

## The Planet Hunters



Watch it online at <http://www.kqed.org/quest/television/view/502> | TV story length 8.52 minutes  
Listen online at <http://www.kqed.org/quest/radio/exoplanets> | Radio story length 5.45 minutes

### QUEST SUBJECTS

**Life Science**  
Biology  
Health  
Environment

**Earth Science**  
Geology  
Weather  
Astronomy

**Physical Science**  
Physics  
Chemistry  
Engineering

### CA SCIENCE STANDARDS

#### Grades 9-12

##### *Earth's Place in the Universe*

1. Astronomy and planetary exploration reveal the solar system's structure, scale and change over time. (a,g)

2. Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies and the universe over time. (a, b, d)

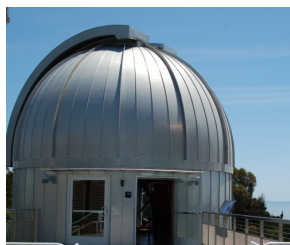
### PROGRAM NOTES

#### Watch **The Planet Hunters**

Do other planets like Earth exist? To find out, a team of astronomers from the University of California is building a new telescope in the hills east of San Jose. QUEST finds out what the chances are that there are others like ours somewhere in the cosmos.

#### Listen to **Exoplanets**

Since 1995, astronomers have identified more than 200 new planets, but these planets aren't in our solar system. Known as exoplanets, they're the planets orbiting other suns and Bay Area scientists are leading the search. QUEST reports on some of the latest efforts to find new planets - and maybe life - in outer space.



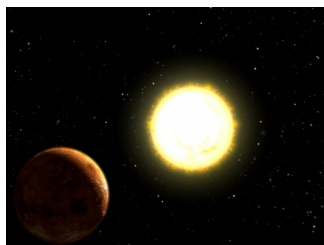
In this segment you'll find...

- ⦿ how scientists use the Doppler technique to discover extra-solar planets.
- ⦿ why astronomers find it difficult to discover Earth-sized extra-solar planets.
- ⦿ the role played by astronomers in the Bay Area in extra-solar planet research.

### TOPIC BACKGROUND

Are we alone in the universe? Do planets like our own exist outside of our solar system? Astronomers are currently finding the answers to these and a host of other questions as they discover planets circling distant stars. These planets, called extra-solar planets or "exoplanets," are creating a buzz in astronomy circles around the world as the search for planets similar to Earth begins in earnest.

The first exoplanets were discovered in 1995 by Swiss astronomers. Since that time, scientists around the world have discovered approximately 250 exoplanets circling stars in other planetary systems.



Scientists observe the light emitted by stars for clues on a planet's existence. Simply put, stars are balls of gas (primarily hydrogen and helium) that give off heat and light. The light emitted from stars can be broken down into its composite colors by an instrument called a spectrograph. Scientists, using the spectrograph and a method known as the Doppler technique, look for "wobbles," or changes in the color (wavelength) of the star's light that are caused by the gravitational pull of a planet on the star. A change in the light's color (wavelength) indicates the presence of a planet orbiting that star.

The first exoplanets discovered were big -- the size of Jupiter or Saturn. Now, scientists are most interested in finding planets the size of Earth. Such a planet is far more difficult to find because it is so much smaller. To help astronomers find these planets, NASA Ames is developing the Kepler, a new satellite telescope designed to look for Earth-like exoplanets. The Kepler satellite's large telescope will be able to look at 10,000 stars at a time, speeding the process of discovery.

## Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

## Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

## PRE-VIEWING

- Do planets exist outside our solar system?
- What evidence is there to support the fact that planets may exist outside our solar system?
- What tools do astronomers use to find planets outside our solar system?

## VIEWING FOCUS

NOTE: You may choose to watch the television and radio segments twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- How many known planets outside our solar system have been discovered?
- When was the first exoplanet discovered?
- Why is hunting for other planets so difficult?
- What happens to a star when there's a planet circling it?
- What technique do scientists use to detect planets?
- What is a spectrograph? What does it do?
- What roles do Chabot Space and Science Center and Lick Observatory play in planet hunting?

## POST-VIEWING – Links to activities mentioned here can be found on the following page.

- **Review** students' answers to the Viewing Focus Questions.
- **Design** a habitable world outside our own by visiting the AstroVenture Web site.
- **Model** a planet crossing in front of a star on the Kepler Web site.
- **Investigate** "wobble"
- **Explore** how Kepler discovers planets <http://kepler.nasa.gov/media/KEPLER.SWF>

*I think it's in our genes that we look up at the night skies ...and in so exploring, perhaps we will learn a little bit more about where we came from, why we humans live our lives, and where our roots are here on the Earth.*

- Dr. Geoff Marcy

## LESSON PLANS / ACTIVITIES



### Kepler Education and Public Outreach Programs NASA

<http://kepler.nasa.gov/ed/epo-chart.html>

- Here you'll find a multitude of resources for grades 1-12, as well as informal education related to the Kepler Mission: A Search for Habitable Planets. Many of the resources were developed by the Lawrence Hall of Science.

### Student Activities Guide, Planet Quest: The Search of Another Earth NASA

[http://planetquest.jpl.nasa.gov/resources/pq\\_activity\\_guide.pdf](http://planetquest.jpl.nasa.gov/resources/pq_activity_guide.pdf)

- The "Looking for Planets without Seeing Them" activity gives students hands-on experience investigating "wobble."

### AstroVenture NASA

<http://astroventure.arc.nasa.gov/>

- Students investigate what makes Earth habitable, then search for and design a habitable planet that is different from Earth.

### A Whole New World New York Times Learning Network

<http://www.nytimes.com/learning/teachers/lessons/19991116tuesday.html>

- Students explore the existence of extra-solar planets through the investigation of direct scientific evidence.

## WEB SITES

### The Extrasolar Planets Encyclopedia

<http://exoplanet.eu/>

- A Web site that provides a catalog of information about extra-solar planets, including a tutorial, "Search for Planets"

### California & Carnegie Planet Search

<http://www.exoplanets.org>






- This site contains information and current research on extra-solar planets.

Look for the



indicating resources from QUEST partner organizations

# QUEST QUAD

<b>FIELD NOTES</b> 	<b>FIELD TRIP</b> 
<p><b>Go outside and ...</b></p> <ul style="list-style-type: none"><li>📍 Identify the constellation Cygnus<ul style="list-style-type: none"><li>This constellation is where astronomers have found evidence of an extra-solar planetary system.</li></ul></li></ul>	<p><b>Visit ...</b></p> <ul style="list-style-type: none"><li>📍 Chabot Space and Science Center  10000 Skyline Blvd., Oakland 94619 <a href="http://www.chabotspace.org">www.chabotspace.org</a><ul style="list-style-type: none"><li>Ask an astronomer questions you may have about exoplanets or what it's like to be a planet hunter.</li><li>View planets during Chabot's free telescope viewing times on Friday and Saturday evenings (check website for details)</li></ul></li><li>📍 American Museum of Natural History<ul style="list-style-type: none"><li>Take a virtual field trip to the Exoplanets and the Search for Life exhibits. <a href="http://www.amnh.org/exhibitions/exoplanets/">http://www.amnh.org/exhibitions/exoplanets/</a></li></ul></li></ul>
<b>FIELD RESEARCH</b> 	<b>FIELD TEST</b> 
<p><b>Find out more about...</b></p> <ul style="list-style-type: none"><li>📍 Lick Observatory and the work scientists are doing there with exoplanets</li><li>📍 The Doppler effect<ul style="list-style-type: none"><li>Why do forecasters use it in their weather reports?</li></ul></li></ul>	<p><b>Experiment with...</b></p> <ul style="list-style-type: none"><li>📍 Looking at the planets of our solar system through a telescope or pair of binoculars</li><li>📍 Building your own spectroscope to see what colors make up white light <a href="http://www.cs.cmu.edu/~zhuxj/astro/html/spectrometer.html">www.cs.cmu.edu/~zhuxj/astro/html/spectrometer.html</a></li></ul>

## VISIT OUR PARTNERS

The Bay Institute  
[www.bay.org](http://www.bay.org)

California Academy of Sciences  
[www.calacademy.org](http://www.calacademy.org)

Chabot Space and Science Center  
[www.chabotspace.org](http://www.chabotspace.org)

East Bay Regional Park District  
[www.ebparks.org](http://www.ebparks.org)

Exploratorium  
[www.exploratorium.edu](http://www.exploratorium.edu)

Girl Scouts of Northern California  
[www.girlscoutsbayarea.org](http://www.girlscoutsbayarea.org)

Golden Gate National Parks Conservancy  
[www.parksconservancy.org](http://www.parksconservancy.org)

The J. David Gladstone Institutes  
[www.gladstone.ucsf.edu](http://www.gladstone.ucsf.edu)

Lawrence Berkeley National Laboratory  
[www.lbl.gov](http://www.lbl.gov)

Lawrence Hall of Science  
[www.lawrencehallofscience.org](http://www.lawrencehallofscience.org)

Monterey Bay Aquarium  
[www.mbayaq.org](http://www.mbayaq.org)

Monterey Bay Aquarium Research Institute  
[www.mbari.org](http://www.mbari.org)

Oakland Zoo  
[www.oaklandzoo.org](http://www.oaklandzoo.org)

The Tech Museum of Innovation  
[www.thetech.org](http://www.thetech.org)

UC Berkeley Natural History Museums  
<http://bnhm.berkeley.edu/>

U.S. Geological Survey  
[www.usgs.gov](http://www.usgs.gov)

## OTHER WAYS TO PARTICIPATE IN QUEST



### LOG ON

[www.kqed.org/quest](http://www.kqed.org/quest)



### LISTEN

**KQED 88.5 FM San Francisco &  
89.3 FM Sacramento  
Mondays at 6:30am and 8:30am**



### WATCH

**KQED Channel 9  
Tuesdays at 7:30pm**

## IMAGE CREDITS

**Chabot Space and Science Center;** Chris Bauer

**Planet orbiting a star;** NASA