

# PLANETARY SOCIETY KIDS

"DOG BONE" COMET  
*Hartley 2*  
ON THE BACK



## Life On Other Worlds?

### ASTROBIOLOGY WILL HELP US FIND OUT!

There are people who think deeply about what it would be like to live on another world—not like an astronaut, but like a living thing that none of us has ever seen, a native species on another planet. The Greek word for star is *astro*. The study of life is called biology. Because planets orbit stars, we combine those words and call the study of life on other planets “astrobiology” (as-troh-bi-AHL-uh-jee). It’s a branch of science that has been getting a great deal of attention these days. After all, using our extraordinary spacecraft and very powerful telescopes, we have discovered hundreds of new planets orbiting fantastically distant stars. With so many planets being found, we figure there might be a great many out there that have conditions suitable for living things.

### SIGNS OF LIFE

Based on studies of all the living things we can find, we’re pretty sure that to be alive, an organism needs some kind of liquid. A living thing needs something to carry chemicals from one place to another. For you, me, dust mites, and trees, it’s water—liquid water. To have liquid water, a planet has to be the right distance from its star. If it’s too close, the liquid might boil off into space. If it’s too far away, the liquid might freeze into a solid, and any form of life

would have a very hard time controlling chemical reactions and growing using water in its solid form.

We like to think of a region around a star in which life has a chance of getting started and growing, a place that could be inhabited by living things. In astrobiology, we call it the “habitable zone.” We used to think our Sun’s habitable zone was right around the Earth’s orbit, and that was it—largely because, not too long ago, even late in the 20th century, people thought that Earth was the only planet we could observe that had liquid water. Recently, however, spacecraft have found water ice on the Moon and ice close to the Sun, in shadows on the planet Mercury. We’ve also found an ocean of water under a layer of ice on Europa, a moon of Jupiter almost as big as Earth’s Moon (many astronomers think of it as a planet in its own right). If there’s water ice and sunlight, perhaps life might get started in a way that we don’t yet understand.

Of course, we can’t help but wonder if there is another liquid or set of liquids that might work to carry chemicals inside an organism—one(s) that we just haven’t thought of yet. Maybe ammonia would work, or maybe a compound of chemicals that includes carbon and hydrogen and works like the liquid in an air conditioner, *continued...*



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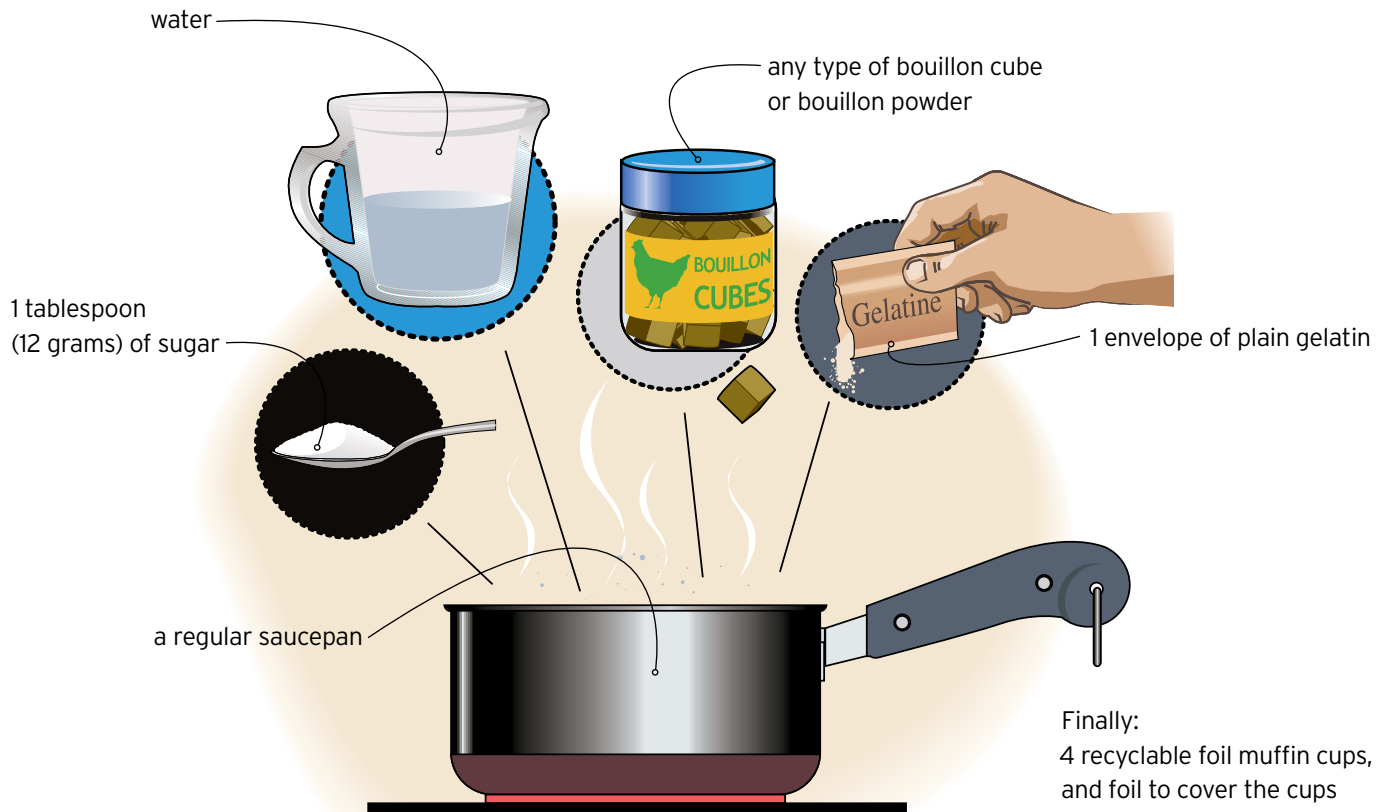
or maybe liquid methane (natural gas). Maybe there's something else no one has even considered. Through their studies so far, astrobiologists think water is the most promising. You and I are made mostly of water, after all. When you step on a bathroom scale, over half of the weight it shows—65 percent—is the weight of water in your body.

Think of it. What would it mean to our world if life were discovered on another world? It would change

all of us. We would think of ourselves and our place among the stars—our place in space—very differently. It would mean that we are not alone. There's a good chance that it would help us discover where we all came from or how we all came to be. It's no wonder that astrobiologists work hard to learn about the nature of life and especially the conditions in an environment that would make life possible at all.

# Warm or Cold: What Are

You can run your own tests with living things here on Earth to learn about a star's habitable zone. If things are too warm or too cold, the life that we know of doesn't grow so well, but when conditions are right, off life goes, growing like crazy. Here's what you need:



**Have more fun learning about space at [planetary.org/kids](http://planetary.org/kids)**

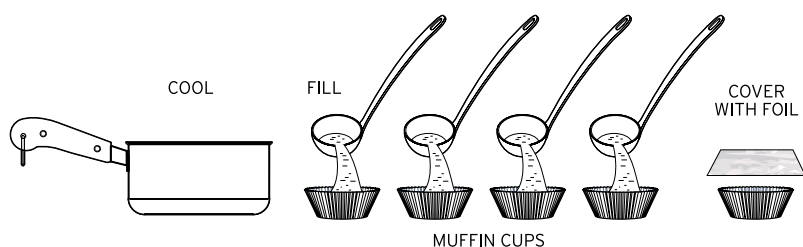


I'M A MICROBE!

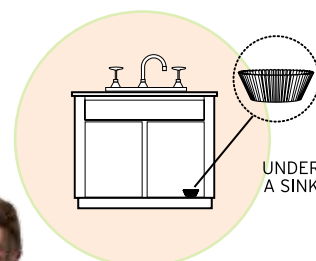
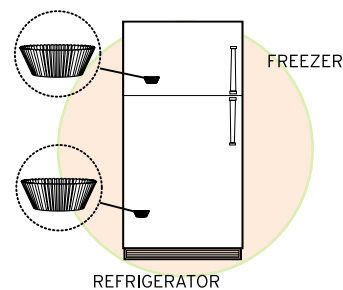
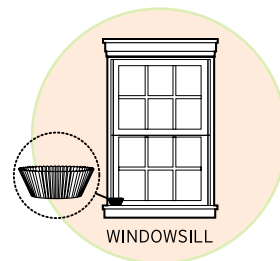


LEFT Scientists believe that the most likely place for life on other planets is some form of liquid. Astrobiologists might be looking for life as small as these microbes. Can you think of some ways that we can look for life on other planets?

# the Conditions for Life?



- ▶ In the saucepan, mix 1 bouillon cube OR 4 grams (1 teaspoon) of bouillon powder, the envelope of gelatin, the sugar, and 250 milliliters of water (about 1 cup).
- ▶ Bring the mixture to a boil. (You may need an adult to help you.)
- ▶ Divide it evenly into the 4 muffin cups.
- ▶ Let the cups of mixture cool in the open air for an hour or so.
- ▶ Lightly cover each cup with a piece of foil.
  - ◆ Leave one cup in a warm place, like next to the heater or on a sunny windowsill.
  - ◆ Put one in the refrigerator.
  - ◆ Put one in the freezer.
  - ◆ Put one in a cool place, like under a bathroom sink or in a dark closet.



Check on the cups in five days. You'll see things growing—colonies of bacteria that fell into the cups right out of our air. Take notes on which colonies grow fast and which ones grow slowly. Based on what you find, how do you think that temperature will affect our chances of finding living things in our solar system and beyond?

Studies like this help astrobiologists learn about what it takes to be a living thing on a warm or very cold world. When I was growing up, everyone believed that living things—all living things—needed to be near sunlight. Either you were a plant and made your own food right out of water, carbon dioxide in the air, and sunlight, or you were an animal (like you or me) that survived by eating plants or things that eat plants. In my lifetime, however, we have discovered astonishing ecosystems at the bottom of the ocean, where there's no light at all, but there is very hot water gushing up, driven by heat from deep in the Earth. Just think what living things may be discovered in your lifetime. For many people, it's hard to imagine. For an astrobiologist, it's a way of life.



"Our special **PLANETARY SOCIETY KIDS** insert in each issue of our magazine is shareable! I want everyone—  
young and old—to know and appreciate our place in space!"

BILL NYE, CEO



**Hartley 2 is the smallest comet that a spacecraft has visited.** (It's only 2,200 meters long by 500 meters wide.)

**Hartley 2 is the fifth comet that's been visited by a spacecraft.** (*Deep Impact* flew by it on November 4, 2010.)

**Hartley 2 may be small, but some of those "little" lumps on its ends are 50 meters tall!** (That's like a six-story building.)

# HARTLEY 2

*The "Dog Bone" comet*

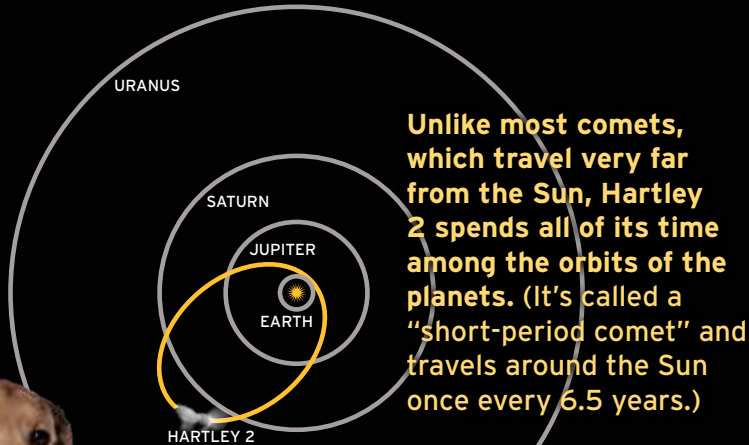
**RIGHT** Comets like Hartley 2 have hit Earth many times. Impacts from comets and asteroids can kill Earth life. Some comet impacts have caused massive extinctions. But comets bring water and other chemicals necessary for life to Earth. We could owe our existence to comets!

**Its "coma"—the cloud of gas and dust that surrounds it—can be nearly half a million kilometers (a third of a million miles) across!**



**Hartley 2's green glow tells you that its coma contains cyanogen, a gas that is deadly to humans!**

**The lumpy double-ended shape of Hartley 2 might mean it was originally two different comets that got stuck together!**



**Unlike most comets, which travel very far from the Sun, Hartley 2 spends all of its time among the orbits of the planets.** (It's called a "short-period comet" and travels around the Sun once every 6.5 years.)

**Notice that Hartley 2 is shaped a little like a dog bone?**



Hartley 2 images: NASA/JPL-Caltech/UMD. Inset photo: Chanan Greenberg, Greenhawk Observatory