Observations

A Monthly Publication Of The
CHESTER COUNTY ASTRONOMICAL SOCIETY

Vol. 29, No. 6 ***Three-Time*** *Winner of the Astronomical League's Mabel Sterns Award ☼ 2006, 2009 & 2016* *June 2021*

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NGC 2261 Hubble's Variable Nebula

Original astrophotography by Dave Hockenberry, CCAS President. For more information about the image and the nebula itself, see pg.2.

June 2021 Dates

2nd • Last Quarter Moon, 3:24 a.m. EDT

10th • New Moon, 6:52 a.m. EDT

13th • The Moon is near Mars, Venus, the Beehive Cluster and "the twins" Castor and Pollux

17th • The First Quarter, 11:54 p.m. EDT

20th • Mars is directly in front of The Beehive Cluster just after sunset

24th • Full Moon, the Full Strawberry Moon or the Full Sockeye Moon, 2:39 p.m. EDT

Membership Dues Increase

CCAS membership dues increased in March 2021. They hadn't changed in 18 years, so it was time to increase the dues to cover increases in the Society's operating costs. All membership types went up $5 except for the Student membership, which remained unchanged.

Here are the old and new rates:

Type	Old Rate	New Rate
Regular	$25	$30
Senior	$10	$15
Student	$5	$5
Family	$35	$40

Spring / Summer Society Events

June 2021

17th • The von Kármán Lecture Series: Oh, Jupiter! We Thought We Knew You, 10:00 pm EDT. Jet Propulsion Laboratory, Pasadena, California. Live stream of free lecture presented by NASA & Caltech.

20th • Summer Solstice is at 11:32 pm in West Chester, PA. In terms of daylight, this day is 5 hours, 41 minutes longer than on Winter Solstice in December.

20th • Open call for articles and photographs for the July 2021 edition of Observations.

26th • Deadline for newsletter submissions for the July 2021 edition of Observations.

July 2021

22nd • The von Kármán Lecture Series: Science + Art: Picturing Discovery, 10:00 pm EDT. Jet Propulsion Laboratory, Pasadena, California. Live stream of free lecture presented by NASA & Caltech.

20th • Open call for articles and photographs for the August 2021 edition of Observations.

26th • Deadline for newsletter submissions for the August 2021 edition of Observations.

August 2021

20th • Open call for articles and photographs for the September 2021 edition of Observations.

26th • Deadline for newsletter submissions for the September 2021 edition of Observations.

Minutes from the May 11, 2021, CCAS Monthly Meeting

by Bea Mazziotta, CCAS Secretary

- Dave Hockenberry welcomed members and guests to the May 2021 CCAS meeting. Zoom and YouTube were the platforms. Attendance topped out at 44.
- John Conrad, our NASA Solar System Ambassador gave an update on the James Webb telescope. The current planned launch date is October 31, 2021. JWST will launch on an Ariane rocket from the European spaceport in French Guiana. The telescope will detect light from the first generation of stars and galaxies that formed in the early universe, will study the atmosphere of habitable planets, and try to provide more information on the universe's rate of expansion, supermassive black holes and the formation of elements via neutron star collisions.
- Don Knabb led a night sky tour with a focus on our moon. He noted that on 5/12 the moon would show as a very slim crescent with Venus visible right next to it, while on 5/13 Mercury would be visible next to it. On the 17th the moon would be positioned above the Beehive Cluster of stars, on the 18th the lunar X and V would be visible and on 5/26 a total lunar eclipse would occur just before dawn.
- Bruce Ruggeri, CCAS Program Chair, introduced the evening's speaker Dr. Laura Kerber. She holds masters degrees in Geology and Fluid Mechanics (Engineering) and a PhD in geology. Dr. Kerber is a research scientist at JPL. Included in her areas of research are vulcanology and extraterrestrial cave environments.
- She is Principal Investigator of a Discovery mission concept called Moon Diver, which was the topic of her presentation. The Moon Diver Mission seeks to send the JPL developed extreme terrain rover Axel to explore a deep volcanic collapse pit on our Moon. Axel is designed to rappel down the steep vertical cave walls and study how they were formed. This mission is still in the proposal phase and, if given the go ahead, will be the first mission to venture below the surface of another world, the first to utilize extreme terrain technology and will provide an advance scout for potential human cave bases.

CCAS Original Astrophotography

by Dave Hockenberry, CCAS President

On the cover: NGC 2261 Hubble's Variable Nebula. Imaged March 2021 with Hyperion 12.5" astrograph telescope, QSI 583wsg camera, QSI Active Optics and Lodestar X2 guiding camera. Astrodon Gen 2 LRGB filters for broadband color images. Image capture and observatory control with MaxIm DL Pro. Image processing with CCDStack and Photoshop CC. Luminance 300 seconds X 14 subs, Red 300 sec X 12, Green 300 sec X 17, Blue 300 sec X 24.

NGC 2261 is a variable nebula in the constellation Monoceros, with the shape and brightness of the nebula changing over weeks and months. These changes can be observed in a small amateur-sized telescope. Discovered by William Herschel and first studied in detail by FC Jordan and George Hale in the early 1900's with photographic plates, it was further studied by Edwin Hubble in the 1920's. When the Hale telescope at Mt. Palomar Observatory, after more than 20 years of construction and delays, was inaugurated on January 26, 1949 it was NGC 2261 that gave the telescope first light. Hubble himself was at the controls, smoking his ever-present pipe. The nebula is illuminated by the nearby star R Monocerotis, and it is suspected that the changes in shape and brightness are caused by gas and dust periodically revolving between R Monocerotis and the nebula. It lies approximately 2500 light years from Earth and has an apparent dimension of around 2 arcminutes.

Dark Energy Survey Releases Most Precise Look at the Universe's Evolution

by Tracy Marc, Fermilab

The Dark Energy Survey has imaged roughly 5,000 square degrees of southern sky. The survey has mapped hundreds of millions of galaxies to help researchers understand the accelerating expansion of our universe. Photo: Reidar Hahn, Fermilab

New results from the Dark Energy Survey use the largest ever sample of galaxies over an enormous piece of the sky to produce the most precise measurements of the universe's composition and growth to date. Scientists measured that the way matter is distributed throughout the universe is consistent with predictions in the standard cosmological model, the best current model of the universe.

Over the course of six years, DES surveyed 5,000 square degrees — almost one-eighth of the entire sky — in 758 nights of observation, cataloguing hundreds of millions of ob-

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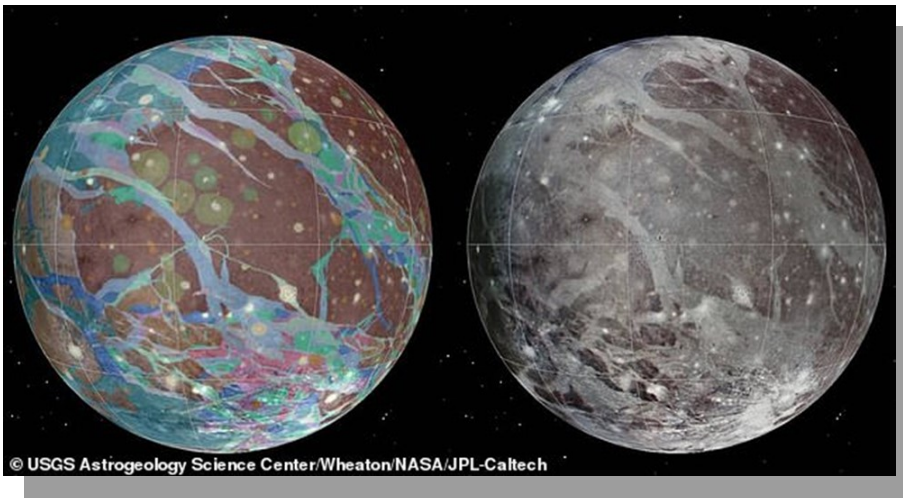
NASA's Juno Spacecraft to Fly within 645 Miles of Ganymede

Jonathan Chadwick for Mailonline



With a diameter of 3,280 miles, Ganymede (pictured) is larger than both planet Mercury and dwarf planet Pluto. This image shows mosaic and geologic maps of Ganymede, assembled incorporating the best available imagery from NASA's Voyager 1 and 2 spacecraft and NASA's Galileo spacecraft

NASA's Juno spacecraft will fly within 645 miles (1,038 kilometres) of Ganymede – Jupiter's largest moon – on June 7, 2021. Juno's instruments will begin collecting data about three hours before the spacecraft's closest approach, which will happen at 1:35pm EDT. Juno, which launched from Cape Canaveral, Florida in August 2011 to study Jupiter from orbit, will provide insights into the moon's composition and temperature.

The celestial event will be the closest a spacecraft has come to Ganymede since Galileo in May 2000. With a diameter of 3,280 miles (5,262 kilometers), Ganymede is larger than both Mercury and dwarf planet Pluto. Ganymede is the largest moon in our solar system and the only moon with its own magnetic field.

Since its discovery in January 1610, Ganymede has been the focus of repeated observation, first by Earth-based telescopes, and later by flyby missions and spacecraft orbiting Jupiter.

These studies depict a complex icy world whose surface is char-

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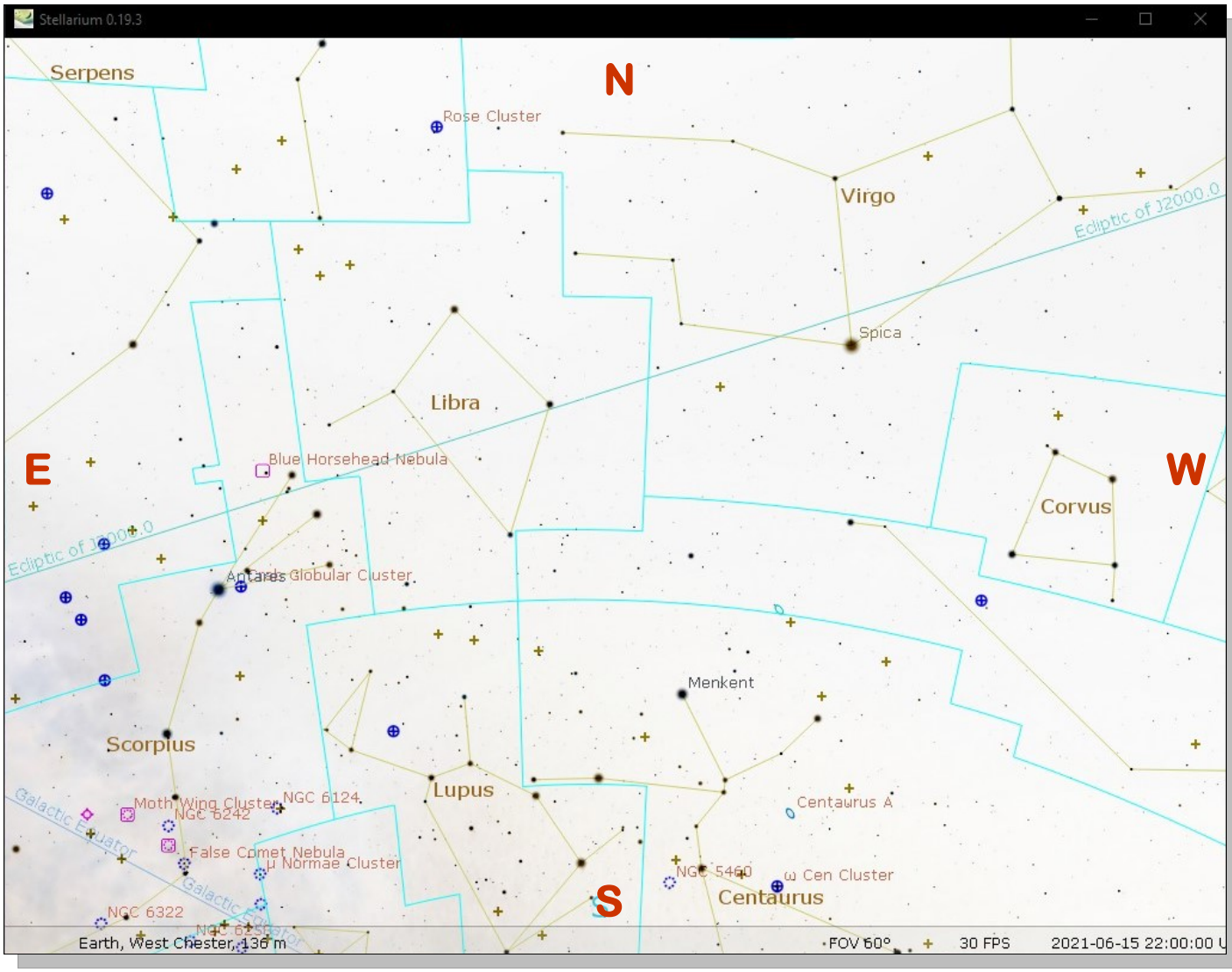
The Sky Over Chester County

June 15, 2021 at 10:00 p.m. ET

Note: This screen capture is taken from Stellarium, the free planetarium software available for download at www.stellarium.org.



Date	Civil Twilight Begins	Sunrise	Sunset	Civil Twilight Ends	Length of Day
06/01/2021	5:03 a.m. EDT	5:35 a.m. EDT	8:25 p.m. EDT	8:57 p.m. EDT	14h 49m 34s
06/15/2021	5:00 a.m. EDT	5:33 a.m. EDT	8:32 p.m. EDT	9:05 p.m. EDT	14h 59m 46s
06/30/2021	5:04 a.m. EDT	5:37 a.m. EDT	8:35 p.m. EDT	9:07 p.m. EDT	14h 57m 55s

Moon Phases					
Last Quarter	06/02/2021	3:24 a.m. EDT	New Moon	06/10/2021	6:52 a.m. EDT
First Quarter	06/17/2021	11:54 p.m. EDT	Full Moon	06/24/2021	2:39 p.m. EDT

June 2021 Observing Highlights

by Don Knabb, CCAS Treasurer & Observing Chair

2	**Last Quarter Moon, 3:24 a.m. EDT**
10	**New Moon and solar eclipse, although we might only catch a glimpse at sunrise**
11/12	**A thin crescent Moon is near Venus**
13	**The Moon is near Mars, Venus, the Beehive Cluster and "the twins" Castor and Pollux**
14	**The Moon is near Mars**
17	**First Quarter Moon, 11:54 p.m. EDT**
18	**The Lunar Straight Wall is visible this evening**
20	**Summer Solstice, 11:32 p.m. EDT**
23	**Mars is directly in front of The Beehive Cluster just after sunset**
24	**Full Moon, the Full Strawberry Moon or the Full Sockeye Moon, 2:39 p.m. EDT**

The best sights this month: An annular solar eclipse occurs at sunrise on June 10th, but we might only catch a glimpse of a partial eclipse as the Sun rises at 5:33 a.m., with the eclipse ending at 6:30 a.m. Other sights include a nice grouping of the Moon, Mars, Venus and the "twins" Castor and Pollux on June 13th and Mars crossing in front of M44, the Beehive Cluster, on June 23rd.

Mercury: Mercury passes behind the Sun on June 10th and is visible late in the month in the predawn sky.

Venus: Our sister planet remains low in the west after sunset during June. On June 11th and 12th a thin crescent Moon is near Venus. This will be a nice photo opportunity!

Mars: Mars is fading slowly through June and spends the month near the "twins" Castor and Pollux in the constellation Gemini. On June 23rd Mars passes in front of M44, the Beehive Cluster.

Jupiter: Jupiter rises around 1 or 2 a.m. during June and is highest in the sky just before dawn.

Saturn: Saturn rises around midnight at the beginning of June and around 10 p.m. at month's end.

Uranus and Neptune: Both Uranus and Neptune are poorly positioned for observation during June.

The Moon: The Moon is full on June 24th. Native Americans called this the Full Strawberry Moon. This name was universal to every Algonquin tribe. However, in Europe they called it the Rose Moon. Native Canadians called this the Trees Fully Leaved Moon or the Sockeye Moon.

On June 10th the Moon passes between the Sun and the Earth, resulting in an annular eclipse. Unfortunately, we might only catch a glimpse of the eclipse at sunrise.

Constellations: Ah, the summer sky. Yes, you must stay up later to see the stars but at least you won't be shivering! Say goodbye to Leo the Lion as he dives into the west. Look for Scorpius if you have a clear southern horizon and see the bright star Antares shining like a red heart in the big bug of summer. In the east, we have bright Vega in Lyra followed by the birds of summer: Cygnus the Swan and Aquila the Eagle.

Messier/deep sky: There are many wonderful deep sky objects to see during June. My favorites this time of year are the globular clusters. Look for M3 and M5 high overhead, then find M4 near Antares in Scorpius and M22 in Sagittarius. Then seek M10 and M12 in Ophiuchus. Of course, I cannot forget to mention the brightest globular cluster in northern skies, M13 in Hercules. There are many nice other globular clusters, but M13 in Hercules is an amazing object if the skies are dark and clear

Comets: There are no bright comets visible during June

Meteor showers: There are no major meteor showers during June.

Dark Energy Survey (Cont'd)

(Continued from page 3)

jects. The results announced today draw on data from the first three years — 226 million galaxies observed over 345 nights — to create the largest and most precise maps yet of the distribution of galaxies in the universe at relatively recent epochs.

Since DES studied nearby galaxies as well as those billions of light years away, its maps provide both a snapshot of the current large-scale structure of the universe and a movie of how that structure has evolved over the course of the past 7 billion years.

To test cosmologists' current model of the universe, DES scientists compared their results with measurements from the European Space Agency's orbiting Planck observatory. Planck used light signals known as the cosmic microwave background to peer back to the early universe, just 400,000 years after the Big Bang. The Planck data give a precise view of the universe 13 billion years ago, and the standard cosmological model predicts how the dark matter should evolve to the present. If DES's observations don't match this prediction, there is possibly an undiscovered aspect to the universe. While there have been persistent hints from DES and several previous galaxy surveys that the current universe is a few percent less clumpy than predicted — an intriguing find worthy of further investigation — the recently released results are consistent with the prediction.

"In the area of constraining what we know about the distribution and structure of matter on large scales as driven by dark matter and dark energy, DES has obtained limits that rival and complement those from the cosmic microwave background," said Brian Yanny, a Fermilab scientist who coordinated DES data processing and management. "It's exciting to have precise measurements of what's out there and a better understanding of how the universe has changed from its infancy through to today."

Ten areas in the sky were selected as "deep fields" that the Dark Energy Camera imaged multiple times during the survey, providing a glimpse of distant galaxies and helping determine their 3D distribution in the cosmos. Photo: Dark Energy Survey

Ordinary matter makes up only about 5% of the universe. Dark energy, which cosmologists hypothesize drives the accelerating expansion of the universe by counteracting the force of gravity, accounts for about 70%. The last 25% is dark matter, whose gravitational influence binds galaxies together. Both dark matter and dark energy remain invisible and mysterious, but DES seeks to illuminate their natures by studying how the competition between them shapes the large-scale structure of the universe over cosmic time.

DES photographed the night sky using the 570-megapixel Dark Energy Camera on the Victor M. Blanco 4-meter Telescope at the Cerro Tololo Inter-American Observatory in Chile, a program of the National Science Foundation's NOIRLab. One of the most powerful digital cameras in the world, the Dark Energy Camera was designed specifically for DES. It was funded by the Department of Energy and was built and tested at Fermilab. The DES data were processed at the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign.

"These analyses are truly state-of-the-art, requiring artificial intelligence and high-performance computing supercharged by the smartest young scientists around," said Scott Dodelson, a physicist at Carnegie Mellon University who co-leads the DES Science Committee with Elisabeth Krause of the University of Arizona. "What an honor to be part of

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Dark Energy Survey (Cont'd)

The Dark Energy Survey photographed the night sky using the 570-megapixel Dark Energy Camera on the Victor M. Blanco 4-meter Telescope at the Cerro Tololo Inter-American Observatory in Chile, a program of the National Science Foundation's NOIRLab. Photo: Reidar Hahn, Fermilab

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this team."

To quantify the distribution of dark matter and the effect of dark energy, DES relied on two main phenomena. First, on large scales, galaxies are not distributed randomly throughout space but rather form a web-like structure due to the gravity of dark matter. DES measured how this cosmic web has evolved over the history of the universe. The galaxy clustering that forms the cosmic web, in turn, revealed regions with a higher density of dark matter.

Second, DES detected the signature of dark matter through weak gravitational lensing. As light from a distant galaxy travels through space, the gravity of both ordinary and dark matter can bend it, resulting in a distorted image of the galaxy as seen from Earth. By studying how the apparent shapes of distant galaxies are aligned with each other and with the positions of nearby galaxies along the line of sight, DES scientists inferred the spatial distribution (or clumpiness) of the dark matter in the universe.

Analyzing the massive amounts of data collected by DES was a formidable undertaking. The team began by analyzing just the first year of data, which was released in 2017. That process prepared the researchers to use more sophisticated techniques for analyzing the larger data set, which includes the largest sample of galaxies ever used to study weak gravitational lensing.

For example, calculating the redshift of a galaxy — the change in light's wavelength due to the expansion of the universe — is a key step toward measuring how both galaxy clustering and weak gravitational lensing change over cosmic history. The redshift of a galaxy is related to its distance, which allows the clustering to be characterized in both space and time.

"There was significant improvement in how to calibrate the redshift distributions of the galaxy samples," said Judit Prat, a postdoc at the University of Chicago who analyzed weak gravitational lensing as captured by DES. "This was a huge effort that people put a lot of work into. We now have a method that nobody has used before, and it's very robust."

Ten regions of the sky were chosen as "deep fields" that the Dark Energy Camera imaged repeatedly throughout the survey. Stacking those images together allowed the scientists to glimpse more distant galaxies. The team then used the redshift information from the deep fields to calibrate measurements of redshift in the rest of the survey region. This and other advancements in measurements and modeling, coupled with a threefold increase in data compared to the first year, enabled the team to pin down the density and clumpiness of the universe with unprecedented precision.

Along with the analysis of the weak-lensing signals, DES also precisely measures other probes that constrain the cosmological model in independent ways: galaxy clustering on larger scales (baryon acoustic oscillations), the frequency of massive clusters of galaxies, and high-precision measurements of the brightnesses and redshifts of Type Ia superno-

(Continued on page 8)

Dark Energy Survey (Cont'd)

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vae. These additional measurements will be combined with the current weak-lensing analysis to yield even more stringent constraints on the standard model.

"DES has delivered cost-effective, leading-edge science results directly related to Fermilab's mission of pursuing the fundamental nature of matter, energy, space and time," said Fermilab Director Nigel Lockyer. "A dedicated team of scientists, engineers and technicians from institutions around the world brought DES to fruition."

The DES collaboration consists of over 400 scientists from 25 institutions in seven countries.

"The collaboration is remarkably young. It's tilted strongly in the direction of postdocs and graduate students who are doing a huge amount of this work," said DES Director and spokesperson Rich Kron, who is a Fermilab and University of Chicago scientist. "That's really gratifying. A new generation of cosmologists are being trained using the Dark Energy Survey."

DES concluded observations of the night sky in 2019. With the experience of analyzing the first half of the data, the team is now prepared to handle the complete data set. The final DES analysis is expected to paint an even more precise picture of the dark matter and dark energy in the universe. And the methods developed by the team

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Ganymede (Cont'd)

A rotating, solar-powered spacecraft, Juno arrived at Jupiter in 2016 after making a five-year journey (depicted here in artist's impression)

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acterized by the striking contrast between its two major terrain types - the dark, very old, highly cratered regions and the lighter, somewhat younger (but still ancient) regions marked with an extensive array of grooves and ridges.

Juno will fly past Ganymede at almost 12 miles per second (19 kilometres per second), which means it will go from being a point of light to a viewable disk then back to a point of light in about 25 minutes. This will give the craft's on-board JunoCam imager just enough time to capture five images on the moon.

"By flying so close, we will bring the exploration of Ganymede into the 21st century," said Juno's principal investigator Scott Bolton at the Southwest Research Institute in San Antonio, Texas. "Juno carries a suite of sensitive instruments capable of seeing Ganymede in ways never before possible."

A rotating, solar-powered spacecraft, Juno arrived at Jupiter on July 4, 2016, after making a five-year journey. It has three giant blades stretching out some 66 feet (20 meters) from its cylindrical, six-sided body.

Juno's flyby will provide scientists with some stunning imagery and yield insights into Ganymede's composition, ionosphere, magnetosphere and icy shell.

Ganymede has three main layers – a sphere of metallic iron at the center (the core, which generates a magnetic field), a spherical shell of rock (mantle) surrounding the core, and an outer shell of mostly ice, about 497 miles thick, surrounding both the rock shell

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Ganymede (Cont'd)

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and the core.

Along with the Ultraviolet Spectrograph (UVS) and Jovian Infrared Auroral Mapper (JIRAM) instruments, Juno's Microwave Radiometer's (MWR) will peer into Ganymede's water-ice crust, obtaining data on its composition and temperature.

On its surface, the mysterious ice moon has large, bright regions of ridges and grooves that slice across older, darker terrains. These grooved regions are a clue that the moon experienced dramatic upheavals in the distant past, according to NASA.

"Ganymede's ice shell has some light and dark regions, suggesting that some areas may be pure ice

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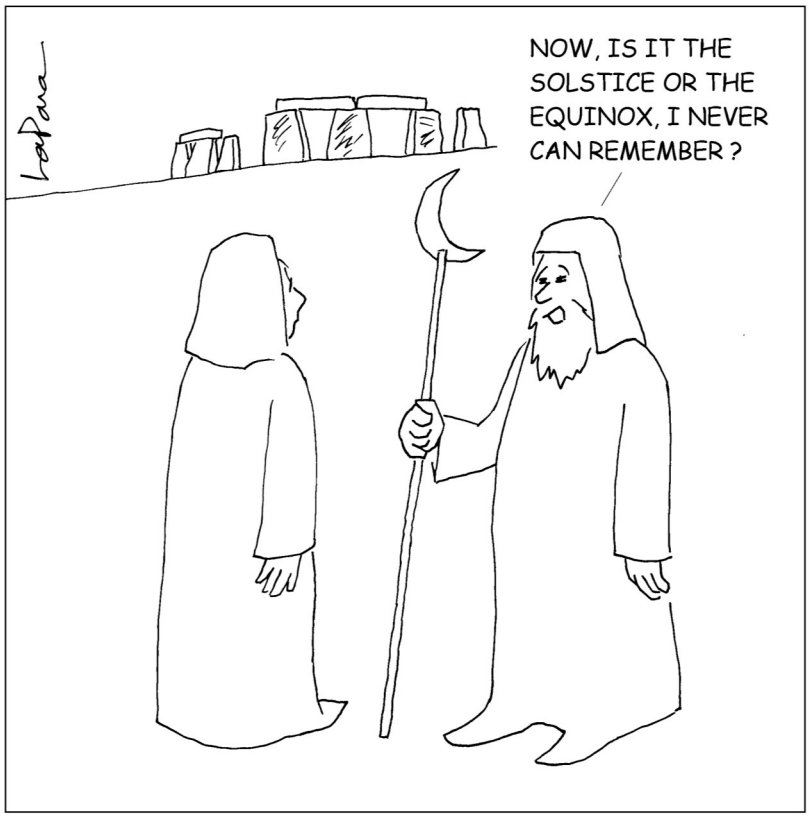
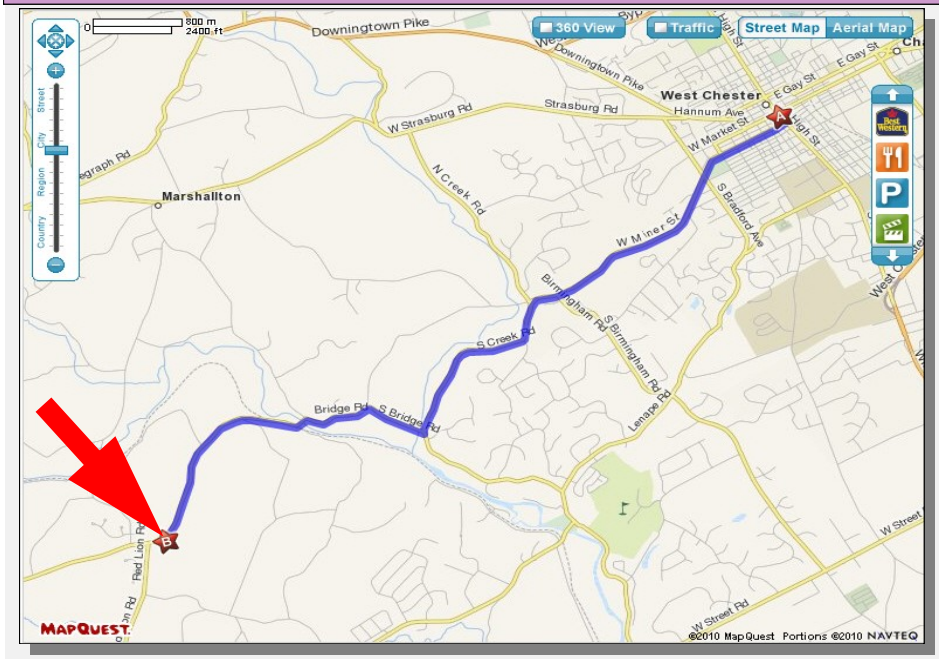
Classic La Para

by Nicholas La Para



CCAS Directions



Brandywine Red Clay Alliance
1760 Unionville Wawaset Rd
West Chester, PA 19382
(610) 793-1090
http://brandywinewatershed.org/

BRC was founded in 1945 and is committed to promoting and protecting the natural resources of the Brandywine Valley through educational programs and demonstrations for all ages.

Brandywine Red Clay Alliance

The monthly observing sessions (held February through November) are held at the Myrick Conservation Center of the Brandywine Red Clay Alliance.

To get to the Myrick Conservation Center from West Chester, go south on High Street in West Chester past the Courthouse. At the next traffic light, turn right on Miner Street, which is also PA Rt. 842. Follow Rt. 842 for about 6 miles. To get to the observing site at the BRC property, turn left off Route 842 into the parking lot by the office: look for the signs to the office along Route 842. From that parking lot, go left through the gate and drive up the farm lane about 800 feet to the top of the hill. The observing area is on the right.

If you arrive after dark, *please turn off your headlights and just use parking lights* as you come up the hill (so you don't ruin other observers' night vision).

Through the Eyepiece: Globular Cluster M5 in Serpens

by Don Knabb, CCAS Treasurer & Observing Chair

Photo credit: Brent Crabb, astrophotographer

Globular clusters are among my favorite deep sky objects. On a dark night they stand out against the background in even the smallest binoculars, and if you are fortunate enough to view one of the larger globular clusters in an 8 inch or larger reflecting telescope you can get lost in the cloud of stars in the eyepiece.

During June, Messier 5, also known as NGC 5904, is in excellent position for comfortable viewing during the late evening. I say late evening because it is at least 9:30 until the glow of the Sun fades from the sky. You will find M5 in the southern sky, about half way between the horizon and the zenith, so if you use binoculars, a refractor or a reflector you won't need to strain your neck to get a good view of this beauty of the night sky.

In late May I stared into M5 for a long time on a dark night with a 12 inch Dobsonian telescope. I was especially fortunate to be using a binoviewer. Although I enjoy the bright view through a wide field eyepiece, the comfort of viewing with both eyes open makes long views of any object more enjoyable.

The photo above of M5 was taken by Brent Crabb, an amateur astronomer and astrophotographer from Orange County, California.

A globular cluster is a spherical collection of stars that orbits a galaxy as a satellite. They can contain anywhere from ten thousand to a million stars. These stars orbit the collective center of mass of the cluster in a veritable bee hive of motion, and the cluster itself orbits the Milky Way as a distinct object, occasionally plunging right through the main disk and out the other side. Although the cluster appears extremely dense, the distance between individual stars is actually quite large. As a result, stars within them rarely collide, and globular clusters survive relatively unscathed by their passage through the galaxy's disk.

M5 was discovered by Gottfried Kirch in 1702 when he was observing a comet. Charles Messier found it in 1764 and thought it a nebula without any

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Eyepiece (Cont'd)

Star chart created with Stellarium planetarium software

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stars associated with it. William Herschel resolved individual stars in the cluster in 1791, counting roughly 200 of them.

M5 has an angular size of 17.4 arc minutes and is located within the borders of the constellation Serpens. It is 24,500 light years from the planet Earth which makes it the 52nd furthest Messier object from Earth.

M5 is, under extremely good conditions, just visible to the naked eye as a faint "star" near the star 5 Serpentis. Binoculars or small telescopes will identify this fine cluster as non-stellar while larger telescopes will start to show individual stars, of which the brightest are of apparent magnitude 12.2. The Peterson Field Guided to Stars and Planets calls M5 "one of the finest in the sky"!

Spanning 165 light-years across, M5 is one of the larger globular clusters known. It is also one of the older globulars within the Milky Way Galaxy. The cluster contains more than 100,000 stars, up to perhaps 500,000 according to some estimates.

Use the star chart above to fine M5. Or, wait until around 10:00 pm for it to be fully dark and find Arcturus high in the southwest. Then find red Antares low in the south. M5 is about 1/3 of the way along an imaginary line from Arcturus to Antares.

Information credits:

Pasachoff, Jay M. 2000. *A Field Guide to the Stars and Planets.* New York, NY. Houghton Mifflin.

Dickinson, Terence 2006. *Nightwatch: a practical guide to viewing the universe.* Buffalo, NY. Firefly Books

http://en.wikipedia.org/wiki/Messier_5

http://www.absoluteastronomy.com/messier_objects/m5.htm

http://www.seds.org/messier/m/m005.html

Ganymede (Cont'd)

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while other areas contain dirty ice," said Bolton. "MWR will provide the first in-depth investigation of how the composition and structure of the ice varies with depth, leading to a better understanding of how the ice shell forms and the ongoing processes that resurface the ice over time."

Juno's measurements of the radiation environment near the moon will also benefit future missions to the "Jovian System" (i.e. Jupiter, its rings and its moons).

The flyby on June 7th will be the closest a spacecraft has come to Ganymede since NASA's Galileo spacecraft made its penultimate close approach back on May 20, 2000. On that day, Galileo – which became the first spacecraft to orbit Jupiter in 1995 – reached 600 miles (1,000 km) from Ganymede.

Juno will continue its investigation of the solar system's largest planet through September 2025, or until the spacecraft's end of life.

NASA Night Sky Notes: Astrophotography with Your Smartphone

by David Prosper

This article is distributed by the NASA Night Sky Network, a coalition of hundreds of astronomy clubs across the US dedicated to astronomy outreach.

Visit nightsky.jpl.nasa.gov to find local clubs, events, stargazing info and more.

Have you ever wanted to take night time photos like you've seen online, with the Milky Way stretched across the sky, a blood-red Moon during a total eclipse, or a colorful nebula? Many astrophotos take hours of time, expensive equipment, and travel, which can intimidate beginners to astrophotography. However, anyone with a camera can take astrophotos; even if you have a just smartphone, you can do astrophotography. Seriously!

Don't expect Hubble-level images starting out! However, you can take surprisingly impressive shots by practicing several basic techniques: steadiness, locked focus, long exposure, and processing. First, steady your smartphone to keep your subjects sharp. This is especially important in low light conditions. A small tripod is ideal, but an improvised stand, like a rock or block of wood, works in a pinch. Most camera apps offer timer options to delay taking a photo by a few seconds, which reduces the vibration of your fingers when taking a shot. Next, lock your focus. Smartphones use autofocus, which is not ideal for low-light photos, especially if the camera readjusts focus mid-session. Tap the phone's screen to focus on a distant bright star or streetlight, then check for options to fine-tune and lock it. Adjusting your camera's exposure time is also essential. The longer your camera is open, the more light it gathers - essential for low

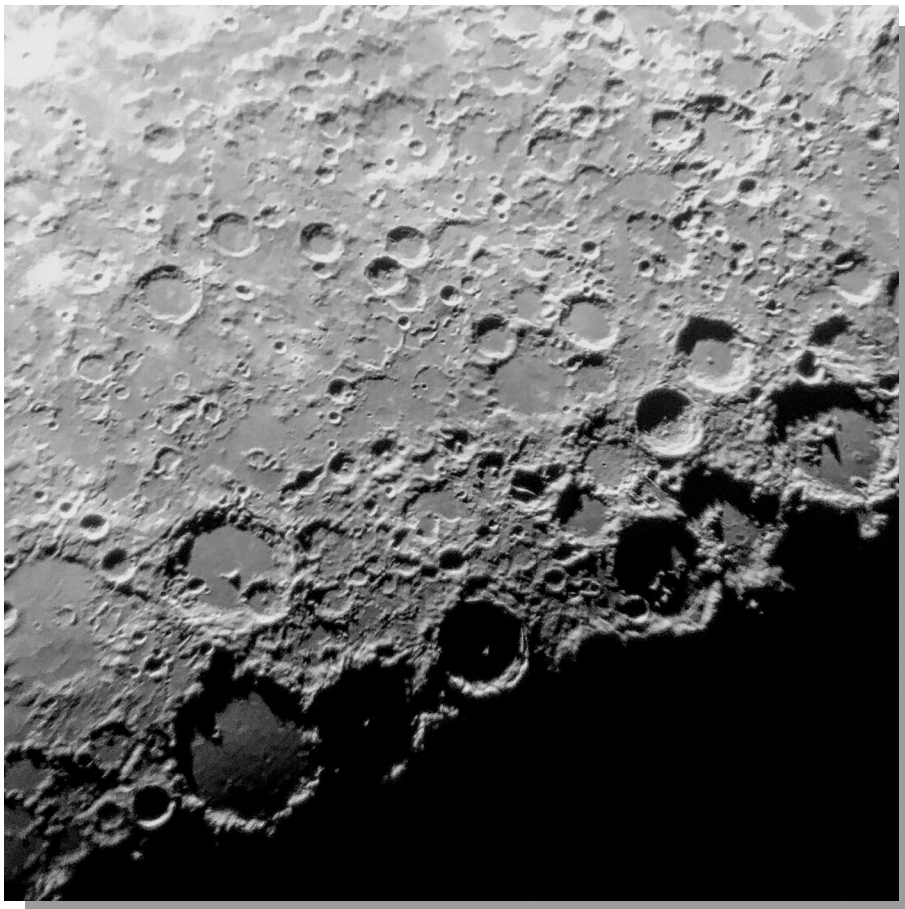
-light astrophotography. Start by setting your exposure time to a few seconds. With those options set, take a test photo of your target! If your phone's camera app doesn't offer these options, you can download apps that do. While some phones offer an "astrophotography" setting, this is still rare as of 2021. Finally, process your photos using an app on your phone or computer to bring out additional detail! Post-processing is the secret of all astrophotography.

You now have your own first astrophotos! Wondering what you can do next? Practice:

(Continued on page 13)

The Moon is large and bright, making it a great target for beginners. The author took these photos using an iPhone 6s. The crescent moon at sunset (above) was taken with a phone propped on the roof rack of a car; the close-up shot of lunar craters (right) was taken through the eyepiece of a friend's Celestron C8 telescope.

Night Sky Notes (Cont'd)



(Continued from page 12)

take lots of photos using different settings, especially before deciding on any equipment upgrades. Luckily, there are many amazing resources for budding astrophotographers. NASA has a free eBook with extensive tips for smartphone astrophotography at bit.ly/smartastrophoto, and you can also join the Smartphone Astrophotography project at bit.ly/smartphoneastroproject. Members of astronomy clubs often offer tips or even lessons on astrophotography; you can find a club near you by searching the "Clubs and Events" map on the Night Sky Network's website at nightsky.jpl.nasa.gov. May you have clear skies!

Left: A small tripod for a smartphone. They are relatively inexpensive – the author found this at a local dollar store!

Dark Energy Survey (Cont'd)

(Continued from page 8)

have paved the way for future sky surveys to probe the mysteries of the cosmos.

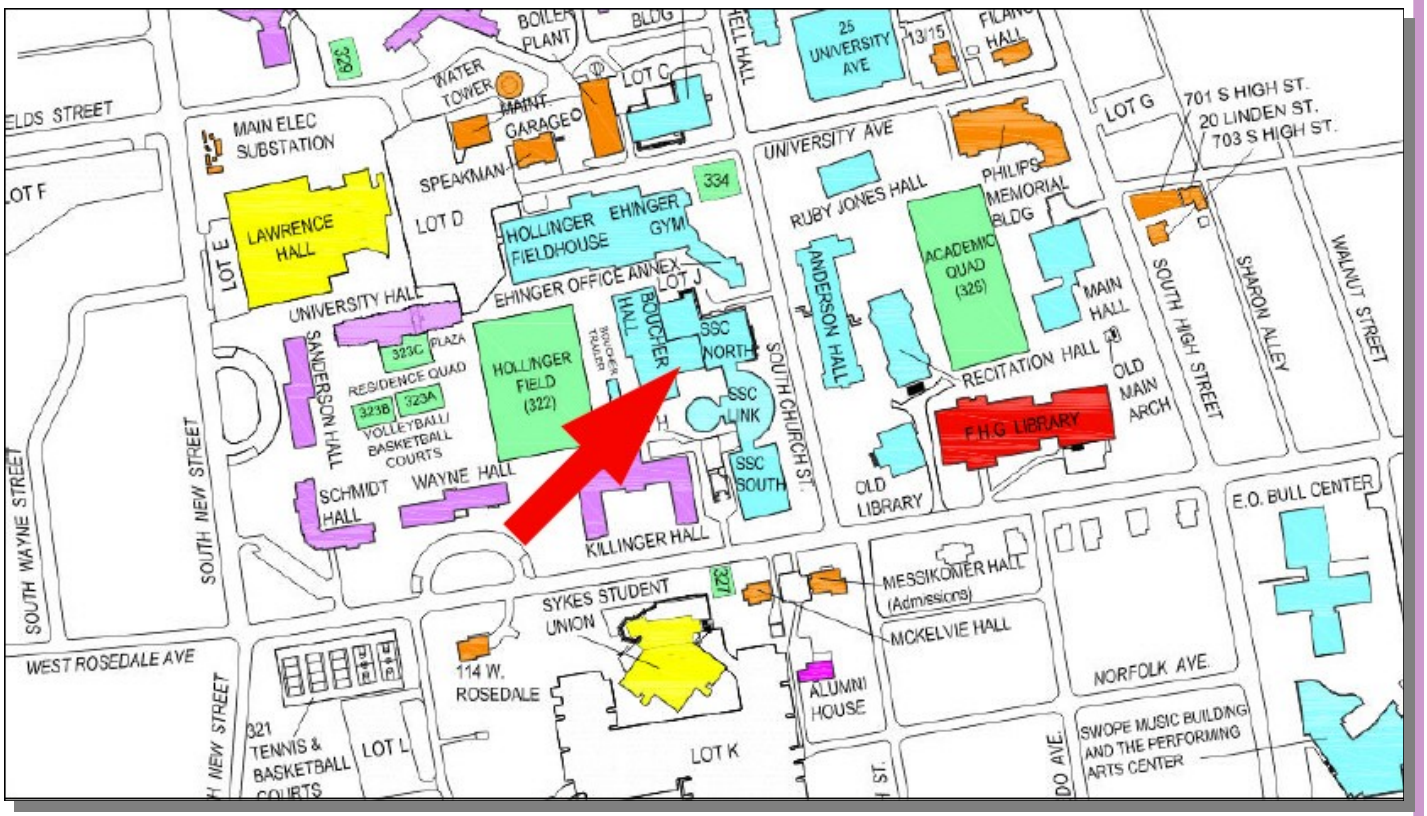
"The real legacy of DES will be the leaps forward we've had to make that were essential for this key result, and which will be critical for the next generation of cosmological experiments starting soon," said Michael Troxel, a physicist at Duke University and the key project coordinator for the DES three-year data analysis. Upcoming experiments include both space-based imaging experiments and ground-based surveys such as the Vera C.

(Continued on page 14)

CCAS Directions

West Chester University Campus

The monthly meetings (September through May) are held in Room 112 in Merion Science Center (formerly the Boucher Building), attached to the Schmucker Science Center. The Schmucker Science Center is located at the corner of S. Church St & W. Rosedale Ave. Parking is generally available across Rosedale in the Sykes Student Union parking lot (Lot K).



Dark Energy Survey (Cont'd)

(Continued from page 13)

Rubin Observatory Legacy Survey of Space and Time.

"With these instruments we've built to stare into the dark, we are working to solve universal mysteries," said Troxel.

The recent DES results will be presented in a scientific seminar on May 27. Twenty-nine papers are available on the arXiv online repository.

The Dark Energy Survey is a collaboration of more than 400 scientists from 25 institutions in seven countries. For more information about the survey, please visit the experiment's website.

CCAS Membership Information and Society Financials

Treasurer's Report
by Don Knabb

May 2021 Financial Summary

Beginning Balance	$1290
Deposits	$105
Disbursements	-$0
Ending Balance	$1395

New Member Welcome!

Welcome new CCAS members Rick Maynard, from West Chester, PA, and Avni Dhargalkar, also from West Chester, PA. We're glad you decided to join us under the stars! Clear skies to you!

Membership Renewals

You can renew your CCAS membership by writing a check payable to "Chester County Astronomical Society" and sending it to our Treasurer:

Don Knabb
988 Meadowview Lane
West Chester PA 19382

The current dues amounts are listed in the *CCAS Information Directory*. Consult the table of contents for the directory's page number in this month's edition of the newsletter.

CCAS Information Directory

Join the Fight for Dark Skies!

You can help fight light pollution, conserve energy, and save the night sky for everyone to use and enjoy. Join the nonprofit International Dark-Sky Association (IDA) today. Individual memberships start at $30.00 for one year. Send to:

International Dark-Sky Association
3225 North First Avenue
Tucson, AZ 85719

Phone: **520-293-3198**
Fax: **520-293-3192**
E-mail: **ida@darksky.org**

For more information, including links to helpful information sheets, visit the IDA web site at:

http://www.darksky.org

Dark-Sky Website for PA

The Pennsylvania Outdoor Lighting Council has lots of good information on safe, efficient outdoor security lights at their web site:

http://www.POLCouncil.org

Find out about Lyme Disease!

Anyone who spends much time outdoors, whether you're stargazing, or gardening, or whatever, needs to know about Lyme Disease and how to prevent it. You can learn about it at:

http://www.LymePA.org

Take the time to learn about this health threat and how to protect yourself and your family. It is truly "time well spent"!

Good Outdoor Lighting Websites

One of the biggest problems we face in trying to reduce light pollution from poorly designed light fixtures is easy access to good ones. When you convince someone, a neighbor or even yourself, to replace bad fixtures, where do you go for good lighting fixtures? Check out these sites and pass this information on to others. Help reclaim the stars! And save energy at the same time!

Light pollution from poor quality outdoor lighting wastes billions of dollars and vast quantities of valuable natural resources annually. It also robs us of our heritage of star-filled skies. Starry Night Lights is committed to fighting light pollution. The company offers the widest selection of ordinance compliant, night sky friendly and neighbor friendly outdoor lighting for your home or business. Starry Night Lights is located in Park City, Utah.

Phone: **877-604-7377**
Fax: **877-313-2889**

http://www.starrynightlights.com

★ ★ ★ ★ ★

Lighthouse Outdoor Lighting is a dedicated lifetime corporate member of the International Dark-Sky Association. Lighthouse's products are designed to reduce or eliminate the negative effects outdoor lighting can have while still providing the light you need at night.

Phone: **484-291-1084**

https://www.lighthouse-lights.com/landscape-lighting-design/pa-west-chester/

Local Astronomy-Related Stores

Listing retail sites in this newsletter does not imply endorsement of any kind by our organization. This information is provided only as a service to our members and the general public.

Skies Unlimited is a retailer of telescopes, binoculars, eyepieces and telescope accessories from Meade, Celestron, Televue, Orion, Stellarvue, Takahashi, Vixen, Losmandy and more.

Skies Unlimited
Suburbia Shopping Center
52 Glocker Way
Pottstown, PA 19465

Phone: **610-327-3500** or **888-947-2673**
Fax: **610-327-3553**

http://www.skiesunlimited.net

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Located in Manayunk, Spectrum Scientifics educates and entertains customers with an array of telescopes, microscopes, binoculars, science toys, magnets, labware, scales, science instruments, chemistry sets, and much more.

4403 Main Street
Philadelphia, PA 19127

Phone: **215-667-8309**
Fax: **215-965-1524**

Hours:
Tuesday thru Saturday: 10AM to 6PM
Sunday and Monday: 11AM to 5PM

http://www.spectrum-scientifics.com

CCAS Information Directory

CCAS Lending Telescopes

Contact Don Knabb to make arrangements to borrow one of the Society's lending telescopes. CCAS members can borrow a lending telescope for a month at a time; longer if no one else wants to borrow it after you. Don's phone number is 610-436-5702.

CCAS Lending Library

Contact our Librarian, Barb Knabb, to make arrangements to borrow one of the books in the CCAS lending library. Copies of the catalog are available at CCAS meetings, and on the CCAS website. Barb's phone number is 610-436-5702.

Contributing to *Observations*

Contributions of articles relating to astronomy and space exploration are always welcome. If you have a computer, and an Internet connection, you can attach the file to an e-mail message and send it to: **newsletter@ccas.us**

Or mail the contribution, typed or handwritten, to:

Dr. John C. Hepler
501 Main St.
Ashland, PA 17921

CCAS Newsletters via E-mail

You can receive the monthly newsletter (in full color!) via e-mail. All you need is a PC or Mac with an Internet e-mail connection. To get more information about how this works, send an e-mail request to Dr. John Hepler, the newsletter editor, at: **newsletter@ccas.us**.

CCAS Website

Dr. John Hepler is the Society's Webmaster. You can check out our Website at:

http://www.ccas.us

Dr. Hepler welcomes any additions to the site by Society members. The contributions can be of any astronomy subject or object, or can be related to space exploration. The only requirement is that it is your own work—no copyrighted material! Give your contributions to Dr. Hepler at (410) 639-4329 or e-mail to webmaster@ccas.us

CCAS Purpose

The Chester County Astronomical Society was formed in September 1993, with the cooperation of West Chester University, as a non-profit organization dedicated to the education and enjoyment of astronomy for the general public. The Society holds meetings (with speakers) and observing sessions once a month. Anyone who is interested in astronomy or would like to learn about astronomy is welcome to attend meetings and become a member of the Society. The Society also provides telescopes and expertise for "nights out" for school, scout, and other civic groups.

CCAS Executive Committee

For further information on membership or society activities you may call:

President:	Dave Hockenberry 610-558-4248
Vice President:	Pete Kellerman 610-873-0162
ALCor, Observing, & Treasurer:	Don Knabb 610-436-5702
Secretary:	Beatrice Mazziotta 610-933-2128
Librarian:	Barb Knabb 610-436-5702
Program:	Bruce Ruggeri 484-883-5092
Education:	Don Knabb 610-436-5702 Dennis O'Leary 610-701-8042
Webmaster & Newsletter:	John Hepler 484-883-0533
Public Relations:	Ann Miller 610-558-4248

CCAS Membership Information

The 2021 membership rates are as follows:

REGULAR MEMBER……$30/year
SENIOR MEMBER…….$15/year
STUDENT MEMBER……..$ 5/year
JUNIOR MEMBER……..$ 5/year
FAMILY MEMBER…….$40/year

Membership Renewals

Check the Membership Renewals on the front of each issue of *Observations* to see if it is time to renew. If you need to renew, you can mail your check, made out to "Chester County Astronomical Society," to:

Don Knabb
988 Meadowview Lane
West Chester PA 19382-2178

Phone: **610-436-5702**
e-mail: **treasurer@ccas.us**

*Sky & Tel*escope Magazine

The club membership subscription cost for *Sky and Telescope* magazine has increased to **$43.95**. This is still a good saving from the regular rate of **$54.95**.

There is no need to go through the CCAS treasurer for subscriptions or renewals. Just go to the Sky and Telescope website and select "Magazine", then under the FAQs you can subscribe at the club rate.

https://skyandtelescope.org/subscribe/

If you have **any** questions call Don Knabb at 610-436-5702.

Astronomy Magazine Group Rates

Subscriptions to this excellent periodical are available through the CCAS at a reduced price of **$34.00** which is much less than the individual subscription price of **$42.95** (or $60.00 for two years).

There is no need to go through the CCAS treasurer for subscriptions or renewals. Just call customer service at 877-246-4835 and request the club rate for your new subscription or renewal.