

## GLOSSARY:

**ALMA:** ALMA (the Atacama Large Millimeter/submillimeter Array) is one of the largest ground-based astronomy projects of the next decade and will be the major new facility for observations in the millimeter/submillimeter wavelength. It will enable transformational research into the physics of the cold Universe, probe the first stars and galaxies, and directly image the formation of planets. When completed, ALMA will be comprised of a giant array of sixty-six 12-meter antennas.

**Array:** Combining signals from several telescopes, they simultaneously receive from the same source, allowing astronomers to see more detail and thus more accurately pinpoint the source. This ability depends on a technique called radio interferometry. When signals from two or more telescopes are properly combined, the telescopes can effectively act as small pieces of a single huge telescope.

**Electromagnetic Radiation:** Energy in the form of transverse and electric waves - radio waves, ultraviolet, x-rays, infrared, visible light, and gamma rays.

**Electromagnetic Spectrum:** The entire range of electromagnetic radiation. At one end of the spectrum are gamma rays, which have the shortest wavelengths and high frequencies. At the other end are radio waves, which have the longest wavelengths and low frequencies. Visible light is near the center of the spectrum.

**Hubble Telescope:** A telescope launched into orbit around the earth in 1990 to provide information about the universe in the visible, infrared, and ultraviolet ranges.

**Interferometry:** 1. Optics: A device that separates a beam of light into two ray beams, usually by means of reflection, and that brings the rays together to produce interference, used to measure wavelength, index of refraction, and astronomical distances. 2. Astronomy: An instrument for measuring the angular separation of double stars or the diameter of giant stars by means of the interference phenomena of light emitted by these stars.



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# Show Me Science Advanced

## Astronomy

### Probing the First Stars & Galaxies

K4609DVD

*Advanced Teachers Guide*

## SYNOPSIS:

ALMA is the acronym for Atacama Large Millimeter/Sub-millimeter Array. The ALMA is a vast array of radio telescopes and the most powerful observatory of its kind. Alma will peer into previously hidden regions of space with unprecedented sharpness and sensitivity to give us extremely detailed pictures of the universe.

The Atacama Desert of northern Chile is one of the world's best sites for this telescope because of the high altitude, nearly non-existent cloud cover, dry air, and lack of light pollution as well as radio interference due to small surrounding populations.

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## CURRICULUM UNITS:

- Astronomy
  - Physics
  - Physical science
  - Space science
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## CAREER OPPORTUNITIES:

- Astronomer
- Astrophysicist
- Chemist
- Computer scientist
- Cosmologist
- Engineer
- Physicist

## PROGRAM OVERVIEW:

Visible light, which can be seen with our eyes, comprises a small sliver of the electromagnetic spectrum. The rest of the spectrum, from short wavelength gamma rays to long-wavelength radio waves, requires special instruments to detect. ALMA uses an array of radio telescopes to detect and study radio waves from space. Radio telescopes are typically large parabolic dish antennas used singly or in an array.

Radio observatories are preferentially located far from major centers of population to avoid electromagnetic interference (EMI) from radio, TV, radar, and other EMI emitting devices. This is similar to the locating of optical telescopes to avoid light pollution, with the difference being that radio observatories are often placed in valleys to further shield them from EMI as opposed to clear air mountain tops for optical observatories.

ALMA is an advanced tool for studying very old stars and galaxies. These objects now are seen at great cosmic distances, with most of their light stretched out to millimeter and sub-millimeter wavelengths by the expansion of the universe.

ALMA provides the unprecedented ability to study the processes of star and planet formation. Unimpeded by the dust that obscures visible-light observations, ALMA will be able to reveal the details of young, still-forming stars, and is expected to show young planets still in the process of developing. In addition, ALMA will

## ISSUES & CRITICAL THINKING:

1. Compare and contrast the Hubble Space Telescope and the ALMA Telescope.
2. Compare and contrast the Very Large Telescope (VLT) and the ALMA Telescope.
3. Discuss with students how radio telescopes work