National Aeronautics and
Space Administration

PlanetQuest

THE SEARCH FOR ANOTHER EARTH

OBSERVING CARDS

There are many resources created for your visitors at your outreach events. However, these cards are created as a reference for *you*, the host.

Use them if you:

- are new to public outreach and aren't sure what to say
- are looking for a new way to explain some of the same objects you've been talking about for years.

Give your visitors a new perspective on the wonders of the sky.

Connect with the exciting science of *exoplanets*!

Cards included for: double stars, galaxies, globular clusters, moons, open clusters, planetary nebulae, planets, red stars, stars with planets, star nurseries, and supernova remnants.

TIPS FOR THE CARDS

Keep these with your telescope

The narratives give *you* - the sky guide - stories to inspire the public at the telescope and beyond. Share the pictures with visitors to illustrate points.

- **Prepare yourself: Think about what you might be observing tonight. Pick one of the anecdotes to try.**
- **Prepare your visitor: While the eyepiece is occupied, talk to the next person in line.**
- **Listen: Often people ask, "How big?" and "How far?" because they don't know what else to ask. By opening with a story, you encourage relevant questions. This also allows you to read your visitors' interests and knowledge levels.**
- **Give Context: Most people have no concept of the distance involved in a light-year or how long a billion years is. Stories engage visitors with a personal connection to the objects you're sharing. Distances are included here in light-years (ly), millions of light-years (Mly), astronomical units (AU), and Earth diameters (D_{Earth}).**

PQ This symbol directs you to stories that connect the night sky with the search for exoplanets. NASA's PlanetQuest aims to answer the big question: ***Are we alone?***
planetquest.jpl.nasa.gov

These cards complement the *Celestial Treasure Hunt* Handout.

Find versions of these cards for mobile devices, plus handouts, presentations, and more from the Night Sky Network nightsky.jpl.nasa.gov

PLANETQUEST
THE SEARCH FOR ANOTHER EARTH

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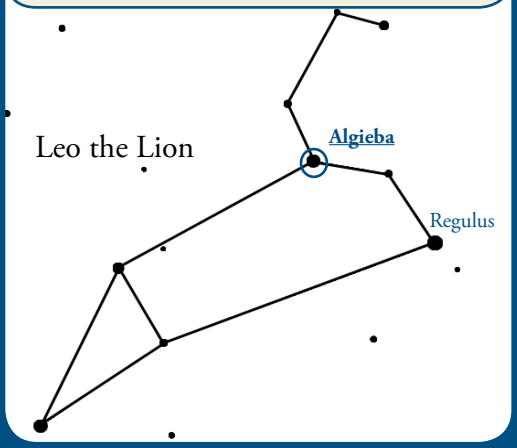
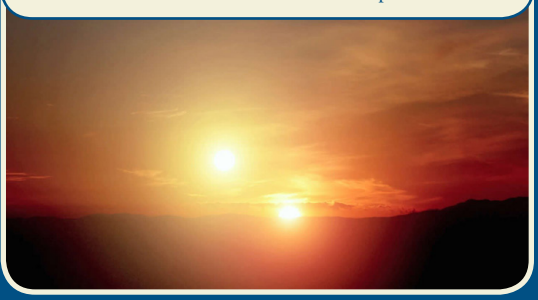
DOUBLE STARS

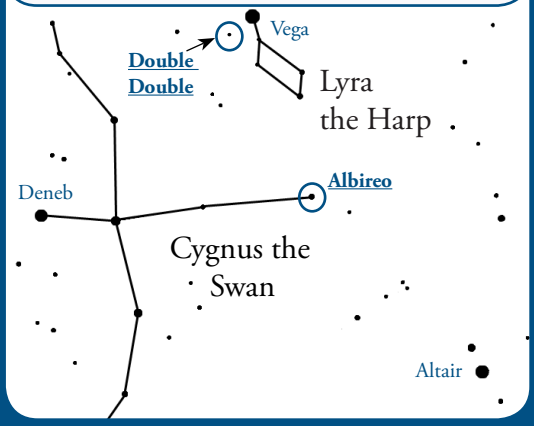
PQ Algieba in Leo's mane is a double-star system with a gas giant planet orbiting the larger star.



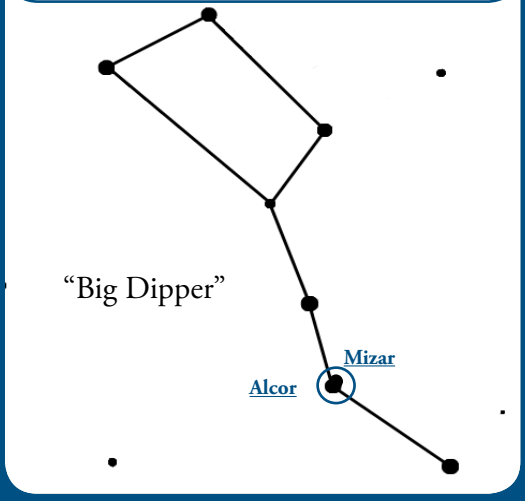
PQ Scientists have even found some planets that orbit both stars in a binary system. An artist imagines the sunset below. NASA/Ames Research Center/Kepler Mission



Cygnus' Albireo appears as a nicely contrasting blue and a yellow double star. The yellow star is another double, but requires a very powerful telescope to observe. The Double Double lies within a binocular view of bright Vega.



Mizar and Alcor, double stars in the Big Dipper, can be seen by those with keen eyesight. There is an Arabic saying, "He can see Alcor but not the full Moon." It's similar to the contemporary saying, "He can't see the forest for the trees."



DOUBLE STARS

EXAMPLES OF DOUBLE STARS

Mizar and Alcor in the Big Dipper, best in Spring and Summer: The ability to see both of these stars is almost identical to tests for 20/20 vision. *Dist: 82 ly*

Castor in Gemini, Winter: Both of the heads of the twins of Gemini are double stars. Each of Castor's component stars are doubles, too. *Dist: 50 ly*

The Summer Triangle hosts many doubles, including colorful **Albireo in Cygnus,** *Dist: 430 ly*, and ε Lyr, the **Double Double** in Lyra, *Dist: 160 ly*, where the brightest 2 stars appear in binoculars and larger telescopes resolve all 4 stars.

PQ **Algieba (*al-jee-bah*) in Leo, Spring:** Both of these large stars are nearing the end of their lives. It doesn't bode well for the planet orbiting the larger star. *Dist: 130 ly*

Twice the fun!

Some stars only appear to be doubles, but aren't "true binaries." They may be very far apart but lie on the same line of sight from our perspective.

It's common for stars to come in pairs but they're not often identical twins. Double stars of different sizes and colors beautifully illustrate the variety of our stellar neighbors.

Why limit it at two? Stars come in even larger configurations. Polaris, the North Star, is a 3-star system.

Imagine planets seeing double

PQ Planets have been found around double stars. Imagine living on a planet orbiting a double star. You could have 2 shadows! Would it ever get dark?

PQ A difference in color means a difference in temperature. Blue stars are hotter than our Sun, red stars cooler. Would a planet around a hot blue star need to orbit nearer or farther away than our orbit to stay warm but not hot?

PQ If Earth had formed around a cooler red star, our eyes may have developed differently because cool stars emit more infrared light than our Sun does. Maybe we could see infrared light instead of the colors of the rainbow.

PLANET QUEST
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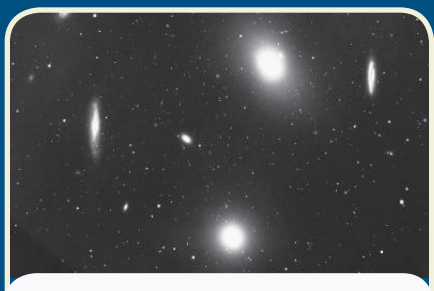
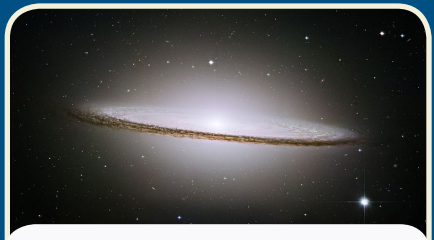
GALAXIES

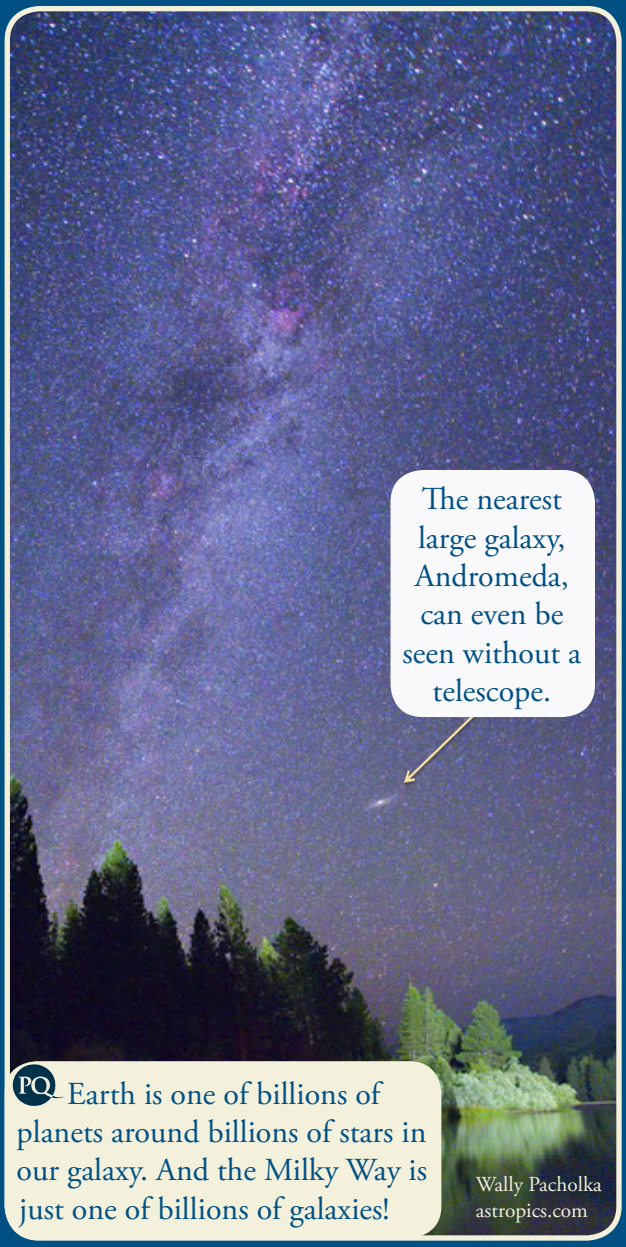


The Virgo Cluster contains thousands of galaxies, including egg-shaped galaxies like these. (M84 and M86). NOAO/AURA/NSF

Note the Whirpool Galaxy's spiral arms and companion. NASA/ESA



Seeing the Sombrero edge-on helps new observers better understand their view of our own Milky Way. NASA/STScI/AURA



PQ Earth is one of billions of planets around billions of stars in our galaxy. And the Milky Way is just one of billions of galaxies!

Wally Pacholka
astropics.com

GALAXIES

EXAMPLES OF GALAXIES

Andromeda (M31), Autumn: If the Milky Way were the size of a CD, Andromeda would be as big as a dinner plate. At that scale, they'd be about 8 feet apart. *Dist: 2.5 Mly, ~1 trillion stars*

Bode's Galaxy (M81), Spring/Summer: This is a great first star-hopping target to find in binoculars or a small telescope. See if newbies can also find the thin starburst galaxy nearby (M82). *Dist: 11.7 Mly*

Sombrero (M104), Spring: Seen edge-on, this spiral galaxy is on the edge of a galaxy cluster, though not part of it. The Virgo Cluster of galaxies is full of many types of galaxies, including ellipticals. *Dist: 29 Mly*

Whirlpool (M51), Winter/Spring: Is actually a pair of interacting galaxies! *Dist: 23 Mly*

Looking up, galaxies are the most distant objects we can see.

There are hundreds of billions of galaxies in the Universe. Each galaxy consists of millions to billions of stars. That means there are more stars in the Universe than all the grains of sand on every beach in the world!

If we want to get an idea of what our galaxy might look like from above, we can look at other galaxies. There are many types. We live in a spiral galaxy, but some galaxies look like eggs or spheres and some have irregular shapes.

Galaxies have planets aplenty!

PQ Most stars probably support planets. Beyond all the stars in our own galaxy, look at that galaxy full of stars! Imagine the alien possibilities with all those worlds.

PQ We can't see the whole Milky Way because we are in the middle of the disk - just like we can't see our whole town from our porch at night, just the lights nearest us. Do you think any of those nearest stars might include a planet orbiting it, with life on it, looking back at us?

PLANET QUEST
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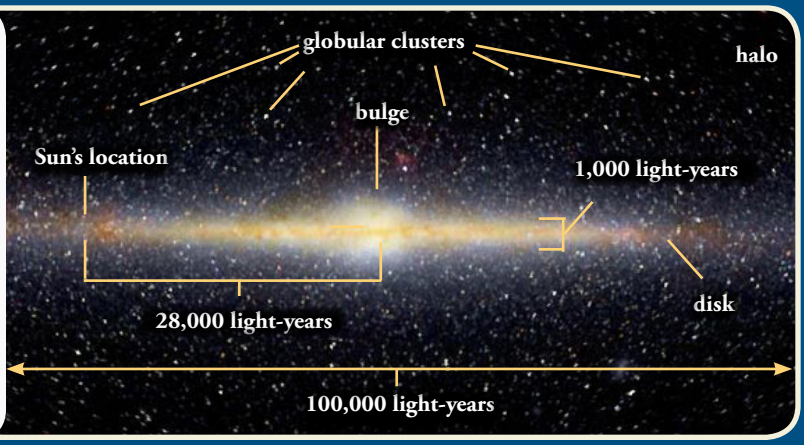
GLOBULAR CLUSTERS

PQ M13, the Great Hercules Globular, is one of the finest you'll observe. In 1974 the first radio message about Earth was sent into outer space from the Arecibo Observatory. It was pointed in the direction of this globular cluster. Its journey will take more than 25,000 years. Our aim was a bit off; by the time the message arrives, the cluster will have moved! Anyway, we have found very few planets in globular clusters. Can you think of closer places to send an alien message? *ESA/Hubble and NASA*

Globular clusters orbit our galaxy (illustration of a side view here) like tight swarms of bees. They are not typically in the disk of the galaxy, unlike most Milky Way objects that we observe.



GLOBULAR CLUSTERS

EXAMPLES OF GLOBULAR CLUSTERS

Scorpius Cluster (M4), Summer: Relatively small, it only has about 10 thousand stars. It is a very easy cluster for new star hoppers to find because it is close to the bright star Antares. *Dist: 7,000 ly*

Hercules Cluster (M13), Spring: Has about 300,000 stars, as many stars as all the hairs on 3 people's heads! *Dist: 25,000 ly*

M5 in Serpens, Summer: This is one of the finest globular clusters in small telescopes. *Dist: 25,000 ly*

M22 in Sagittarius, Summer: Just above the tip of the "Teapot," this is an easy find. *Dist: 10,000 ly*

M79 in Lepus, Winter: This is one of few globular clusters seen in winter, when we face away from the galactic center. *Dist: 41,000 ly*

Small, old, and far away, so what?

Stars in globular clusters are some of the first stars to have formed in the Milky Way. Some clusters even formed in different galaxies and were stolen during past interactions.

Globular clusters aren't actually small, they are just much farther away than anything else we observe, except other galaxies.

In a globular cluster, many stars are packed into a small space. *Imagine* the view from inside a globular cluster.

PQ If you were on the edge of the cluster closest to Earth, all of the cluster's stars would be in one half of the sky and the other half would be lit up with the hazy Milky Way.

PQ In the center, it would never get dark. There are so many stars that even at night it would never get dark. Imagine dozens of brilliant stars for every star you see tonight!

PQ Could we look back at the Milky Way and see our Sun? No, it would be like trying to pick out your porch light on a map of the US at night!

PQ Hailed as one of the best science fiction stories of all time, Isaac Asimov's "Nightfall" tells of a society living on a planet in a globular cluster.

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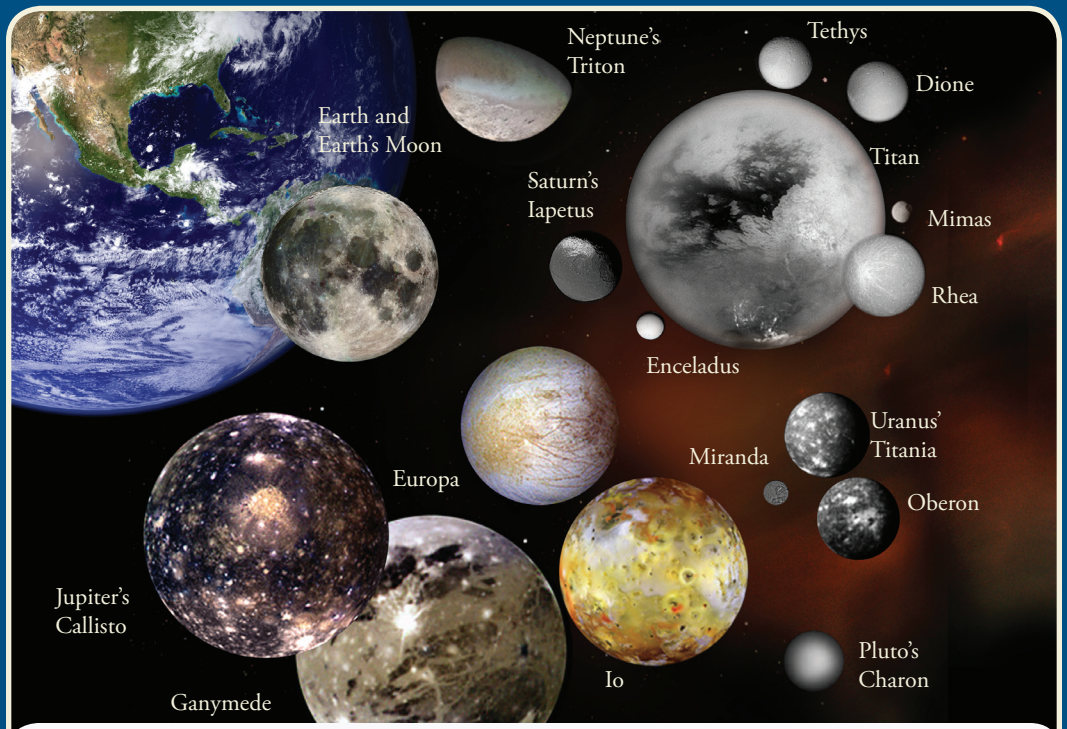
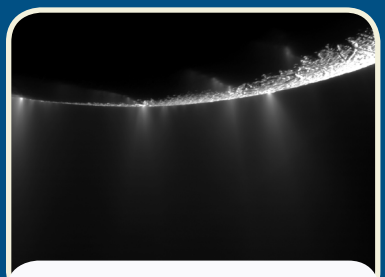
MOONS

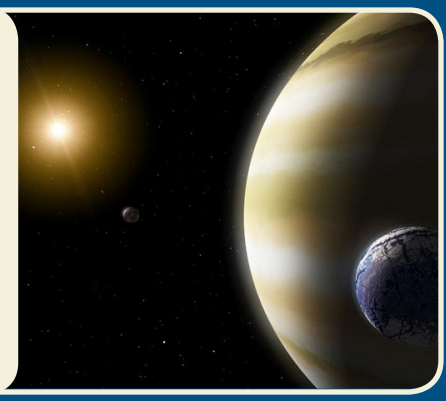


Pictured to scale are photographs of Earth and its Moon, Jupiter's four largest moons, seven of Saturn's moons, Neptune's largest moon (Triton), three of Uranus' moons, and Pluto's largest moon (Charon). *NASA*



Saturn's Enceladus sprays jets of water from its south pole. *Credit: NASA/JPL*

PQ Exoplanets in habitable zones of their parent stars could have rocky moons. An artist imagines habitable exomoons. *Credit: NASA/JPL-Caltech*



MOONS

EXAMPLES OF OUR SOLAR SYSTEM'S MOONS

Earth's Moon is covered with craters, easily visible through binoculars. Earth was hit by even more asteroids and comets than the Moon, but we have an atmosphere and active crust that erased most past impacts. *Distance: 238,900 miles (384,400 km) or 1.4 light-sec.*

PQ **Jupiter's Moons:** Galileo discovered Jupiter's four large moons. We now know these moons are much more active than Earth's Moon, hosting volcanoes (Io), ice-covered oceans (Europa), and a magnetic field (Ganymede, largest moon in the Solar System). *Dist: ave. 500 million miles (800 Mkm), or 30 light-min. (4.2 - 6.2 AU)*

Earth's Moon - our most distant human exploration

Earth's Moon is the farthest that humans have voyaged. Neil Armstrong's footprints are still there and will remain there for millions of years. There's no wind on the Moon to blow it away.

Can we see the flag on the Moon through our telescope? No, the smallest feature we can see through most telescopes is about a mile (or 2km) across.

Our Moon was once much closer to Earth. It is moving away from us at about the same rate as our fingernails grow - about an inch and a half (3.8 cm) a year.

Exoplanet moons expand the possibilities

PQ All life on Earth requires water to survive, so scientists look for watery worlds when searching for possible life beyond Earth. Saturn's moon Enceladus has jets of water, evidence of an ocean beneath its icy surface. See image.

PQ Saturn's moon Titan has a thick atmosphere and lakes of methane. With worlds like Saturn's moons nearby, imagine what we might someday find on exoplanet moons.

PQ While moons around exoplanets are still very hard to detect, imagine the possibilities if gas giant planets could host habitable moons. See an artist's idea of a world like this on the other side.

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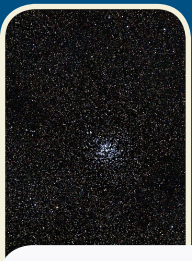
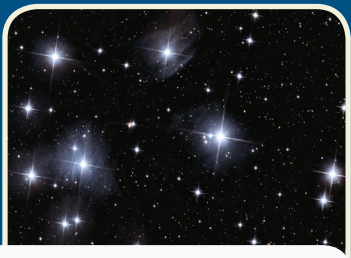
OPEN CLUSTERS

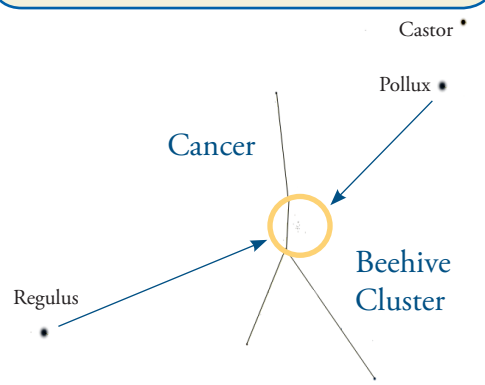
PQ A large amount of warm dust found orbiting the star HD 23514 in the Pleiades star cluster suggests a collision of two Earth-sized bodies. *Credit: Gemini Observatory/Lynette Cook*



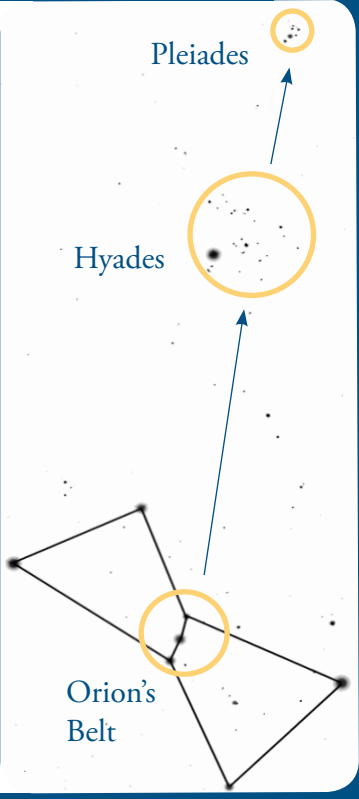


Open clusters vary in appearance, as seen in the contrast above between the Wild Duck Cluster (left) and the Pleiades (right). *Credit: Rawastrodata*

PQ Scientists are finding planets around Sun-like stars in open clusters like the Beehive. We can find the Beehive Cluster between the two bright stars, Regulus and Pollux.



Two clusters that are easy to spot in dark skies are the Hyades, or head of Taurus the Bull, and the nearby Pleiades, also known as the Seven Sisters. Just follow the line of Orion's Belt as seen on the right.



OPEN CLUSTERS

EXAMPLES OF OPEN CLUSTERS

Pleiades (M45), Winter: The Pleiades stars were born while the dinosaurs were roaming the Earth – about 100 million years ago. This cluster happens to be drifting through a cloud of gas - not the one from which it was born. *Dist: 424 ly*

Hyades, Winter: The closest open cluster makes a large V shape (Aldeberan is not part of the cluster). *Dist: 151 ly*

Wild Duck (M11) in Scutum, Summer/Autumn: One of the richest clusters. Does it look like a flock of ducks in flight to you? *Dist: 6,200 ly*

Beehive (M44), Spring: This is an easy first star-hopping target with binoculars. Find it between Pollux and Regulus. *Dist: 570 ly*

Meet some of our newest neighbors, stars in open clusters.

Stars in open clusters are bright, young, and often blue - the teenage sisters of stars. They've blown off the rest of their parental gas and dust and hang together. Eventually the stars drift apart, but for now, they travel in a pack through their neighborhood (spiral arm).

The newly-formed stars in an open cluster were born from the same cloud of gas and dust. The haze that surrounded them at birth has blown away and you can see the individual stars.

Planets forming around new stars

PQ Planets orbiting new stars within open clusters likely live very chaotic lives. They have not yet formed stable orbits so collisions occur often. While our Sun was still in an open cluster, a Mars-sized planet probably slammed into Earth, eventually creating our Moon.

While globular clusters and open clusters sound similar, they are very different in number and age. Globular clusters can include hundreds of thousands of very old stars bound in a tight swarm. In roughly the same amount of space, an open cluster may have just 100 or so young stars.

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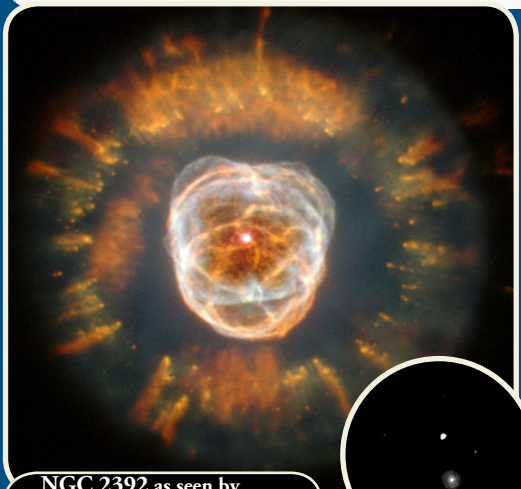
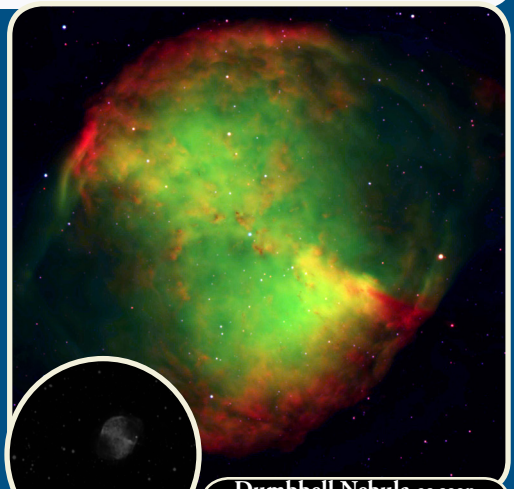
PLANETARY NEBULAE

Large images below are taken with professional telescopes, often from space and using special filters. The smaller images give a better idea of what you can expect to see through a telescope. Filters on small telescopes can also bring out features, as seen here in the center images by Ole Nielsen.

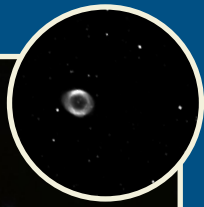


NGC 2392 as seen by Hubble - NASA/Andrew Fruchter (STScI)

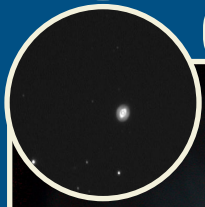


Dumbbell Nebula as seen by the Very Large Telescope (ESO)

Ring Nebula as seen by Hubble - NASA, ESA, and C. Robert O'Dell (Vanderbilt University)



Ghost of Jupiter as seen by Hubble - HST/NASA/ESA



PLANETARY NEBULAE

EXAMPLES OF PLANETARY NEBULAE

Dumbbell Nebula (M27), Summer: Some observers think it looks like an apple core. This large nebula spreads out over more than 4 light-years. *Dist: 1,300 ly*

Ring Nebula (M57), Summer/Autumn: We see this nebula from the top of its cylindrical shape. If we could see it from the side, it would look like a rectangle. From an angle, it would likely look more like the Dumbbell. *Dist: 2,300 ly*

Eskimo Nebula, best viewed in Winter/Spring: Notice the bright central star puffing off its outer layers. Does the outer shell look like a parka to you? *Dist: 3,000 ly*

Ghost of Jupiter Nebula, Spring: Like many planetary nebulae, this one appears greenish and not quite round. Green is the color humans see best, which is lucky because it is faint. *Dist: 1,400 ly*

From red giant to white dwarf in a few puffs

The name "planetary nebula" is a misnomer. It was given to this class of object because they appear small & round and possibly planet-like through primitive telescopes. It was very quickly recognized that these were not planets, but the name stuck.

Planetary nebulae are the swan songs of stars like our Sun after the red giant stage. They puff off their outer layers, collapse, and slowly cool off as a white dwarf.

The planetary nebula phase of a star's life represents a short but important time in the life of stars up to 8 times the mass of our Sun. If we compared that period in a Sun-like star's life to a human lifetime, it would correspond to about the last hour of our life. The whole display fades into the galaxy in about 10,000 years.

What *does* a planetary nebula have to do with planets?

PQ_ Planetary nebulae help enrich the galaxy with elements like carbon and nitrogen. These elements may eventually be incorporated in the seeds of new planets in the next cycle of star birth. Some of Earth's carbon and nitrogen may have come from a planetary nebula.

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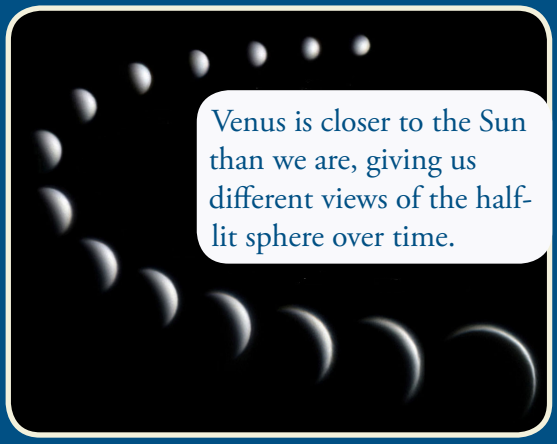
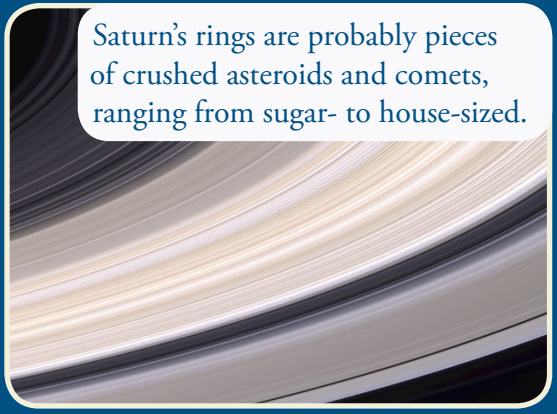
PLANETS



Venus is closer to the Sun than we are, giving us different views of the half-lit sphere over time.

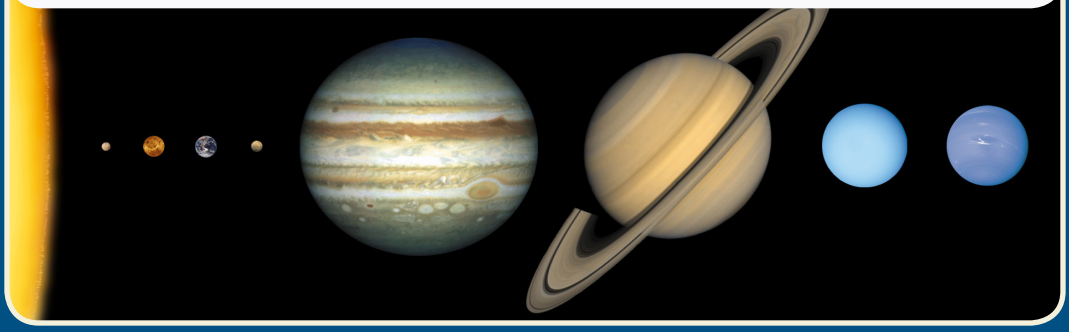
The visible features on Jupiter are mostly ammonia clouds.



Saturn's rings are probably pieces of crushed asteroids and comets, ranging from sugar- to house-sized.

Rovers on Mars give great views, but only see a small portion of the planet. Imagine trying to learn all about Earth from a golf cart.

Compare sizes (not distances) of the Sun and planets in our Solar System.



PLANETS

EXAMPLES OF PLANETS

Venus: Named for the Roman goddess of love and beauty, Venus would not be a good choice for a romantic get away. Its surface is hot enough to melt lead and it has a crushing atmosphere of carbon dioxide with clouds of sulfuric acid.
Dist. from Sun: 0.7 AU, Diameter: 0.95 D_{Earth}

Mars: The planet's reddish hue is caused by rust on the surface and dust in the atmosphere. Missions to Mars reveal great channels and flood plains, likely carved by ancient water. *Dist. from Sun: 1.5 AU, Dia: 0.53* D_{Earth}

Jupiter: This gas giant forms a sort of miniature solar system, including many moons and a magnetic field, but the planet did not grow big enough to become a star. It would have needed about 80 times more mass for this.
Dist. from Sun: 5.2 AU, Diameter: 11 D_{Earth}

Saturn: Saturn's days are only about 10 hours long. This rapid spinning causes the planet to bulge around the equator. *Dist. from Sun: 9.6 AU, Diameter: 9.1* D_{Earth}

The ancients' "wandering stars" are today's laboratories

PQ The planets, Sun, and Moon all pass in front of the stars of the zodiac. That's why these constellations were important to ancient cultures. While we have known about the dance of Sun's planets for millennia, finding exoplanets around other stars has recently expanded humanity's view of our place in the universe.

PQ Our Solar System divides nicely into four regions: the inner rocky planets, the Asteroid Belt, the gas giant planets, and finally the small icy bodies beyond. Until we began discovering planets around other stars, we thought all planetary systems might look something like this. We were wrong. See *Stars With Planets* card.

PQ Astronomers are searching for rocky exoplanets orbiting within the habitable zones of other stars. In the Solar System only Earth has liquid water in the Sun's habitable zone, but changes in the atmospheres of Venus and Mars could make them habitable as well.

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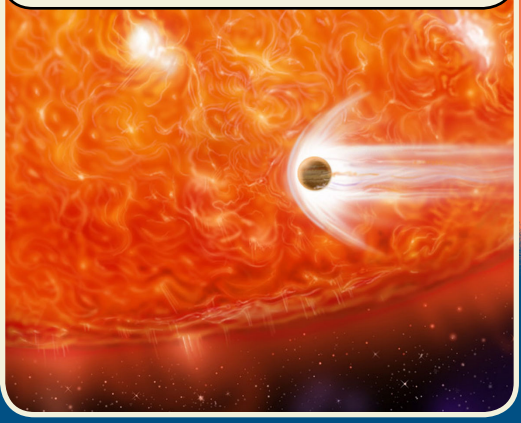
RED STARS

If we shrink the Sun to the size of a tiny pebble... a red giant would be about as big as this card.

Think of how big and important our Sun is to us. Now compare the Sun to a red giant (right). Even more astounding is the size of the red *super*giants. On the scale shown on the right, stars like Betelgeuse would be as tall and wide as an adult standing with arms outstretched.

The Sun will eventually become a red giant, expanding and likely engulfing the inner rocky planets.

PQ When stars expand, they may consume the planets orbiting them.
Artist's impression by James Gitlin/STScI



PQ However, there is evidence of planets surviving the giant stage. Here, an artist imagines a planet orbiting dangerously close to a red giant star.
Credit: NASA

RED STARS

RED GIANTS

Aldebaran, Spring: It appears to be part of the V-shaped Hyades cluster but in fact is much closer to us than those stars. *Dist: 65 ly*

Arcturus, Summer: This bright star was called the "star of joy" by ancient Polynesian sailors. It helped them navigate the long distance to Hawaii. *Dist: 37 ly*

RED SUPERGIANTS

Betelgeuse, Winter: This bright star formed millions of years ago in Orion's Belt. Centuries ago, Chinese astronomers recorded that this star was yellow, before it cooled to its present red color. *Dist: 650 ly.*

Herschel's Garnet Star (Mu Cephi), Autumn: This star is so large that if it replaced our Sun, it would extend all the way past Jupiter. *Dist: 6,000 ly*

Red giants are dying stars, cooling down and puffing up

As stars use up all of their available fuel, they become cooler and expand, entering the giant phase. For a star like our Sun, this phase can last about 10% of its lifetime, or a billion years.

Red ***super***giants are larger by far than the red giant (see comparison, reverse). These dying stars are so large that they will end their lives in a massive supernova explosion. When that happens, it will be so bright, we'll be able to see them during the day! But don't worry, they pose no danger to us.

Exoplanet eaters and dwarfs

PQ Our Sun will become a red giant in about 5 billion years. Mark your calendars! When that happens, it will get so big it could engulf Mercury, Venus, Earth, and maybe even Mars. In 2012, astronomers detected a rocky exoplanet being devoured by its star.

PQ Not all red stars are giants. In fact, most of the stars in our galaxy are red and *small*. These red dwarfs are all around us, making up about 3/4 of the stars in our galaxy. However, they are so dim that none are visible with the unaided eye. These stars are stable for much longer than Sun-like stars. They also host planets, so they may be good places to look for advanced lifeforms.

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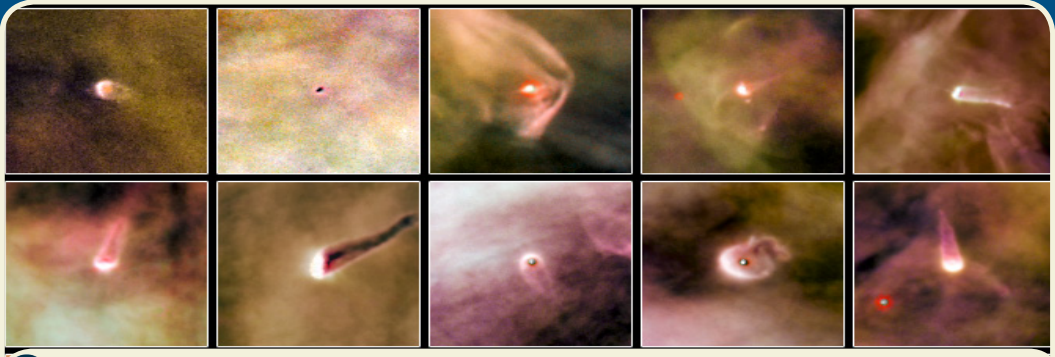
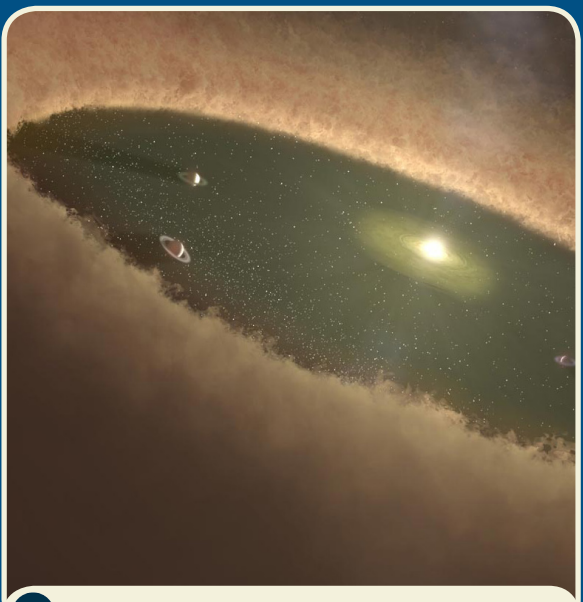
STAR NURSERIES

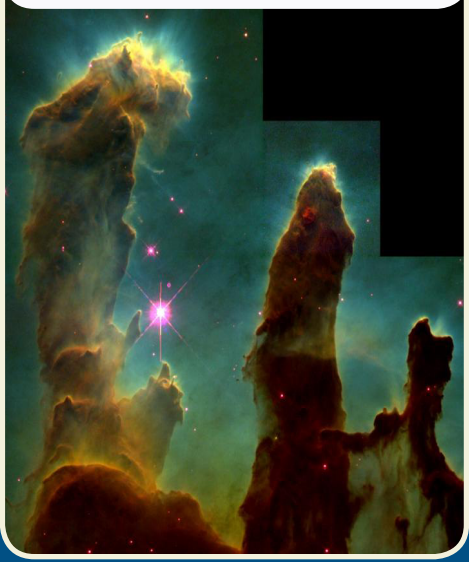


PQ Hubble spotted these new stars in the Orion Nebula. They are surrounded by gas and dust in the process of becoming planets, called "protoplanetary discs."
Credit: NASA, ESA and L. Ricci (ESO)



PQ An artist imagines a star with planets forming in the depths of a star nursery.
Credit: NASA/JPL-Caltech

The iconic Pillars of Creation image of a star-forming region in the Eagle Nebula. *Credit: NASA, ESA, STScI, J. Hester and P. Scowen (ASU)*



STAR NURSERIES

EXAMPLES OF STAR NURSERIES

Orion Nebula, Winter/Spring: You can cover the star-forming region with your thumb at arm's length. There are hundreds of stars being born here. *Dist. 1,300 ly*

Eagle Nebula, Summer: The new stars seen emerging from this nursery are only about 5 million years old. They formed as human ancestors were diverging from the apes. This star nursery includes the famous "Pillars of Creation" picture by the Hubble Space Telescope. *Dist. 7,000 ly*

Lagoon Nebula (M8), Summer/Autumn: This nebula is very young and has probably created fewer than 100 stars so far. But it is active and creating more all the time. *Dist. 4,100 ly*

Trifid Nebula, Summer/ Autumn:: The name of this nebula refers to the dark gas lanes that seem to separate the bright areas into 3 sections. *Dist. 5,000 ly*

Do you know where stars are born? In a star nursery!

Have you ever looked through the window of a hospital nursery full of newborn babies? They're often bundled in warm fleecy blankets. A star nursery is similar. Warm blankets of gas and dust surround these newborn stars.

How long does it take for stars to form? A star like our Sun takes about 10 million years to form. If we compare the life of a star to the life of a human, this stage would correspond roughly to the time we spend developing in our mom's bellies before birth.

Worlds in the womb

PQ Where did this gas and dust come from? Dying stars exploded and flung their remains into the galaxy, recycling the material to make new stars and planets.

PQ This huge cloud of gas and dust is collapsing on itself to create new stars. Many of these new stars will have planets around them. Our Sun and all of the planets in the Solar System also formed from a dense cloud of gas and dust, like this stellar nursery.

PLANET QUEST
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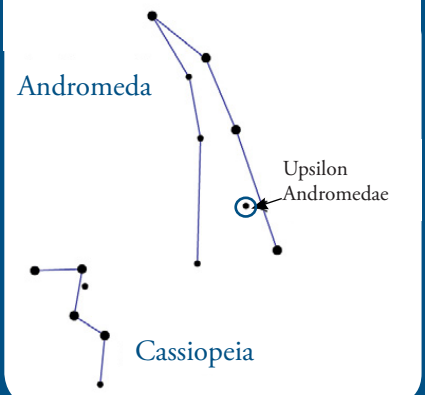
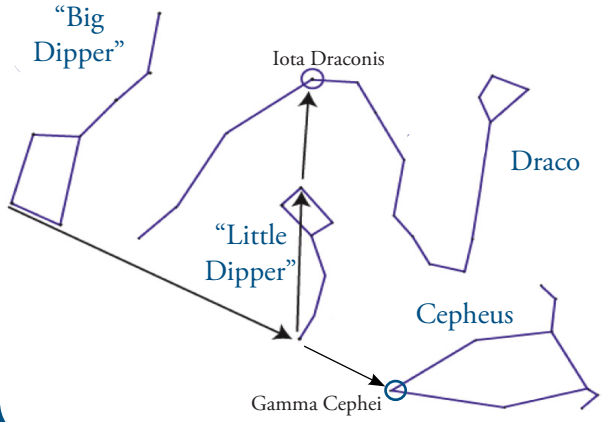
STARS WITH PLANETS

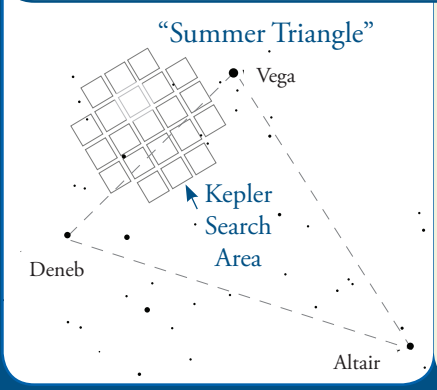
PQ Upsilon Andromedae system is two stars and at least four large planets. They are not all in the same plane like our Solar System but orbit at various angles.

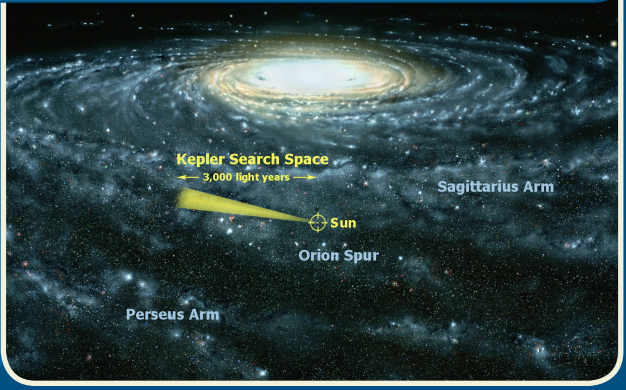


PQ Find Gamma Cephei by following a line from the Big Dipper's pointer stars, through Polaris, and onto the next bright star. Iota Draconis is on the other side of the Little Dipper in Draco the Dragon.



PQ The space-based Kepler telescope continuously monitored over 150,000 stars in the Summer Triangle, searching for exoplanets in the habitable zones of stars. While exoplanets are very distant compared to planets in our Solar System, we have yet to explore most of our galaxy. *Milky Way portrait by John Lomberg www.johnlomberg.com*





STARS WITH PLANETS

EXAMPLES OF VISIBLE STARS WITH PLANETS

While stars with exoplanets may not be regular observing targets, they inspire wonder and provide easy conversation starters for those new to astronomy.

Find the latest number of confirmed exoplanets here: planetquest.jpl.nasa.gov

Gamma Cephei, all year (N. Hemisphere): This double-star system will become the new "North Star" in about 1,000 years. The brighter star is orbited by a gas giant planet (every 2.5 years) and a second small red dwarf star (every 60 years). *Dist: 46 ly*

Iota Draconis, all year (N.H.): This star's huge planet was the first planet discovered orbiting a giant star. *Dist: 101 ly*

Pollux in Gemini, Winter: Pollux's huge planet causes the star to wobble back and forth every year and a half. Detecting that wobble is how scientists found the planet. In the same way, other stars in Gemini have also been discovered to have planets, but those stars are too dim to see with just our eyes. *Dist: 34 ly*

Upsilon Andromedae, Autumn: This was the first double-star system discovered to have multiple planets. The primary star of this system is similar to our Sun. But instead of 8 planets orbiting, it has another star and at least 4 gas giant planets, like Jupiter, in orbit around it! There may be even more we haven't detected yet. *Dist: 44 ly*

Visions of other worlds inspire wonder: *Are we alone?*

The planetary systems we are finding are much different than our Solar System. There are hot gas giant planets that orbit their stars in hours, planets around cool red stars, and even rogue planets with no stars at all.

We're also finding rocky planets that might be the right temperature for liquid water. We don't know if there's life on any other planets, but it's fun to speculate.

As technology improves, more exoplanets are found. Current data suggests that most stars in our galaxy have planets orbiting them. Imagine the possibilities with so many worlds!

PLANET QUEST
THE SEARCH FOR ANOTHER EARTH

National Aeronautics and
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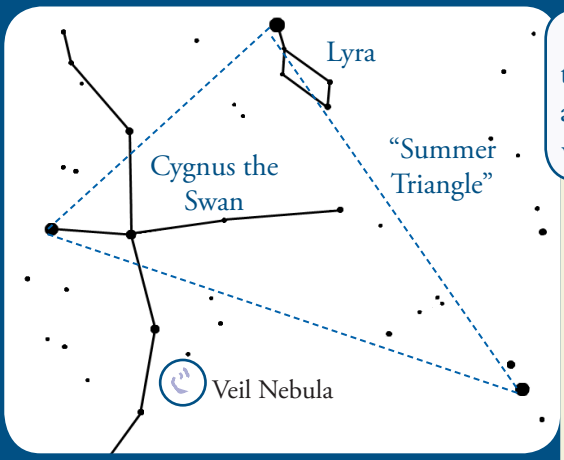
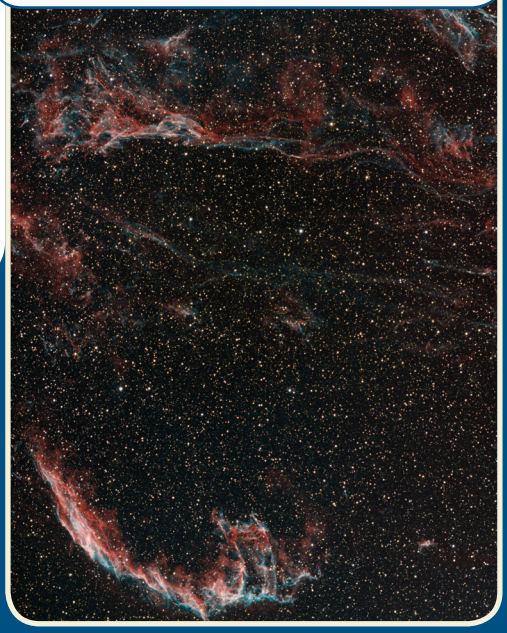
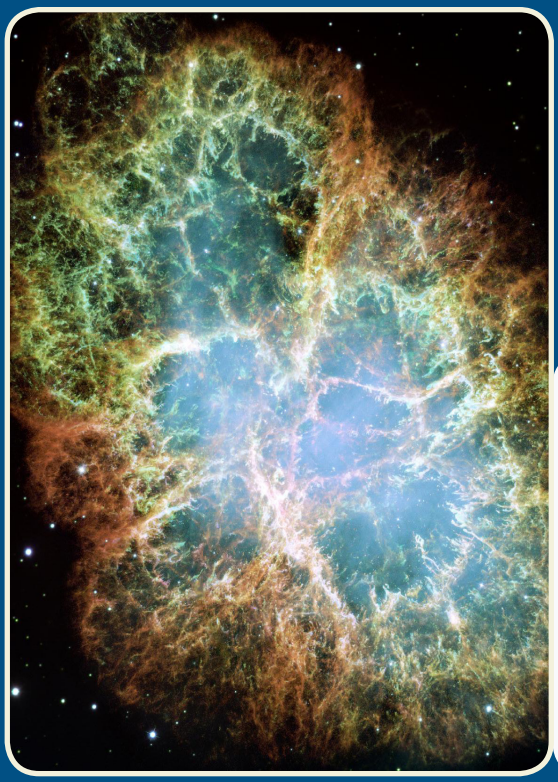
SUPERNOVA REMNANTS



If you make a circle with your thumb and index finger and hold it at arm's length, the Veil Nebula (below) would fit inside. *Credit: Eric Africa*





While looking for Halley's Comet in 1758, Charles Messier saw the Crab Nebula and thought it might be a comet. After noting that it did not move for many days, he was inspired to create a list of faint fuzzy objects that could be mistaken for comets. Ultimately, he listed 110 objects and the Crab Nebula became Messier 1, or M1. *Credit: NASA, ESA, J. Hester, A. Loll (ASU)*

SUPERNOVA REMNANTS

EXAMPLES OF SUPERNOVA REMNANTS

Crab Nebula (M1), Autumn:
We see the remains of a massive star that ended its life in a huge explosion almost 1,000 years ago. Chinese astronomers observed this supernova as it became visible in the year 1054. It was called a "guest star" because it appeared suddenly as a bright dot in the sky, visible even in the daytime. It remained visible at night for about two years.
Dist: 6,500 ly

Veil Nebula, Summer:
This supernova remnant began with a giant stellar explosion around 5,000-10,000 years ago. Perhaps some of the first humans sowing crops saw a daytime star as they were planting. The moment is lost to history as it occurred before there were written records.
Dist: 1,470 ly

We mostly see the brightest stars

Only the very largest stars will end their lives in a supernova. Since we only see the brightest stars from most locations, many of the most common stars we see will someday go supernova.

The last supernova observed in our galaxy was in 1604, but it's estimated that an average of 3 go off in our galaxy every year. Betelgeuse could go anytime - tonight or a million years from now. It will probably be visible during the day as a bright star for a few months and eventually fade to a remnant like these.

One type of supernova always emits a standard amount of light, so we can determine the distance of the explosion, helping us answer a very important question in astronomy - how far?

Exoplanet eulogy?

PQ Such a violent event seems likely to destroy any exoplanets that were orbiting the massive star. Yet, the first discoveries of exoplanets were made for planet-size bodies orbiting pulsars, the neutron star remnants of an exploded supernova.

PQ Supernovae are the reason rocky planets like Earth exist at all. These huge explosions create the heavier elements like iron and calcium. Without these elements, trees, rocks, and people could not exist.

PLANET QUEST
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