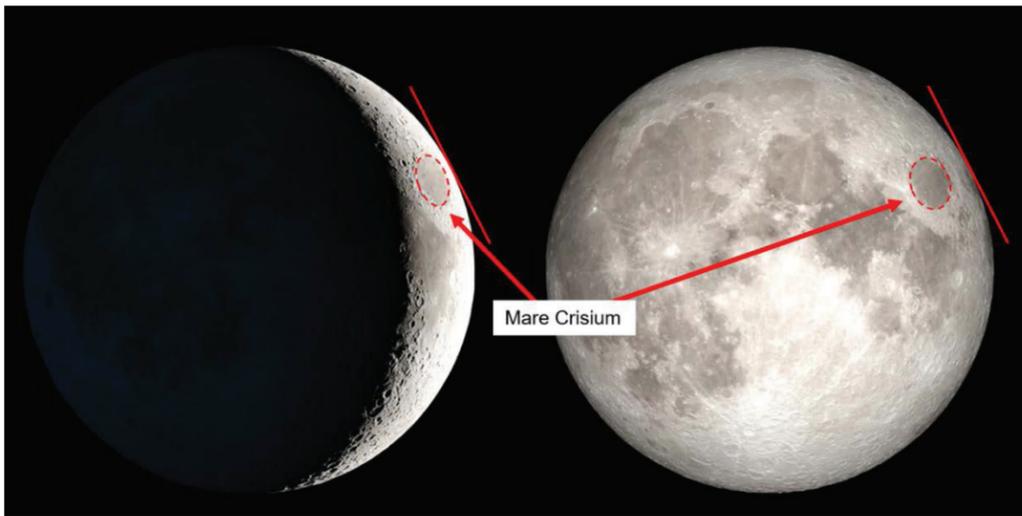


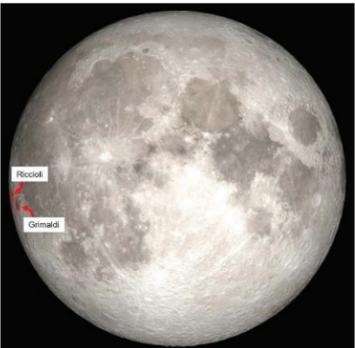
WHAT'S UP?

Happy Ides. No, not the Ides of March, but just, the *Ides*. Originally, the Ides marked the day of the Full Moon. The Romans, as they began to standardize their calendar, marked the Ides as the day in the middle each month. So, with the Full Moon occurring at 4:44 a.m. on Sunday – Happy Ides! Because the same side of the Moon always faces Earth, on Saturday night we'll be seeing the same ½ of the Moon that humans had ever seen prior to the Space Age. Or will we? It turns out that through some quirks of alignments and physics, from Earth we can actually see about 59% of the lunar surface. This is so because the Moon undergoes *libration* which results in an apparent wobbling. The Moon undergoes three librations. The Moon's orbit is tilted about 5 degrees from the ecliptic plane and its rotational axis is tilted an additional 1.5 degrees to the ecliptic. This 6.5-degree movement above and below the plane of Earth's orbit allows us to regularly see a bit beyond the north (when the Moon is below the ecliptic) and south (when the Moon is above the ecliptic) poles of the Moon. This is called a *libration in latitude*. The second libration, a *libration in longitude*, occurs because (as we know from Kepler's 1st and 3rd Laws) the shape of the Moon's orbit is an ellipse and it moves faster in its orbit when it is nearer to the Earth than when it is farther away. These factors contribute to our ability to see a bit "around the sides" of the Moon (about 7.5 degrees) over the course of its orbit. Finally, there is a minor (less than 1 degree) movement, the *diurnal libration*. This is the result of our changing viewpoint from the Earth as it rotates each day. Taken together, the librations mean that we can see an additional 9% of the Moon's surface than we would otherwise be able to see. An animation of the Moon's librations is found at



<https://svs.gsfc.nasa.gov/4768> (the background photos of the Moon used in this and in the last article are from this site.) As you get to know the Moon better and learn where to find Mare Crisium and the crater Tycho, you can use these to judge where in the range of the longitude and latitude librations the Moon is on any given night. The figure shows the changing distance of Mare Crisium from the edge of the visible part of the Moon over the first half of this lunar cycle. You can see for yourself, how we can see "around the back" at the Moon's eastern edge. Note also that the shape of the mare has changed from an ellipse to more of a circle as our viewing perspective has changed.

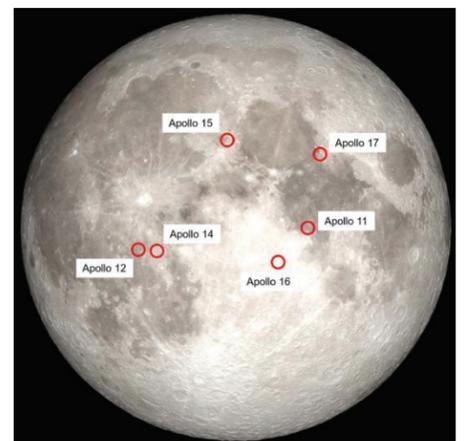
By Sunday night, you'll start to notice that the right-hand edge of the Moon has started to look different. It no longer forms part of a perfect circle. The Moon has entered one of its two *gibbous* phases. A gibbous moon is the shape when the Moon is between 1Q and Full and Full and 3Q. Be sure to take a good look at the rays from the craters Tycho and Copernicus again. They are in their full glory



at this part of the lunar cycle. While we mentioning craters, if you're using a telescope, look toward the very western edge of the Moon. There you will find the craters Grimaldi and Riccioli. They were the creators of an atlas that included most of the lunar feature names that we still use today (see Installment #22 for more information.) On Tuesday, using binoculars or a telescope, take another look at the Sea of Crises. As the sun begins to set on the mare, note the shadow being cast by the western edge of the sea. Hour-by-hour the length of the shadow will increase. Note where the shadow falls in relation to one of the craters in the sea and check back later in the night to see if the crater can still be seen. The Moon presents an ever-changing landscape to those who know what to look for! Thursday night, look again at the craters in the Eastern half of the Moon. Two weeks ago, I pointed out that along the terminator (the line dividing night

from day on the Moon) there were crater walls and mountain peaks lit by the Sun while the surrounding areas were still in darkness. Now, the same is true but it's the other sides of the crater rims and mountain peaks that are lit by the setting Sun.

Before I close, there are six lunar features I particularly want to note. Between the years of 1969 and 1972, six Apollo missions landed on the Moon. While we can't see them with even the most powerful telescopes on Earth or in Earth orbit, we can observe the spots at which they landed and try to imagine what the astronauts experienced when they were there. The six locations are marked on this picture of the Moon. The Lunar Reconnaissance Orbiter, a satellite orbiting the Moon, has been able to photograph the sites and the lunar module descent stages, flags, and equipment left behind can be identified. You can find the pictures at <https://svs.gsfc.nasa.gov/31052>. I think you will enjoy the images.



If you're enjoying this tour of the Moon and have young children in your lives, I think you will enjoy sharing *The Sun and the Moon* with them. Written by my wife, Carolyn Cinami DeCristofano, the book takes readers on a trip to explore these two places and contains hand-on activities to engage young readers. It is part of the HarperCollins *Let's Read and Find Out* series.

You can reach me at astroblog@comcast.net with any questions and comments you have. This is *What's Up?* Installment #24.

Until next time, Keep looking up!

Barry