TEACHER BACKGROUND INFORMATION

(*Observing and Studying Space*)

A. YOUR EYES ONLY:

For thousands of years, humans have only observed objects in space with the use of the unaided eye. Early stargazers grouped visible stars into constellations and described the phases of the moon, as well as solar and lunar eclipses.

Constellations: Constellations are configurations of stars visible from Earth which appear to form shapes of animals, mythological figures, and other objects. All 88 recognized constellations are not visible from one place on Earth. Some constellations are visible only from the northern hemisphere and others are visible only from the southern hemispheres. Different constellations are visible as the Earth revolves around the sun and rotates on its axis. In the past, constellations were used largely for navigation. For example, in the northern hemisphere the constellation the Little Dipper contains the star Polaris (the North Star) which is located above the North Pole. Travelers wanting to locate north can look for the Little Dipper and easily find Polaris. (It is much easier to locate a constellation in the sky than a single, specific star.) Constellations are also useful for mapping where objects such as planets appear in the night sky.

Phases of the Moon: The moon generates no light of its own, but we can see it on Earth because it reflects light from the sun. Just like the Earth, one half of the moon is always lit by sunlight, but because the moon revolves around the Earth, the amount of the sunlit half visible to us varies. The changes in the amount of sunlit moon visible from Earth are called the **phases of the moon**. The eight phases of the moon as it revolves around

the Earth every 27.3 days are as follows: new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, last quarter, and waning crescent. Figure 4 illustrates the position of the moon, Earth, and sun in each phase, as well as the phase as it appears as from the Earth. (Note: The figure does not show what the moon looks like from space, because the moon is always half lit. A **blue moon** is when the moon is in its full moon phase for the second time in a given month.)

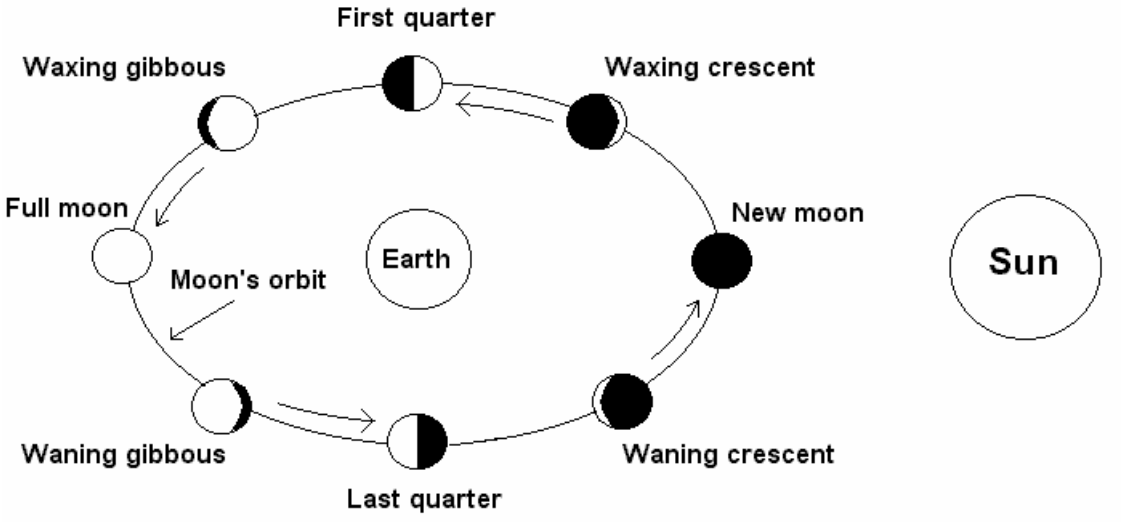

Figure 4: Phases of the Moon. (Note: Diagram is not to scale and depicts the phase you see from Earth, NOT the view from space.))

Eclipses: Eclipses occur when one object in space obscures (blocks the light from) another. A total eclipse occurs when the object is completely obscured, while a partial eclipse happens when only part of the object is obscured. The two most common eclipses visible from earth are solar and lunar eclipses. A **solar eclipse** takes place when the moon during its new moon phase moves directly between the Earth and the sun, causing the moon's shadow to fall on the Earth (see figure 5). Those people on Earth where the moon's shadow falls will not be able to see the sun for a few minutes. Because the moon's orbit is not in the same plane as the Earth's, the moon's shadow does not usually fall on the Earth, making solar eclipses

fairly rare. **Lunar eclipses** occur when the Earth is directly between the sun and the moon in its full moon phase. The shadow of the Earth falls on the moon, making the moon appear to be in its new moon phase for several hours (see figure 6).

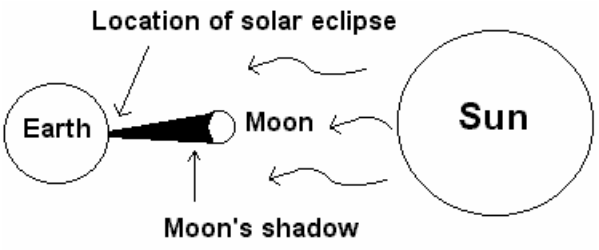

Figure 5: The positions of the sun, moon, and Earth during a solar eclipse. (Note: Figure is not to scale.)

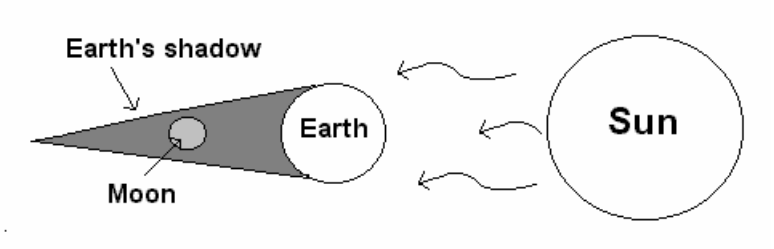

Figure 6: The positions of the sun, moon, and Earth during a lunar eclipse. (Note: Figure is not to scale.)

B. TELESCOPES:

Optical telescopes: Optical telescopes help gather and focus light from objects in space so that we may see them better. The two types of optical telescopes are refracting telescopes and reflecting telescopes. **Refracting telescopes** use lenses to collect and bend light to make objects appear larger. **Reflecting telescopes** use mirrors to reflect and gather light for enlarging images. Most optical telescopes used for research are reflecting telescopes because the lenses in refracting telescopes bend light, which tends to distort its color. One limitation of optical telescopes is that atmospheric conditions (such as rain or clouds) can interfere with the

transmission of light; however, placing these telescopes in space, instead of on Earth, alleviates this problem.

Radio telescopes: Radio telescopes are devices which collect and focus radio waves emitted from objects in space. Because radio waves are not affected by rain, sunlight, wind, or clouds, observations from radio telescopes are not weather dependent. By studying radio waves, scientists can learn about the structure, composition, and motion of distant celestial bodies. (Note: Radio waves have the longest wavelength of the electromagnetic spectrum.) X-rays and gamma rays are collected by **space telescopes**.

C. ARTIFICIAL SATELLITES AND SPACE PROBES:

Artificial satellites: Artificial satellites are any manufactured objects which orbit an entity in space. Artificial satellites include all space stations, telescopes, and other astronomical equipment with an orbit. Orbiting satellites are able to collect extensive amounts of data from the object they revolve around, making them invaluable sources of scientific information.

Space probes: Space probes are unmanned space craft which collect data from celestial bodies which are too far away or too dangerous for humans to visit yet. Probes can be designed to take pictures, run tests, collect samples, and perform a number of other functions to aid us in the understanding of the structure of our universe.

D. CREWED MISSIONS:

Crewed space missions allow for people to conduct experiments in space first hand. In addition, these missions give scientists an opportunity to repair satellites and other instruments in space, as well as launch new ones.

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