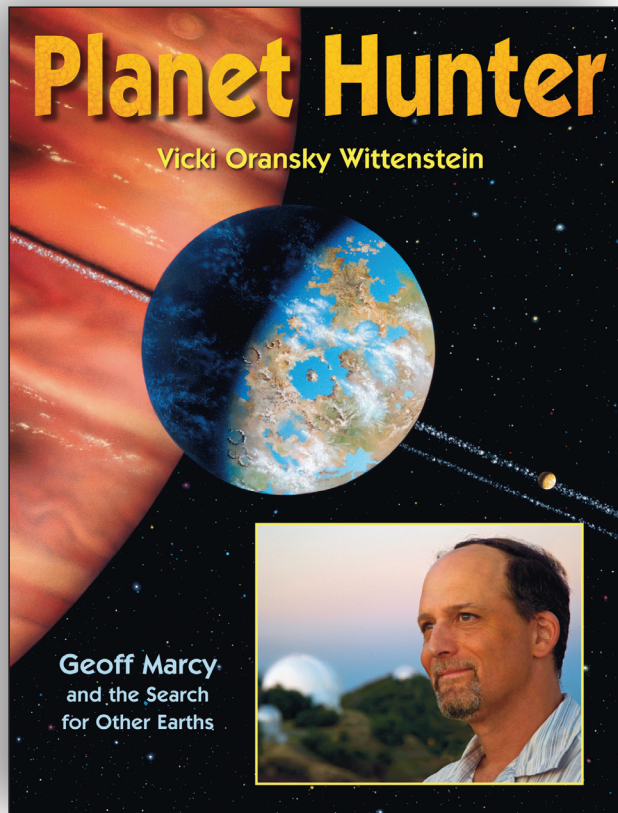


Planet Hunter

Geoff Marcy and the Search
for Other Earths

By Vicki Oransky Wittenstein



GEOFF MARCY HAS DISCOVERED more planets than anyone else in history. When he was a boy, he spent hours looking at the night sky wondering what might be out there, orbiting faraway stars. Were there planets that could support life? As an adult, Marcy became an astronomer. Since 1995, he and fellow astronomer Paul Butler have discovered nearly half of the more than 400 known “extrasolar” planets.

This compelling book tells the story of how Dr. Marcy and other astronomers like him are discovering more extrasolar planets every year. In clear, easy-to-understand language, *Planet Hunter* shares the techniques these scientists employ to discover strange, new worlds outside our solar system that just might harbor life.

Discussion Topics

1. Astronomer Geoff Marcy faced many challenges in his pursuit of a career as a scientist—from his early difficulties in math to criticism from his fellow scientists. He never thought he was smart enough in school or when he first became an astronomer. Marcy persevered through the trials to realize his dream of becoming a planet hunter. How did he overcome these challenges? How are Marcy’s efforts like the goals of other explorers, inventors, and scientists?

2. Discuss how the discovery of extrasolar planets affects what we believe about life on other planets. Do you think there is intelligent life on other worlds? Why or why not? With the discovery of so many more planets and solar systems, does it seem more likely that intelligent life exists elsewhere in the universe? [More advanced readers can discuss the Drake Equation (*Planet Hunter* page 41) and how the discovery of extrasolar planets orbiting other stars increases the chances for intelligent life.] What about non-intelligent life? What kinds of life might we find on alien worlds? What would be the impact of finding life—even just tiny microbes—somewhere else in the universe?

3. Knowledge of extrasolar planets may also affect how we think about life on Earth. How might this knowledge influence how we interact with our environment on Earth? If it were possible, what might intelligent life from another planet have to say about life here on our planet?

4. Though the tools planet hunters use have improved, Marcy feels that his research could benefit from more advanced equipment like stronger telescopes. Discuss space-bound telescopes, such as the Kepler, which has already detected several hundred planet candidates that astronomers are working to confirm. Why are scientists excited about the Kepler mission? What possibilities do space-bound telescopes offer? Also discuss terrestrial telescopes. Why are they located in remote mountain areas? Why do you think Marcy travels all the way to the top of Mauna Kea, a dormant volcano 14,000 feet above sea level, to use the Keck telescope?

5. The “Goldilocks zone” is the area around a star where conditions are “just right” to sustain life. Discuss how Earth’s ability to support liquid water, one of the conditions needed for a planet to be habitable, places it in the “Goldilocks zone” of our solar system. Why are Mercury and Mars considered outside the “Goldilocks zone”? How does the concept of the “Goldilocks zone” help planet hunters narrow their search for habitable planets outside our solar system?

6. Gravity plays a crucial role in extrasolar planet detection. Discuss the concept of gravity and how it affects our life here on Earth. What role does gravity play in the way our solar system operates? Planet hunters use their knowledge of gravity to help them find extrasolar planets: If a planet is orbiting a star, the star will wobble as the planet’s gravity pulls on it. The wobble detection experiment on the following page can help illustrate this concept.

7. Discuss Doppler spectroscopy and its use in discovering planets. Why does Marcy use light waves to detect a planet? What is a spectrum of light? How can you “see” spectra? How is a spectrum of light relevant to planet hunting? [More advanced readers can discuss the details of Doppler shifts in more depth (*Planet Hunter* page 21).] The Doppler and light spectrum experiments that follow can help stimulate this discussion.

Activities for Further Exploration

Wanted: Earth-like Planet; Gas Giants Need Not Apply

Create a planet resume (guide page 5). Geoff Marcy and his fellow planet hunters are on the lookout for other Earths. What characteristics make a planet habitable? Create an illustration of what this extrasolar planet might look like.

Where's the Wobble?

A key element in detecting the presence of an extrasolar planet is the “wobble” of the star the planet orbits. Select two students to help illustrate this effect. Put one student in the center of the room and give him/her one end of a 8- to 10-foot long rope. Place the other student at the end of the rope. Tell the student at the center that she/he is the dog owner and the other student is a frisky puppy. Have the “puppy” run around the “owner” in a circle tugging on the rope leash. Instruct the owner to rotate along with the puppy but to try to rein in the leash as the puppy tugs. Point out how the owner is wobbling because of the puppy’s tugs as the students perform the exercise. The puppy in this scenario represents the orbiting planet, the owner is the star, and the leash is gravity. Shorten the rope so that the planet is only 3 to 4 feet from the star and repeat the exercise, but this time tell the planet/puppy to tug harder on the rope. With the planet closer to the star, the gravitational effect is much stronger and the star wobbles even more dramatically, making it easier for planet hunters to detect.

Doppler Detection: Waves of Light and Sound

The concept of the Doppler effect is used by planet hunters to detect tiny shifts of starlight. Astronomers notice that light waves change when a light source like a star moves toward or away from an observer. Sound waves also make these Doppler shifts. Think about how a siren or train whistle sounds as the vehicle approaches your position and then moves away. To better understand how the Doppler effect works, hit a tuning fork against a hard surface to generate sound waves. Walk close to and away from the students carrying the ringing fork so they can notice how the sound changes. The pitch of the ringing tuning fork lowers when the tuning fork is moving farther away and the sound waves are stretched out. The pitch is higher when the tuning fork is moving closer and the sound waves are compressed. Light waves shift in much the same way.

Over the Rainbow

Planet hunters use spectrometers to record the changes in a star’s light waves. View the spectrum of light by the use of a prism. Prisms break our normal white light into a band of rainbow colors known as the color or visible spectrum. Inexpensive prisms can be purchased through online science kit websites; common crystal watch faces and window hangings also reveal the visible spectrum when placed in sunlight. Use a prism or crystal to show the spectrum of light in your classroom and have the students note the order of the colors (always a constant). Compare the spectrum created in the classroom with the Visible Light Spectrum Diagram (last page of guide) to show the wave lengths of the various colors in the spectrum. Point out how the red end of the spectrum has longer waves and the blue end has shorter waves. This helps demonstrate why during a shift in detected light from a star, the colors look bluer or redder. As a star wobbles closer to Earth, the light waves are compressed and shift toward the blue end of the spectrum. When the star moves away from Earth, the light waves stretch out and shift toward the red end of the spectrum. Read the “Doppler Effect” box in *Planet Hunter* (page 20) aloud, including the italicized caption, and share the diagram with the students.

Additional Activities

Experiments on the Doppler effect and tools used to measure shifts of light:

<http://blog.growingwithscience.com/?s=planet+hunter>

Information about the Kepler mission's search for habitable planets:

<http://kepler.nasa.gov/education/>

Explore astronomy through the Hubble telescope:

http://hubblesite.org/explore_astronomy/

Classroom resources and lesson plans developed by NASA:

<http://www.nasa.gov/audience/foreducators/index.html>

Search for and design a habitable planet:

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

A virtual tour of exoplanets exhibit at the American Museum of Natural History:

<http://www.amnh.org/exhibitions/exoplanets/>

Network of astronomy clubs that may host local stargazing events nearby:

<http://nightsky.jpl.nasa.gov/>

Listing of science museums across the United States:

http://museumca.org/cgi-bin/cgiwrap/museumca/usa_search.cgi?category=science



VICKI ORANKSY WITTENSTEIN has worked as a prosecutor and an advocate for children and families. Since the 1990s, she has been writing nonfiction for children, with an emphasis on science, and has published articles in *Highlights for Children*, *Odyssey*, *Faces*, and *The Best of the Children's Market*. *Planet Hunter* is her first book. Recently she received an M.F.A. in writing for children and young adults from Vermont College. She and her husband live in Brooklyn, New York. Visit her website at www.VickiWittenstein.com for more information.

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Visible Light Spectrum Diagram

