# February Skies over the Pinnacles 

February 2023
February's Four Principal Phases of the Moon

| February 5 | Full Moon | $\mathbf{O}$ |
| :--- | :---: | :---: |
| February 13 | Last Quarter | $\mathbf{0}$ |
| February 20 | New Moon | $\mathbf{O}$ |
| February 27 | First Quarter | $\mathbf{D}$ |

## Got the Time?

You would measure time the measureless and the immeasurable. You would adjust your conduct and even direct the course of your spirit according to hours and seasons. Of time you would make a stream upon whose bank would sit and watch its flowing. Kahlil Gibran, The Prophet

Science is said to be forever approaching the truth but never quite getting there. Even so, it's still the best way we have of understanding the physical universe. In pre-science times, angels, demons and gods controlled all the workings of the world. It was not a very predictive system but it satisfied our need to make sense of what was happening around us. Illness might be thought to be brought on by a magic spell or a planet passing through a given constellation. The term, 'flu' or 'influenza' refers to a negative influence of the stars. Most of us today recognize that germs or other factors bring on disease.

The $16^{\text {th }}$ century astronomer, Copernicus, used his great mind, observations of the stars, planets and mathematics to create a model of the universe that had the Sun at it's center. For most, tradition had the Earth as the center of everything. In the next century Johannes Kepler used his great mind, the precise observations of the planets by Tycho Brahe and mathematics to get closer to the truth of our solar system. Kepler didn't define the sun as the center of the universe but he did refine our knowledge of how the 6 planets, (known at the time) moved about the Sun. Finally, we could not only know where the planets are right now, but Kepler gave us the tools to predict where the planets would be at some time in the future. Isaac Newton developed a model that accurately described the force that kept the planets in their places that was so good that NASA uses his tools, including calculus, to plot the courses of the spacecraft sent into interplanetary space. In 1968, Apollo 8 astronaut, William Anders, was asked how he was controlling the path of his spacecraft. He replied, "I think Isaac Newton is doing most of the driving now." Newton called this force, "gravity". In the $20^{\text {th }}$ century, a scientist called Albert Einstein defined gravity as not so much a force but as a warp in spacetime. Spacetime is a mathematical model that links the concepts of space and time. Any object that has mass causes spacetime to warp, or pucker around it.



If you were to draw a line that represents the shortest distance between the Earth and the Mariner 4 spacecraft that was sent to explore the planet Mars in 1969, it might look like the first diagram, right? Wrong! The Sun has enough mass to cause a pucker, or gravity well, in space. Because space-time is warped by the Sun, the shortest distance really looks like the second diagram.

Don't believe it? Scientists measured the time it took radio waves, traveling at the speed of light, to get from the Earth to Mariner 4 and back again. They knew the "unwarped" distance between Earth and Mariner 4, represented by the straight white line in the first diagram. So, they knew precisely how long it would take the radio signal to travel to Mariner 4 and back again. It took the signal exactly 204 microseconds longer to travel to Mariner 4 and back again than if the signal had traveled straight through unwarped space. The radio signal took a longer "detour" in and out of the Sun's gravity well.

Observations made with the new Webb Space Telescope have suggested that the combined mass of everything in the Universe has slowed time as we think we know it over the 13.8 billion light year distance to its origin.


## And that that which sings and contemplates in you is still dwelling within the bounds of that first moment which scattered the stars into space. Kahil Gibran, The Prophet

## Attractions in February

Astronomers use a measuring scale of angular distance to show the apparent distance that separates two objects in the sky. A trip all the way around the sky would take 360 degrees. Here's a handy guide to estimate angular distance that you can use when you're out under the stars.


For instance, when you hold your hand all the way out and hold three fingers out, like the scout's salute in panel 2 , your fingers create an angular distance of 5 degrees, about the width of the bowl of the Big Dipper. When I talk about the distance between, say, the Moon and a star or planet, I'll say that they are separated by a certain number of degrees. Sky and Telescope magazine is my source of most of the following information.

February 5-6 How far does the Moon travel in one day? Check out the Full Moon as it rises in the east on the 5th. On this evening, at about 9:30, notice the backward question mark (?) On the Moon's left. That's called the "sickle" of Leo and it represents the lion's mane.


Now look to the same sky on February 6. The Moon's orbit has carried about 13 degrees eastward to land it to the lower-left of Regulus, the brightest star in Leo.

February 6 While you're outside go get your binoculars or telescope and maybe you'll see a comet tonight! Faint Comet ZTF C/2022 E3 can be glimpsed just 1-1/2 degrees west of the bright star Capella, of the constellation Auriga. Below is a finder chart that shows the comet's path through the night sky through March. You will need binoculars or a small telescope.


Binocular Alert! Tonight offers another opportunity to see how much the Moon travels in one day. As soon as it gets dark on the $21^{\text {st }}$ go outside and look low in the west. You'll find the fingernail-thin crescent moon tucked in neatly below the planets Venus and Jupiter. At the same time the next night, you'll find the moon has nearly covered up (occulted) Jupiter. This should make a nice sight in binoculars or a small telescope! On the 22d, Jupiter is about 1 degree away from the Moon.


February 26 Lots to see tonight. First find the Moon sitting neatly between the two famous star cluster, the Hyades and the Pleiades and catch Jupiter and Venus, inching closer to each other, low in the west.


March 1 Binocular Alert! Check out Jupiter and Venus before they set before 8:00 to see them almost seem to touch! They will be separated by one degree (the width of your pinkie at arm's length).

