Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers April 2025

Events: General Meeting, Monday, April 7, 2025, at the Ronald H. Roberts Temecula Library, Room B, 30600 Pauba Rd, and/or ZOOM, at 6:00 PM.

- **IFI & Gallery by Clark Williams**
- **Refreshments – Paulo Lopez**
- **Speaker: Sam Pitts – Palomar Observatory's 48-inch Samuel Oschin Telescope**
- **Star Parties at Europa Village every Friday evening**
- **For upcoming school Star Parties check the Calendar on the web page.**

WHAT'S INSIDE THIS MONTH:

Send newsletter submissions to Sharon Smith <sas19502000@yahoo.com> by the 20th of the month for the next month's issue.

General information:
Subscription to the TVA is included in the annual $25 membership (regular members) donation ($9 student; $35 family).

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TVA MARCH 2025

THE SEARCH FOR LIFE

The science community (including NASA) has been trying to understand how life started on Earth. How extreme are the conditions that it can exist in on Earth and the other planets in our solar system and, by extension, the universe.
At first look it may appear that how living things first came to be on Earth is not really a subject for an astronomy article: however, the question does qualify for astronomy for two reasons. First of all a universal finding in Anthropology studies and Archeology studies is the presence of a creation story or myth of how we came to be. It seems that all Homo sapiens have wanted to know how they came to be. Second, on the practical astronomy side understanding what a celestial body must have to foster life can save a lot of trips, when we finally have inter stellar capable spacecraft.

Before we go looking for life we should have a definition of life. NASA did just that and did a search for a definition of life that went back 150 years. What they got was not a consensus of a definition but 48 significantly different definitions; so, they came up with their own and we will use it.

NASA DEFINITION of LIFE

1) All life is chemical reactions
2) Life sustains itself by gathering energy from its surroundings
3) All life displays variation (Darwinian evolution)

The second concept we need to have was stated by Steven J. Gould (a geologist turned evolutionary biologist) who said in a paper “Life has not evolved on Earth” this statement naturally shocked me, I think as Steven intended it to, but his next statement clarified things “ Life and Earth have evolved together”. It appeared that Steven was trying to emphasize the results of the 1952 Miller-Urey experiment (Fig. 1) that attempted, and succeeded, in producing some of the amino acids needed for life in what was thought to be early Earth atmosphere with simulated lightning providing the energy to drive the system. Without photosynthesis to capture the energy of the Sun to power life’s necessary chemical reactions, chemical energy is all we have and it must be renewed for life to go on.

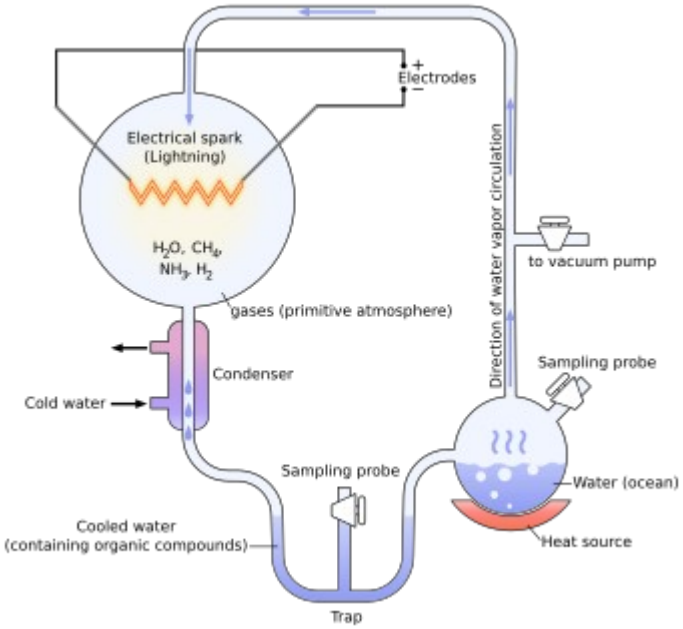


Figure 1

The Miller-Urey experiment was the only game in town until 1979 when a geologic mapping mission from the Scripps Institute of Oceanography discovered the first black smoker in the Eastern Pacific Rise area. The sea life in the area of the black smoker was 1,000 to 10,000 denser than the average ocean floor area. This was an indication that there was an abundance of chemical energy for our first cells to feed on. The base of the food chain at black smokers are chemosynthetic bacteria that have adapted to live just outside of the hottest waters and turn the chemical energy into sugars that the other lifeforms feed on. Unfornately we cannot tell if this type of community was the first life on earth because the oldest parts of the ocean floors around the world are only 180 million years old and we are looking for older than that.

How old are the geological structures we are looking for and where do we find them? From thousands of geologists taking millions of samples we have good indications that there was solid crustal material on Earth four billion years ago and some indications that there was water too. This geological search has centered on Craton's (large plates of crustal material that don't really get around much and thus they are not folded, spindled, or mutilated and get to be the oldest structures on Earth).

Our first stop is the Yilgarn Craton in Australia in an area called the Jack Hills. In the Jack Hills are Gneiss minerals. Gneiss are sedimentary rocks that have been squeezed together by pressure and heat but importantly not altered from the original minerals. In the Jack

Hills Gneiss are zircon crystals. Zircon crystals are very tough, stable and can incorporate Uranium 235 and 238 into their crystalline structure when forming. U-235 and U-238 have different ½ lives and decay into different isotopes of Lead this enables geologists to actually determine the age of rocks rather than say this is older than that. Age of our Jack Hills zircons in the Gneiss only 4.4 billion years. Figure it took two hundred million years for our zircons to form, capture the Uranium, weather, and end up in the sediment that formed our Gneiss; so, this is our starting point for finding life at about 4.2 billion years.

Our next stop is Greenland. All of Greenland is one big craton but we are interested in the Isua Green Stone Belt. This formation is 3.7 to 3.8 billion years old and although it does not have micro fossils of single celled life it does have pockets of carbon that are abnormally rich in the isotope C-12. Carbon has two stable isotopes C-12 and C-13 but because C-12 is much easier to move around inside cells and build proteins with, living organisms are very rich in C-12 compared to the environment. The finding of multiple small pockets of C-12 rich carbon could be our earliest evidence of actual living cells. Third stop - back to Australia; this time to the Pilbara Craton in the Dresser Formation, 620 miles from the Jack Hills. Here we find in a formation that is 3.48 billion years old complete with fossils of stromatolites. Stromatolites are mats of Cyanobacteria (Blue-green algae) that get covered with silt and fossilize over time (you can see living stromatolites today in Shark Bay Australia) and this is our first definite example of life on Earth.

If you are good at math you will realize that from the first surface of Earth that life could form on to our first fossil is just about 800 million years and from our first indications of life to advanced Blue-green Alge is 300 to 400 million years (I say advanced algae because Blue-green Algae is capable of photosynthesis and researchers are fairly certain that the first life forms used chemosynthesis for their energy source). Somewhere between 800 million years and 400 million years Earth had the appearance of first life and the appearance of the first fossils of living organisms. This gives scientists hope that life is a common occurrence and will be found on other planets in our solar system and on the exoplanets of other stars. But hope is not knowledge (Fig. 2) and at this time we just do not know what the reality is. Research into the subject is an area of great pursuit. I think researchers see this as an area of strong funding and many Nobel Prizes.

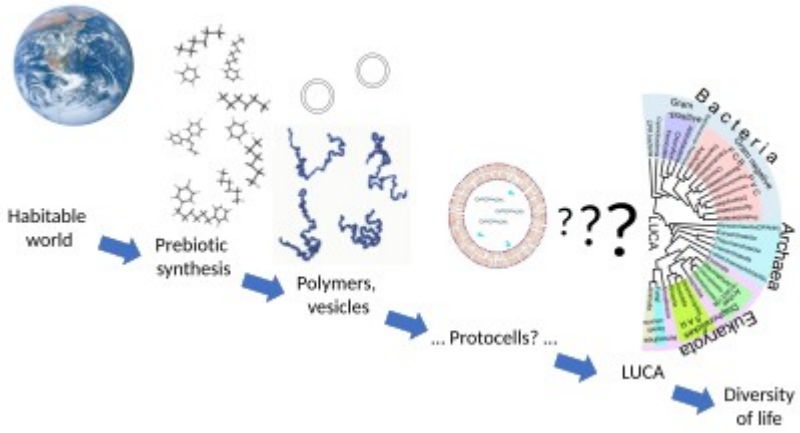


Figure 2

Why is NASA so fascinated with the extremophile bacteria on Earth? Remember Steven J. Gould's comment about life and Earth are suited for each other and when we have had disruptions in the average weather things have gone really badly for the plants and animals especially humans. An example is in 1815 the volcano Tambora erupted and shot an estimated equivalent of 40 cubic kilometers of rock equivalent into the atmosphere (Mt. St. Helen's eruption launched just 1.2 cubic Kilometers of rock equivalent into the atmosphere). The next year 1816 is known as the year without summer for the northern hemisphere. With temperatures down just 1.7 degrees Fahrenheit crops failed in Europe and the Eastern United States. With this sudden but small temperature change causing so much disruption to the ecosystem, when one looks at Venus, Mars, and Europa it would be silly to expect organisms that look like the average organisms of Earth to be there.

Extremophiles are not just organisms that can tolerate hot, cold, acidic, high saline, high pressure environments; they are organisms that need to be in these environments to survive because their metabolism and protein structures are that much different from the metabolism and protein structures of non-extremophiles. Are there natural limits to how adaptable extremophiles can be? In Ethiopia there is the Dallol geothermal field, Yellowstone is also a geothermal field, with numerous ponds; however, the mineral content of the area has turned the Dallol ponds into very hot, high salinity, and high acidity ponds that are completely incompatible with life. To date these are the only ponds found on our planet that do not have some form of living organism in them, so there are limits to where life can form.

Extremophiles are found in all three classifications of bacteria (Archaea, Prokaryotic, and Eukaryotic) but are there any multicellular organisms that could be classed as an extremophile? Enter the Phylum Tardigrada with about 1,300 different species.

Tardigrades, Italian for slow walker, are small, 0.1mm to 1.2mm in size, and are very, very hard to kill no mater what method you use to try and kill them. Tardigrades have been frozen (30 years), taken for a ride on the outside of the space shuttle (0 atmosphere lots of radiation), completely dried out (4 years), and given a bath in 150 degree Celsius water and have lived to tell their friends about the experience. The tardigrade gives me hope that we will find more than single cell animals in extreme environments on other planets.

FUN FACTS

Is California a good place to look for signs of the first life on our planet? NO, the San Gabriel Mountains just north of us at 1.8 billion years have the oldest strata in California at about ½ the age we are looking for.

Is the summit of Mt. Everest a good place to look for first life? NO, in 1924 the British Everest Expedition brought back rock samples from near the summit. The samples now called the Qomolangma Lime Stone (Qomolangma is the Tibetan name for Mt. Everest) had an abundance of Trilobite fossils in them indicating an age of 420 million years. Just think 420 million years ago the summit of Mt. Everest was a sea bottom, rocks do get around.

Are all one celled organisms microscopic? NO, the unicellular algae Valonia ventricose grows to 10 to 40 mm in size, average size 25mm. The average human cell is .02mm in size. If you were five feet eight inches tall and all of your cells grew to the average size of a ventricose cell you would be one and one third miles tall, now that is a real growth spirt.

CHEERS CHUCK

Cosmic Comments – April 2025

It saddens me to no small degree that if you approach anyone anywhere and ask what they know about an active extraplanetary science mission, they will probably say they don't know of one, not a single one!!! And if they do, it's extremely unlikely that they know its status…

That being the case, I don't want any of you to fall in with that majority so I will provide a mission description and update every month going forward… hopefully I will cover your favorite along the way!!!

So let's start with JUNO… I like to tell people that the name demonstrates that JPL and NASA have a sense of humor. Some people do know that the Galilean moons are named after Jupiter's "girlfriends", so it was appropriate that we send his wife, JUNO, to keep an eye on things…literally!!! Following is some information I hope interests you…

On August 5, 2011, NASA's Juno spacecraft embarked on a 5-year journey to Jupiter, our solar system's largest planet. Juno arrived at Jupiter on July 4, 2016, after a five-year, 1,740-million-mile journey, and settled into a 53-day polar orbit stretching from just above Jupiter's cloud tops to the outer reaches of the Jovian magnetosphere.

During the prime mission's 35 orbits of Jupiter, Juno collected more than **three terabits** of science data and provided dazzling views of Jupiter and its satellites, all processed by citizen scientists with NASA's first-ever camera dedicated to public outreach!!! Juno's many discoveries have changed our view of Jupiter's atmosphere and interior, revealing an atmospheric weather layer that extends far beyond its water clouds and a deep interior with a dilute heavy element core. Near the end of the prime mission, as the spacecraft's orbit evolved, flybys of the moon Ganymede initiated Juno's transition into a full Jovian system explorer.

Now in its extended mission, Juno will continue its investigation of the solar system's largest planet through September 2025, OR until the spacecraft's end of life. This extension tasks Juno with becoming an explorer of the full Jovian system – Jupiter and its rings and moons – with additional rendezvous planned for two of Jupiter's most intriguing moons: Europa and Io.

Maybe all this good stuff will serve as an "ice breaker" and open up a dialog on JUNO, and maybe spur interest on others as well…talk 'em up people!!!

Clear, Dark Skies my Friends…

Temecula Valley Astronomer

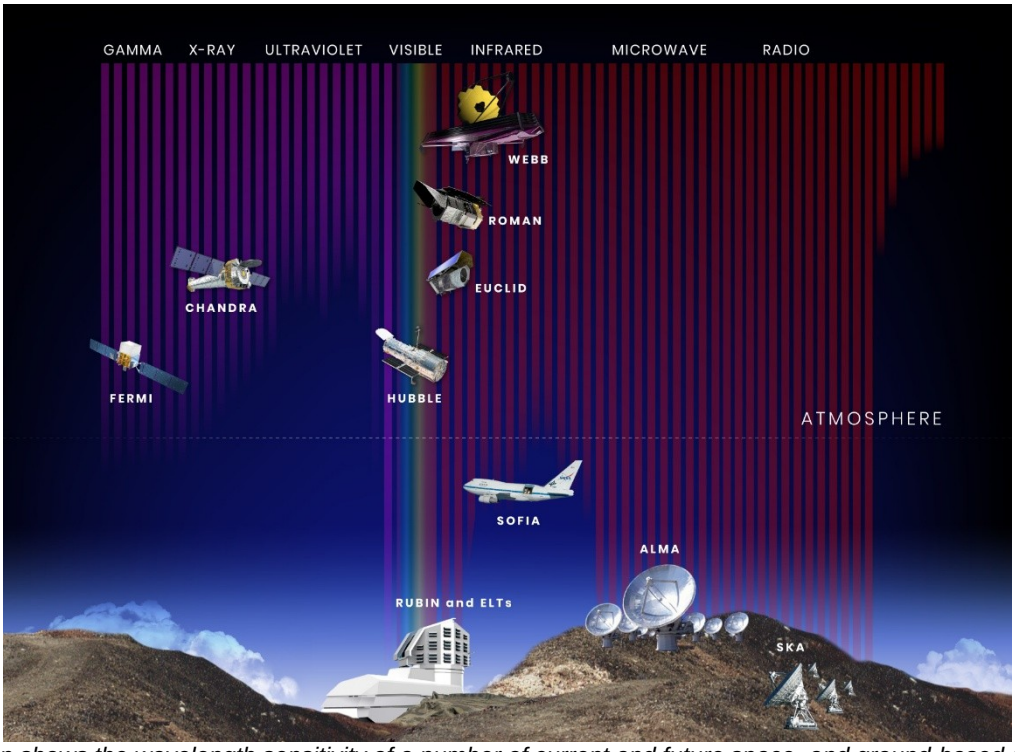
The monthly newsletter of the Temecula Valley Astronomers April 2025

April's Night Sky Notes: Catch the Waves!

By Kat Troche

The Electromagnetic Spectrum

If you've ever heard the term "radio waves," used a microwave or a television remote, or had an X-ray, you have experienced a broad range of the electromagnetic spectrum! But what is the electromagnetic spectrum? According to Merriam-Webster, this spectrum is *"the entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light."* But what does **that** mean? Scientists think of the entire electromagnetic spectrum as many types of light, only some that we can see with our eyes. We can detect others with our bodies, like infrared light, which we feel as heat, and ultraviolet light, which can give us sunburns. Astronomers have created many detectors that can "see" in the full spectrum of wavelengths.



This illustration shows the wavelength sensitivity of a number of current and future space- and ground-based observatories, along with their position relative to the ground and to Earth's atmosphere. The wavelength bands are arranged from shortest (gamma rays) to longest (radio waves). The vertical color bars show the relative penetration of each band of light through Earth's atmosphere. Credit: NASA, STScI

Telescope Types

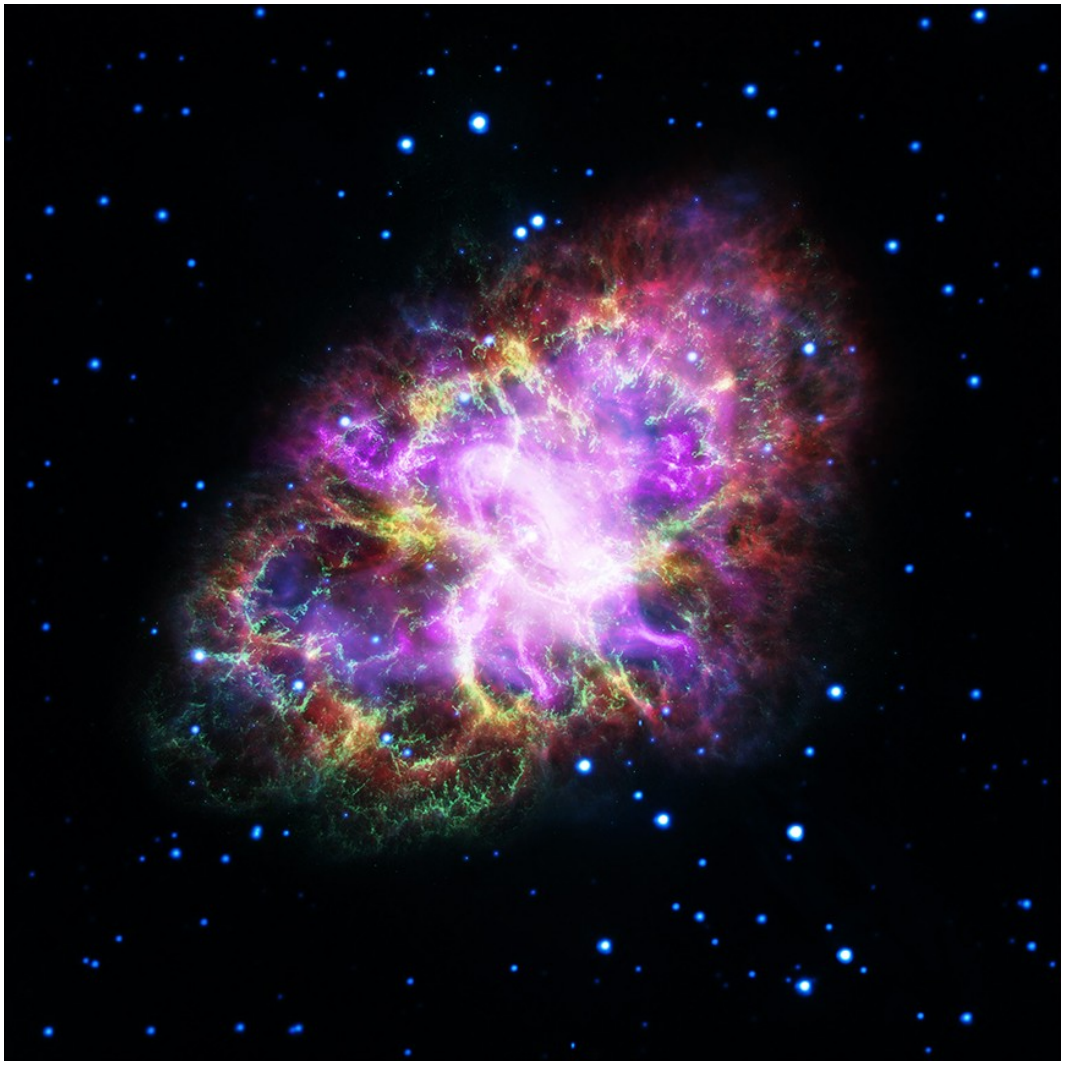
While multiple types of telescopes operate across the electromagnetic spectrum, here are some of the largest, based on the wavelength they primarily work in:

- **Radio:** probably the most famous radio telescope observatory would be the Very Large Array (VLA) in Socorro County, New Mexico. This set of 25-meter radio telescopes was featured in the 1997 movie Contact. Astronomers use these telescopes to observe protoplanetary disks and black holes. Another famous set of radio telescopes would be the Atacama Large Millimeter Array (ALMA) located in the Atacama Desert in Chile. ALMA was one of eight radio observatories that helped produce the first image of supermassive black holes at the center of M87 and Sagittarius A* at the center of our galaxy. Radio telescopes have also been used to study the microwave portion of the electromagnetic spectrum.

- **Infrared:** The James Webb Space Telescope (JWST) operates in the infrared, allowing astronomers to see some of the earliest galaxies formed nearly 300 million years after the Big Bang. Infrared light allows astronomers to study galaxies and nebulae, which dense dust clouds would otherwise obscure. An excellent example is the Pillars of Creation located in the Eagle Nebula. With the side-by-side image comparison below, you can see the differences between what JWST and the Hubble Space Telescope (HST) were able to capture with their respective instruments.

NASA's Hubble Telescope captured the Pillars of Creation in 1995 and revisited them in 2014 with a sharper view. Webb's infrared image reveals more stars by penetrating dust. Hubble highlights thick dust layers, while Webb shows hydrogen atoms and emerging stars. You can find this and other parts of the Eagle Nebula in the Serpens constellation. Credit: NASA, ESA, CSA, STScI, Hubble Heritage Project (STScI, AURA)

- **Visible:** While it does have some near-infrared and ultraviolet capabilities, the Hubble Space Telescope (HST) has primarily operated in the visible light spectrum for the last 35 years. With over 1.6 million observations made, HST has played an integral role in how we view the universe. Review Hubble's Highlights here.



The Crab Nebula, located in the Taurus constellation, is the result of a bright supernova explosion in the year 1054, 6,500 light-years from Earth. Credit: X-ray: NASA/CXC/SAO; Optical: NASA/STScI; Infrared: NASA/JPL/Caltech; Radio: NSF/NRAO/VLA; Ultraviolet: ESA/XMM-Newton

- **X-ray:** Chandra X-ray Observatory was designed to detect emissions from the hottest parts of our universe, like exploding stars. X-rays help us better understand the composition of deep space objects, highlighting areas unseen by visible light and infrared telescopes. This image of the Crab Nebula combines data from five different telescopes: The VLA (radio) in red; Spitzer Space Telescope (infrared) in yellow; Hubble Space Telescope (visible) in green; XMM-Newton (ultraviolet) in blue; and Chandra X-ray Observatory (X-ray) in purple. You can view the break-down of this multiwavelength image here.

Try This At Home

Even though we can't see these other wavelengths with our eyes, learn how to create multiwavelength images with the Cosmic Coloring Compositor activity and explore how astronomers use representational color to show light that our eyes cannot see with our Clues to the Cosmos activity.

The TVA is a member club of The Astronomical League