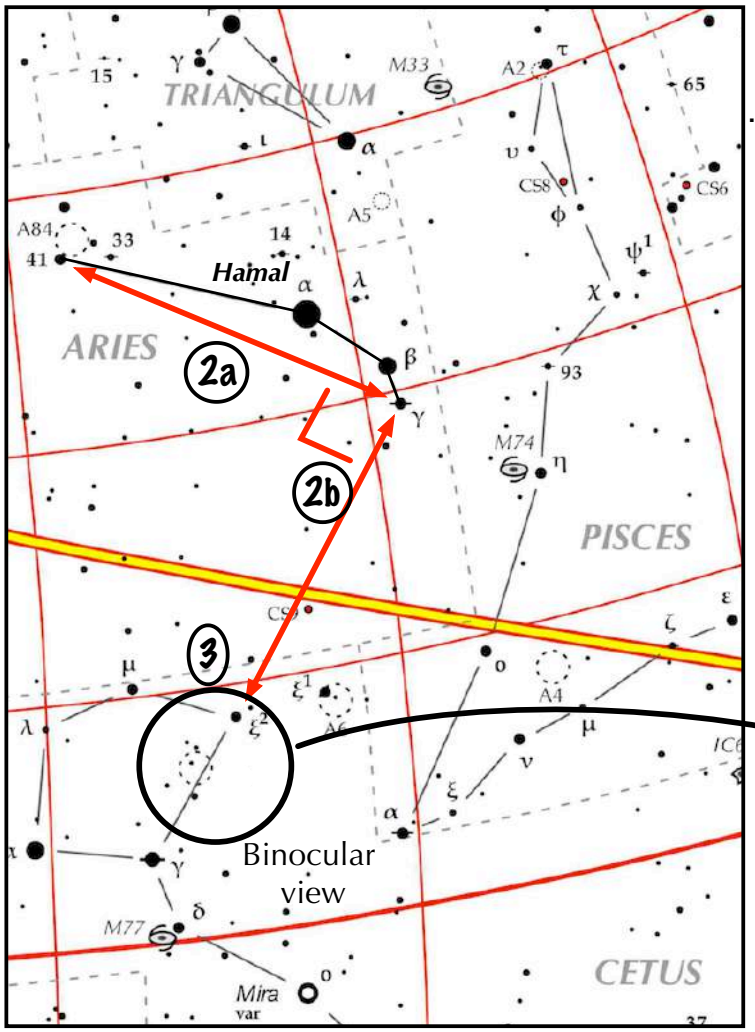

**View in the southeast**
**on November 15-18**
**90 minutes before sunrise**

**What a great way to start your day!**

# The Questionmark, an asterism for binoculars

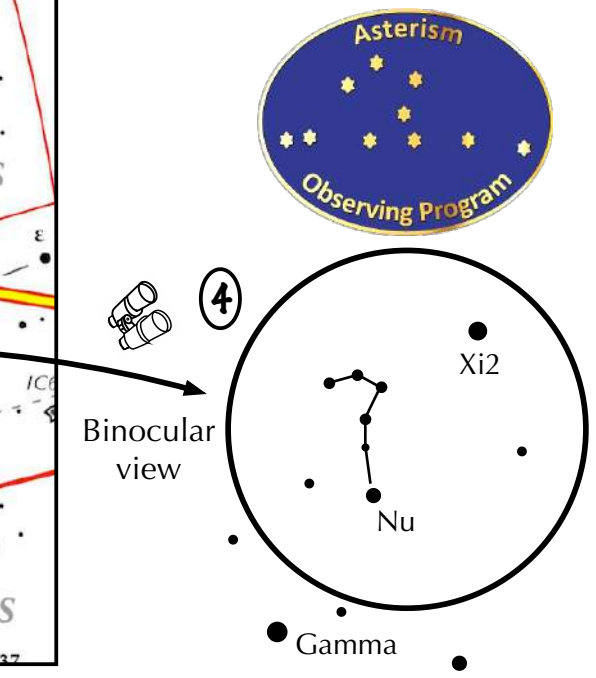
*On the Astronomical League's Asterism list*




## How to find ...

1. Find Aries, which sits mid way between the Great Square in Pegasus and bright star Aldebaran in Taurus. Moderately bright Hamal (Alpha Arietis) is easy to spot, lying near the midway point. Find the dimmer stars Gamma and 41 Arietis.
2. Draw a line from Gamma to 41 and make another line of similar length extending 90º to the south–southeast of Gamma.
3. That line ends near Xi2. It occupies the northwestern vertex of the pentagon of Cetus' head.
4. Place Xi2 near the northwestern edge of the binocular field. The stars of the Questionmark are near the center of the field. These stars are arranged by chance, they are nowhere near each other in three-dimensional space.




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