What's Happening IN THE WORLD?

BY LAWRENCE GABLE *VOL 11, NO 5 JANUARY 2011*

Humans always have looked at the night sky and wondered what is out there. Astronomers are still trying to learn about the origins of the universe, and they still wonder about whether Earth is the only planet with life on it. Now new equipment is giving them completely new views of what is in space.

In recent years astronomers have found new planets. Only twenty years ago they did not know whether planets existed outside our Solar System. That has changed dramatically. In 2010 alone they discovered more than 100 of these extrasolar planets that orbit their own stars. That brings the total to 516, and astronomers think they probably have found hundreds more.

Astronomers pay special interest to planets that resemble Earth. Our galaxy, the Milky Way, has about 200 billion sun-like stars. There must be billions of Earth-sized planets orbiting at a distance that supports life. Scientists call that distance a habitable zone. They also call it the "Goldilocks" zone, because it is neither too hot nor too cold, neither too large nor too small. Above all, it means that liquid water could be on the planet's surface.

In 2010 astronomers who use the Keck I Telescope in Hawaii announced that they had found such a planet. They call it Gliese 581 g. It is invisible, but astronomers know that it exists because they have studied light from its star. As planets orbit, they block some of the light from their stars at regular intervals. Astronomers can detect those changes and calculate a planet's size and distance from its star.

The National Aeronautics and Space Administration (NASA) has a planet-hunting space telescope named Kepler. NASA launched the spacecraft early in 2009 to look for planets in habitable zones. In 2010 the small telescope sent back its first discoveries of a few new planets. NASA believes that Kepler may find hundreds more before its mission ends late in 2012.

One big problem is that astronomers must share viewing time at an observatory with other astronomers. They may get only twenty nights per year. The Lick Observatory in San Jose, California, has solved that problem. Its Automated Planet Finder telescope operates robotically every clear night of the year and studies light from stars. If the light wobbles, it means that the star has a planet.

Construction of the world's largest land-based astronomy facility, ALMA, is going on now 16,500 feet high in the Andes Mountains in Chile. It is one of the best places in the world to look at the sky because there is no pollution or light from cities. ALMA is the product of an international partnership of Europe, North America and East Asia.

Astronomers at ALMA are using a revolutionary radio telescope to observe tiny light waves. The light comes from some of the coldest, oldest and most distant places in the universe where gas and dust combine to form new stars and planets. ALMA will generate images of the earliest galaxies as they were more than 10 billion years ago. They may give astronomers some understanding of the origin of life itself.

ALMA will make its first observations in 2011. It will begin with sixteen 40-foot-diameter antennas, but in two years it will have 66 antennas. They will spread for ten miles across the landscape, but function as one giant telescope. It will give astronomers images that are ten times clearer than images from the Hubble Space Telescope that now orbits Earth.

An international partnership also operates the Gemini Observatory. It has telescopes in two locations, one in Chile and one in Hawaii. Together they give astronomers access to the entire sky. In 2011 the location in Chile also will add the new Gemini Planet Imager, which will provide images of large extrasolar gas planets.

Astronomers now are getting equipment that not long ago they only could dream about. They are finding and studying fainter objects than ever before. They are also discovering planets that could have life. Although complete answers may not come quickly, the old questions no longer seem so impossibly hard.

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Humans always have wondered what is in the night sky. Astronomers are still trying to learn about the origins of the universe. They also still ask whether Earth is the only planet with life on it. Now new equipment is giving them completely new views of space.

Only twenty years ago astronomers did not know whether planets existed outside our Solar System. That has changed. In 2010 alone they discovered more than 100 planets that orbit their own stars. That brings the total to 516.

Astronomers are especially interested in planets like Earth. Our galaxy, the Milky Way, has about 200 billion sun-like stars. Billions of Earth-sized planets orbit them at a distance that supports life. Scientists call that distance the "Goldilocks" zone, because it is neither too hot nor too cold. That means that liquid water could be on the planet's surface.

In 2010 astronomers who use the Keck I Telescope in Hawaii reported such a planet. They call it Gliese 581 g. It is invisible, but astronomers know that it exists because they have studied light from its star. As planets orbit, they regularly block some of the light from their stars. Astronomers use those changes to calculate a planet's size and distance from its star.

The National Aeronautics and Space Administration (NASA) has a planet-hunting space telescope named Kepler. NASA launched the spacecraft early in 2009 to look for planets in Goldilocks zones. In 2010 the small telescope sent back its first discoveries of a few new planets.

Mostly astronomers do not get enough viewing time at an observatory. The Lick Observatory in San Jose, California, has solved that problem. Its Automated Planet Finder telescope operates robotically every clear night of the year and studies light from stars. If the light wobbles, it means that the star has a planet.

Construction of the world's largest astronomy facility, ALMA, is going on now in the Andes Mountains in Chile. It is a great place to look at the sky because there is no light from cities. ALMA is the product of an international partnership of Europe, North America and East Asia.

Astronomers at ALMA are using a new radio telescope to observe tiny light waves. The light comes from some of the most distant places in the universe. It is where gas and dust form new stars and planets. ALMA will produce clear images of the earliest galaxies from more than 10 billion years ago. They may even help astronomers understand the origin of life.

ALMA will make its first observations in 2011. Now it has sixteen 40-foot-diameter antennas, but soon it will have 66 antennas. They will spread for ten miles across the landscape, but act as one giant telescope.

An international partnership also operates the Gemini Observatory. It has one telescope in Chile and another in Hawaii. Together they show astronomers the entire sky. In 2011 it also will add the new Gemini Planet Imager, which will provide images of large gas planets.

Astronomers now are getting equipment that not long ago they only could dream about. They are studying more distant objects than ever before and discovering planets that could have life. Full answers may not come quickly, but the old questions no longer seem so impossibly hard.

Background Information

In 1992 astronomers first began finding planets that orbit other stars. Now such planets are called either "extrasolar planets" or "exoplanets."

2009 was the International Year of Astronomy, when people celebrated the 400th anniversary of the first use of a telescope by Galileo Galilei.

Gliese 581 g gets its name from the German astronomer, Wilhelm Gliese, who discovered the planet's star. The planet is relatively close to Earth, only 20 light-years away. It is probably no more than 1.5 times Earth's diameter and four times Earth's mass. One of the astronomers who discovered the planet said, "It's pretty hard to imagine that water wouldn't be there."

ALMA stands for "Atacama Large Millimeter/submillimeter Array." Atacama is the name of the desert in the Andes where the array of antennas stands, 800 miles north of the capital, Santiago.

ALMA has two sites in the mountains. The "high site" is at 16,500 feet where the antennas stand. Working there is difficult because the air contains only half as much oxygen as at sea level. ALMA allows employees to stay at the high site for a maximum of 8 hours at a time. The "low site" is at 10,000 feet. Employees live and work there. It includes housing for 500 people, a power station, cantina, cinema and medical clinic. Technicians will operate the antennas from there.

ALMA's antennas each weigh about 100 tons. The high site will have about 200 pads for the 66 antennas. Two huge transporters will reposition them on different pads for different observations.

Gemini was built and is operated by a partnership of seven countries including the United States, United Kingdom, Canada, Chile, Australia, Brazil and Argentina.

The Space Shuttle took the Hubble Space Telescope into orbit in 1990. It will function until at least 2014, when NASA replaces it with the James Webb Space Telescope. It will be 100 times more powerful than Hubble.

The Giant Magellan Telescope will be the next major astronomy facility. It will come from a partnership among the Carnegie Institution of Washington, Harvard University, Massachusetts Institute of Technology and others. It also will be in the Andes Mountains, and will be ready in 2016. It too will provide images of extrasolar planets.

Topics for Discussion and Writing

Pre-reading:

- Give a general description of how our Solar System is organized.

Comprehension:

- Describe the new ALMA astronomy facility.

Beyond the Text:

- How do you think it would affect humans if they learned that life existed on other planets?
- Name some things that humans can see easily in the night sky without a telescope.
- What observatory is closest to where you live? If you have been there, describe your experience there.

Vocabulary (*advanced article only)

Article-specific: origin; universe; Solar System; galaxy; habitable*; Goldilocks; invisible; mission*; observatory; robotically; to wobble; antenna; faint*

High-use: astronomer; equipment; to resemble*; interval*; to detect*; to launch; facility; pollution*; to generate*; image; diameter; to function*; access*

Sources

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Popular Science December 1, 2010

Tulsa World November 21, 2010

Times-Tribune (Scranton, PA) November 14, 2010

Los Angeles Times October 29, 2010

Boston Globe October 2, 2010

San Francisco Chronicle August 21, 2010

ALMA **www.almaobservatory.org**

Gemini Observatory **www.gemini.edu**

CA Curricular Standards (4–12)

English-Language Arts

Reading 1.0 Vocabulary Development
2.0 Comprehension (Informational Materials)

Writing 1.0 Writing Strategies
2.0 Writing Applications

ELD—*Intermediate and Advanced*
Reading Vocabulary Development/Comprehension
Writing Strategies and Applications
Listening and Speaking

Science
4.5; 6.2; 7.4
Ecology

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