Stargazing at Home
April 2020

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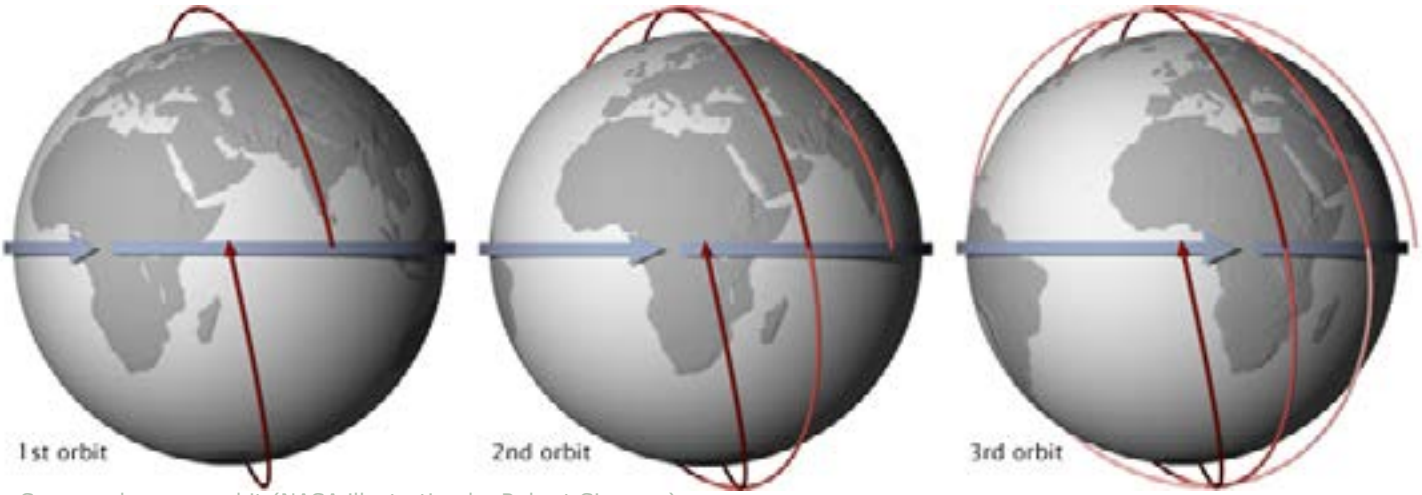
EARTH STUDYING SATELLITE

Every year April 22 is Earth Day, a time for humans to collectively think about how their actions affect the Earth. Earth Day also invites us to consider how we can impact change in action and policy to support a cleaner future for our home, and only, planet. This year is particularly special as it is the 50th anniversary of the first Earth Day. That inaugural Earth Day brought 20 million Americans, 10% of the population at that time, together to call for increased protections for our planet. The movement led to the creation of the clean air, clean water, and endangered species acts, and since 1970, April 22 has become a global celebration where people all over share innovative ways to help improve the human-Earth connection.

On December 18, 1999 NASA launched 'Terra,' the flagship satellite for the Earth Observing System (EOS) program. Terra is the Latin word for Earth. This program, consisting of many satellites, is designed to monitor and understand key components of Earth's climate system's and their interactions through long term observations.

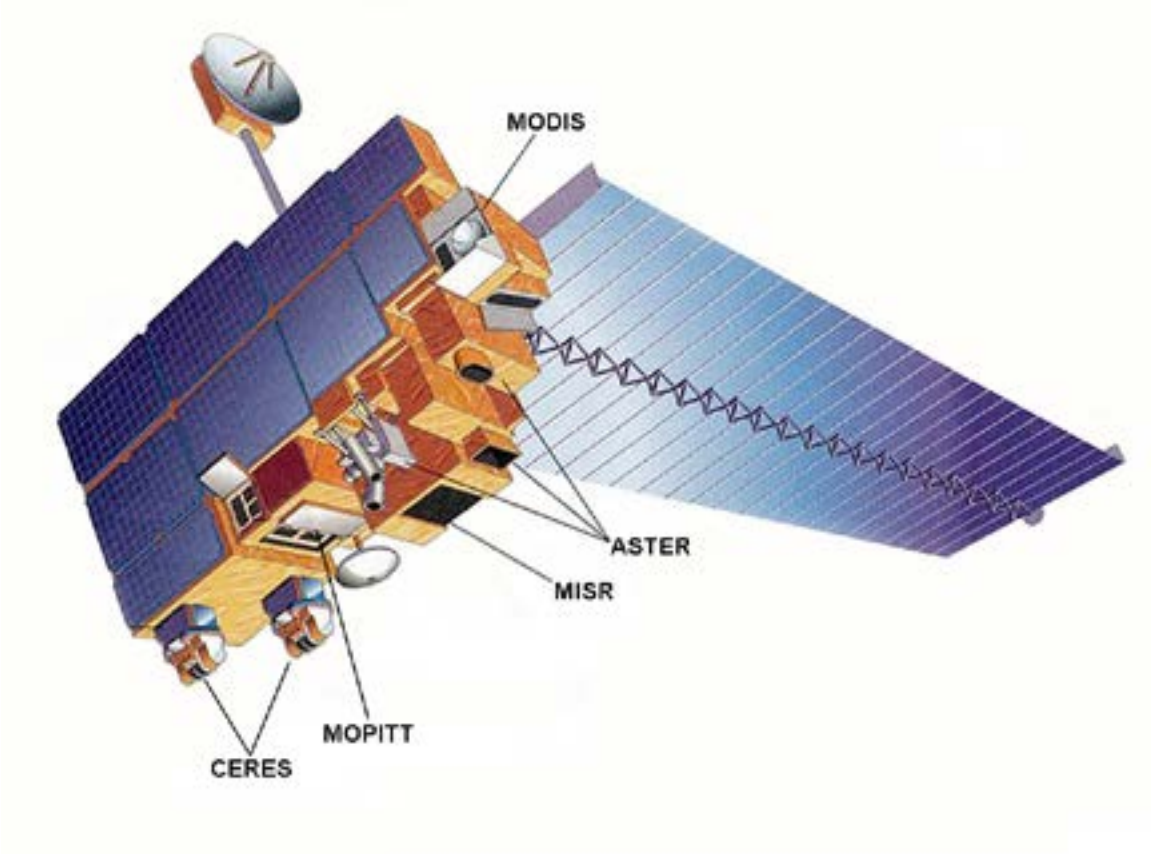
NASA EOS satellites (NASA)

Terra, about the size of a small bus, orbits about 440 miles above Earth, completing one orbit in just under 100 minutes. The orbit is a circular sun-synchronous polar orbit, meaning the satellite goes from pole to pole, spending half the time looking at the day side of the Earth, and half the time looking at the night side. As Terra comes back to the day side, the Earth has rotated just enough so that the satellite is now looking at a swath of area directly adjacent to what was captured on the previous pass. This allows Terra to collect data for the entire Earth in one 24-hour period.



Sun-synchronous orbit (NASA illustration by Robert Simmon)

Terra has five main instruments on board and truly embraces the international partnership that relates to the mission's global endeavors. The United States teamed up with Japan and Canada to build and manage the five instruments: ASTER, CERES, MISR, MOPITT, and MODIS.



Terra's five scientific instruments (NASA)

These instruments collectively study atmospheric composition, carbon cycle and ecosystems, climate variability and change, Earth's surface and interior, water and energy cycle, and weather. Each instrument looks at different wavelength bands of light allowing them to collect different data of the same area. ASTER studies land surface temperature, emissivity, reflectance, and elevation; CERES studies Earth's radiation budget (radiation in v. radiation out); MISR studies the amount of atmospheric aerosol particles; MOPITT studies carbon monoxide in the lower atmosphere and how it interacts with the land and ocean; MODIS studies a wider array of the Earth's vital signs including cloud cover, photosynthetic activity for land and ocean plants, and temperature measurements. These data sets are not just helping researchers and scientists to better understand our planet, but they are also helping us to monitor actions that affect us every day. The EPA, NOAA, FAA, US Forest Service, and the Department of Agriculture all use Terra's satellite data to keep track and monitor air quality, volcanic eruptions, fires, weather forecasts, agriculture, floods, and oil spills. In 2010, during the Deepwater Horizon Oil Spill, ASTER provided over 200 high-resolution images to help determine the impact to surrounding wetlands, MISR produced high-angle images to help differentiate between the oil spill and false sun glint areas, and MODIS provided bird's eye images of the site every two days. Because of Terra and similar Earth studying satellites, we can track and respond quicker to these natural disturbances, as well as monitor and better prepare for them in the future.

The importance of these types of satellites extends beyond the physical data sets. Terra gives us a global perspective of what is happening on Earth and how humans may or may not be affecting the planet. Terra, along with the International Space Station, help to provide us all with the ability to see global connections and how systems like the water cycle, carbon cycle, and biosphere all interact and change throughout the seasons, years, and decades. Witnessing cyclic changes and patterns over these longer timescales helps to show Earth as an evolving and dynamic place. By studying these data sets, we see these global systems, all working together, to continue to provide the Earth with what makes life possible. To explore MODIS datasets in more detail, click on the link below:

https://worldview.earthdata.nasa.gov/

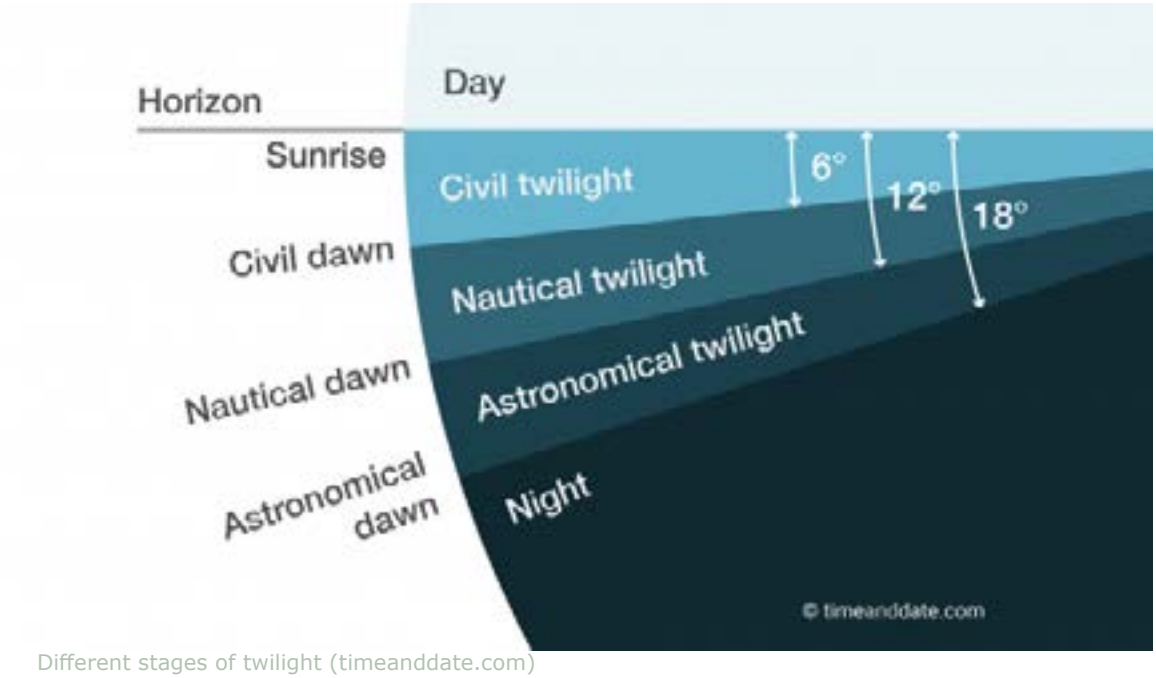
NIGHT SKY OBSERVATIONS

Although the nights are getting shorter and the sun is staying out longer, there are still some amazing night sky objects to try and spot. The first, Venus, has been visible for a few months now, but it continues to shine brightly, in the western sky, just after sunset. Known as Earth's sister planet,

Venus (NASA)

Venus is roughly the same size, distance from the sun, is composed of similar material, and contains an atmosphere. Once thought to be covered with swamps and life, Venus has become a clear example of an inhospitable world. With surface temperatures close to 900° F, and pressures almost 100 times that of Earth, spacecraft, let alone astronauts, would have a challenging time traversing its rugged terrain. Given our current understanding of the planet, it is curious why Venus was the first planet to have a spacecraft reach the surface (USSR Venera 3), land safely on the surface (USSR Venera 7), and take a picture from the surface (USSR Venera 9). Each of these milestones happened before similar Mars exploration milestones. One reason for focusing on Venus might have been the distance. At their closest points Venus is almost 17 million miles closer to the Earth than Mars. Given the early era of solar system robotic exploration, this distance was certainly taken into consideration.

The sun sets around 9:42pm on April 22, but it still takes a few more hours to get dark enough skies to see stars. Twilight occurs between day and night when there is light outside, even though the sun is below the horizon and has set. There are three levels of twilight, each defined by the degrees below the horizon the sun is located. Generally, during civil twilight there is usually enough light to continue outside recreation. During nautical twilight, both the horizon and brighter stars are visible. Finally, during astronomical twilight, most stars and celestial objects can be seen. After twilight, true night, is when the sky is darkest and best suited for stargazing. During the summer Anchorage loses more and more of these twilights, until close to the summer solstice when only civil twilight occurs. True night does not even return until August 25th!

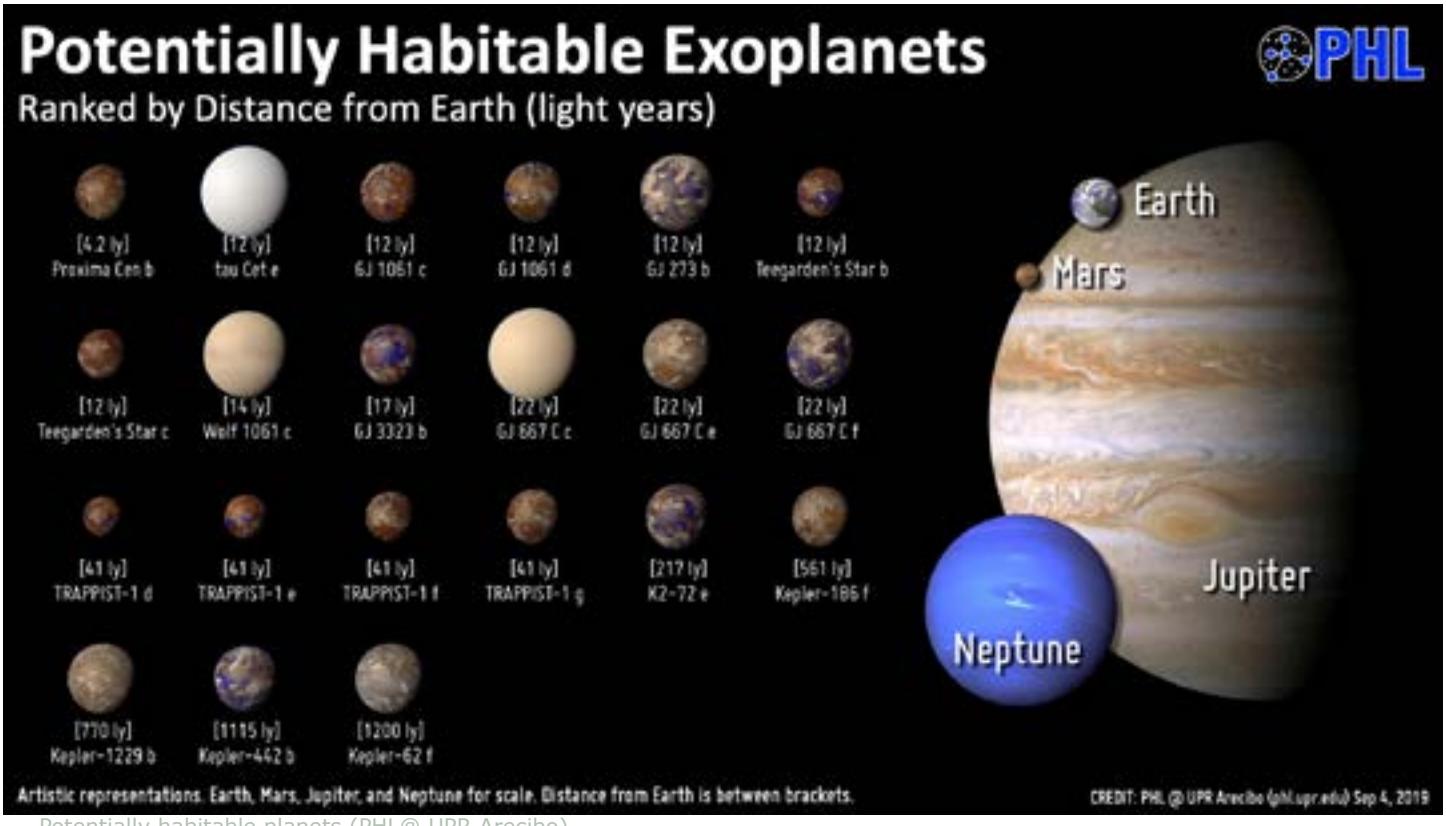


Different stages of twilight (timeanddate.com)

Luckily, right now we still have dark enough skies to see some amazing things. If you stay up long enough you can experience the peak of the Lyrids meteor shower. This meteor shower happens every April and peaks between April 16 - April 22, producing around 10-15 meteors per hour. The meteors look like they radiate from the constellation Lyra (radiant). At midnight tonight, Lyra is in the northeast and dominated by its brightest star Vega. Vega is about 30° above the horizon and continues rising higher throughout the night. Generally, the higher in the sky the radiant, the better for viewing meteor showers, however in Anchorage that does not always correlate with the darkest sky. By 5am Vega is around 60° above the horizon, but the sun is also starting to rise, drowning out visible meteors. A nice balance of these factors should be between 12am and 4am.

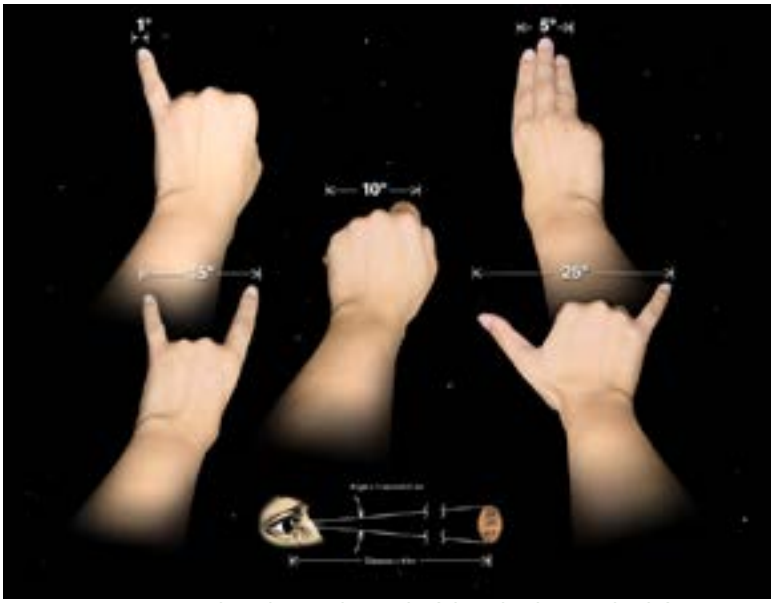
Lyrids meteor shower radiant (EarthSky.org)

In the same constellation of Lyra we find two Earth-like exoplanets, Kepler 442b and 62f. As of this writing NASA has discovered over 4,000 confirmed exoplanets (planets discovered orbiting stars outside of our own solar system), and according to the Planetary Habitability Laboratory at the University of Puerto Rico at Arecibo, 55 of them are potentially habitable; and 20 are terran, or Earth-sized. What makes an exoplanet potentially habitable? Both exoplanets orbit their host star at a distance where temperatures allow liquid water to exist. Exoplanets that are too close to their host stars are too hot for liquid water, and exoplanets too far from their stars are too cold. These two host stars are both smaller and cooler than the sun, which requires the planets to be closer to stay in the habitable zone, and therefore be potentially habitable. As the saying goes, these exoplanets are in the Goldilocks zone, where it is not too hot, and not too cold, but just right.



Potentially habitable planets (PHL@ UPR Arecibo)

Around 12:30am tomorrow, the Andromeda Galaxy is due north and about 12° above the horizon. You can refer to this chart to help you use your hands to measure the altitudes of objects in the sky. If you can find the Andromeda Galaxy, M31, you will be looking at an object that is 2.5 million light years away, meaning that light took 2.5 million years to reach your eyes. M31 is the only object outside of our own Milky Way galaxy that can be observed without the help of a telescope in the northern hemisphere. With the naked eye you will most likely just see a faint smudge, but with a telescope, it becomes an incredible collection of bright and colorful stars, spread out over a disk of glistening spiral arms.



Measuring star altitudes scale guide (chandra.harvard.edu)


Andromeda Galaxy (Robert Gendler)

If you are interested in more astronomy resources, check out our set of lesson plans about stars. In those lesson plans you can also find a 'How To' guide for using an online planetarium program called Stellarium. This is a free resource that allows you to turn your computer into a personal planetarium at home.