

*Bonus Activity*

# What Goes On at the Observatories?

## ● ● ● In Advance *Student Internet Research Assignment*

- Assign Student Page “Surf the Net to Research the Haleakalā Observatories” (pp. 36-38) and Student Page “Research Instructions and Questions” (pp. 39-40) as homework.

## ● ● ● Class Period One *Learning From Each Other’s Research*

### Instructions

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- 1) Ask one student to give a brief report on his or her research, then invite other students who researched the same facility to add details. Continue until you have covered all of the facilities. If there is time left at the end of class, begin a class discussion using the journal ideas listed below.

### Journal Ideas

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- Does knowing more about the research and work that is performed at the Haleakalā Observatories change your opinion about the proposal to relocate the broadcast facility to another location where radio frequency interference will not be a problem? Explain your response.
- Think of other ways that people might have understood or explained the phenomena being studied at the Haleakalā Observatories without the benefit of scientific inquiry and the instrumentation housed in the observatories. Describe one or more of these different ways of understanding the world.
- Describe at least one way in which you think the work being done at the Haleakalā Observatories will (or does) benefit people.

### Assessment Tools

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- Student Page “Research Instructions and Questions”
- Participation in class discussion
- Journal entries



# Surf the Net to Research the Haleakalā Observatories

You've heard of "Science City," haven't you? It's the collection of observatories and other research facilities that sit clustered together near the summit of Haleakalā. Many people call it "Science City," but the scientists who work there prefer to use another name: "Haleakalā Observatories." This more official and respectable name is also an accurate reflection of what goes on in this group of white and metallic domes and a scattering of other buildings.

"What DOES happen up there?" you might ask. You are going to find out by doing your own research on the Internet. Most of the research facilities have excellent websites that can help you learn about what goes on behind the sign that says, "Authorized Access Only."

The Haleakalā High Altitude Observatory Site is—you guessed it—home of the Haleakalā Observatories. It is just downhill from the *Pu'u'ula'ula* (Red Hill) Overlook near the mountain's summit. The 18-acre site was given to the University of Hawai'i by the State in 1961. This land must be used for observatory purposes only or it must be given back to the State.

Since 1961, several facilities have been built on this site to study and track all kinds of things having to do with the sun and moon, the earth's atmosphere, satellites, and other objects traveling through space.

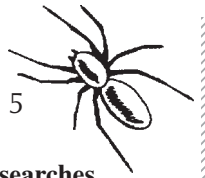
## Your Assignment

From the following listing of the observatories on Haleakalā, you will select one or more to research on the Internet. In addition to the observatories listed, there are other facilities proposed or being built at Haleakalā Observatories, some of which are mentioned on the Haleakalā Obser-

vatories website at <[www.ifa.hawaii.edu/haleakala](http://www.ifa.hawaii.edu/haleakala)>. (These include the Faulkes telescope, Solar C telescope, and MAGNUM project.) As progress continues toward making these facilities operational, there is likely to be more information available about them on line and they could make interesting Internet research projects as well.

## Other Internet Resources

- Personal web pages of researchers. Some of the observatory websites have links to researchers' web pages that describe the research they are doing.
- Glossary of terms related to the sun and solar research at <[solar-center.stanford.edu/gloss.html](http://solar-center.stanford.edu/gloss.html)> or <[www.hao.ucar.edu/public/education/glossary.html](http://www.hao.ucar.edu/public/education/glossary.html)>.
- "Ask a Solar Physicist," where students can direct solar questions to the staff of the Stanford University Solar Center, <[solar-center.stanford.edu/ask-solar/asksolar.html](http://solar-center.stanford.edu/ask-solar/asksolar.html)>.
- Educational materials on solar physics, National Solar Observatory, <[www.sunspot.nao.edu/](http://www.sunspot.nao.edu/)>.
- Government departments that collect and archive data from heliospheric projects. Each has a website: National Space Science Data Center (NSSDC), National Oceanic and Atmospheric Administration (NOAA), and World Data Center (WDC).



Facility name and website	Brief description of research	Related websites	Keywords for searches
<p><b>Air Force Maui Space Surveillance Complex (MSSC) at</b> &lt;ulua.mhpcc.af.mil&gt;</p>	<p>Space surveillance activities are conducted here for the U.S. Department of Defense.</p>	<p>Air Force Research Laboratory home page, which provides more information about the Maui Space Surveillance Complex at &lt;ulua.mhpcc.af.mil/amos.html&gt;</p> <p>Overview of space surveillance at &lt;www.spacecom.af.mil/usspace/space.htm&gt;</p>	<p>-Adaptive optics -Air turbulence -Space surveillance</p>
<p><b>Cosmic Ray Neutron Monitor Station at</b> &lt;ulysses.uchicago.edu/NeutronMonitor/neutron_mon.html&gt;</p>	<p>A neutron monitor detects incoming energy from cosmic rays emanating from sources including solar flares.</p>	<p>“Listening for Cosmic Rays,” an overview of cosmic rays, their significance, and how they are detected at &lt;www.bartol.udel.edu/~neutronm/listen/main.html&gt;</p> <p>Overview of cosmic rays and how they are monitored at &lt;www.ngdc.noaa.gov/stp/SOLAR/COSMIC_RAYS/cosmic.html&gt;</p> <p>Neutron monitor information, links, and general solar weather information, Solar-Terrestrial Division of the Izmiran Institute (Russia) at &lt;helios.izmiran.rssi.ru/cosray/main.htm&gt;</p>	<p>About the kinds of observations done at the monitor station: -Cosmic rays -Particle astrophysics -Air showers -Space weather</p> <p>Why scientists measure cosmic rays: -Stellar nucleosynthesis -Diffuse gamma-ray emission -Anti-particles</p> <p>Techniques for studying cosmic rays from the ground: -Neutron monitors -CASA/MIA -Fly’s eye</p> <p>Spacecraft with instruments that measure cosmic ray intensity and related conditions in space. Each has a website: -Ulysses -Voyager -ACE -IMP-8 -SMAPEX -WIND -POLAR -GEOTAIL</p>



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<p><b>Lunar and Satellite Ranging (LURE) Observatory at</b> &lt;koa.ifa.hawaii.edu/Lure/&gt;</p>	<p>Laser equipment is used to track the distance between the earth and the moon and to track satellites.</p>	<p>A brief history of laser (lunar) ranging at &lt;almagest.as.utexas.edu/~rlr/history.html&gt;</p> <p>An introduction to lunar laser ranging at &lt;wwwrc.obs-azur.fr/cerga/laser/laslune/englishintro.htm&gt;</p> <p>Article on lunar laser ranging written to commemorate the 30<sup>th</sup> anniversary of the Apollo 11 mission at &lt;www.xs4all.nl/~carlkop/ap11.html&gt;</p>	<p>-Satellite laser ranging -Lunar laser ranging</p>
<p><b>Mees Solar Observatory at</b> &lt;koa.ifa.hawaii.edu&gt; and &lt;www.ifa.hawaii.edu/research&gt;</p>	<p>Optical instrumentation housed here is used to observe the sun. Research topics include solar flares, magnetic fields on the sun, and solar oscillations.</p>	<p><i>A Primer on the Space Environment</i>, with basic information about solar phenomena and their relationship to earth at &lt;sec.noaa.gov/primer/primer.html&gt;</p> <p>SpaceWeather.com, a Nasa site with daily updates of sunspots, solar flares, near Earth asteroids, aurora, meteor showers; streaming video, text, at &lt;http://spaceweather.com/&gt;</p> <p><i>Space Weather Today</i>, with information about the earth/sun relationship and how solar phenomena affect earth at &lt;windows.engin.umich.edu/spaceweather/&gt;</p> <p>Overview of “helioseismology,” the study of wave oscillations in the sun at &lt;soi.stanford.edu/results/heliowhat.html&gt; or &lt;helios.tuc.noao.edu/helioseismology.html&gt;</p>	<p>-Solar flares -Solar oscillations (or low frequency solar oscillations) -Solar cycle -Solar physics -Helioseismology -Precision solar photometry (or PSPT)</p>





3. Pick one kind of research or work that happens at this observatory. What do scientists hope to learn? How do they apply, or hope to apply, what they learn?

4. List one interesting fact that you learned about this observatory or the research that is done there.

5. List two questions you have about this research.