What makes a planet habitable?

By NASA.gov, adapted by Newsela staff on 01.26.17

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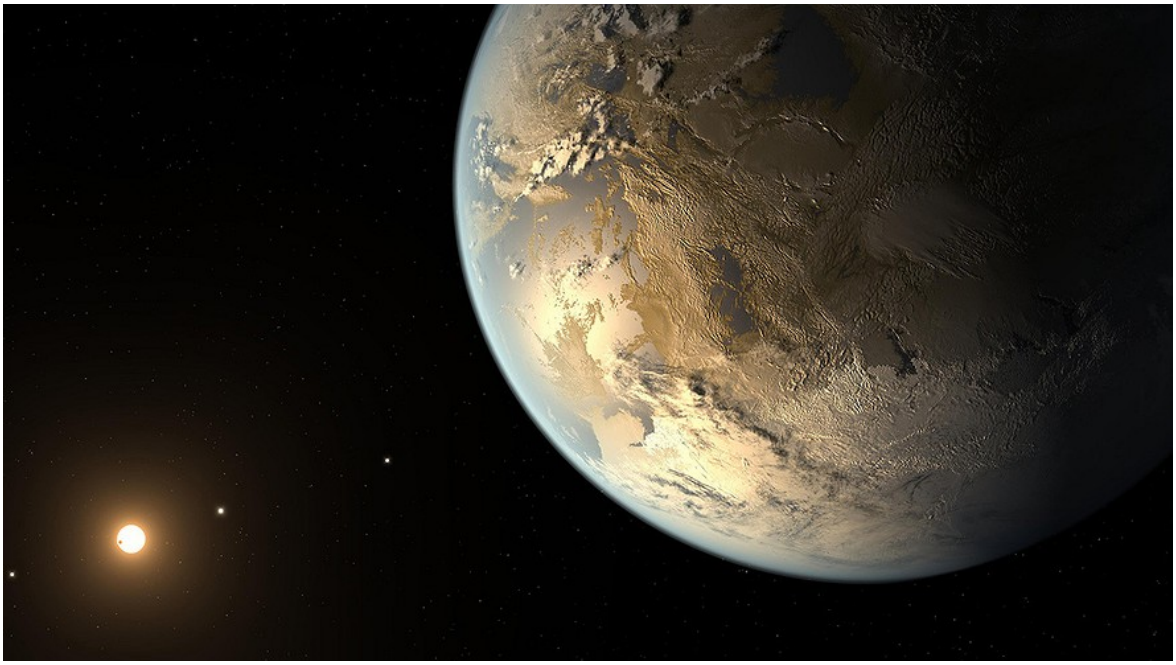


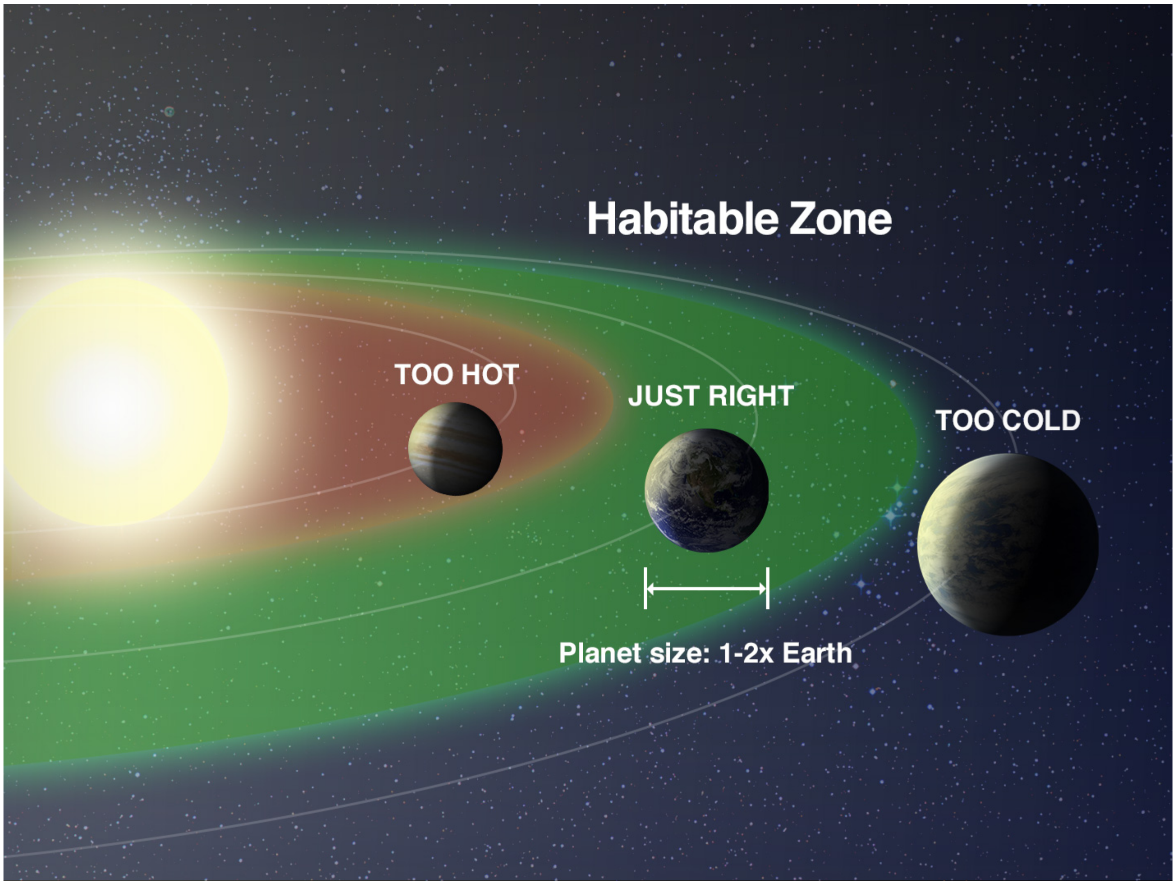
TOP: This artist's concept depicts Kepler-186f, the first proven Earth-sized planet to orbit a distant star in the habitable zone, which is a range of distance from a star where liquid water might stay on a planet's surface. The discovery of Kepler-186f confirms that Earth-sized planets exist in the habitable zones of other stars. it signals a significant step closer to finding a world similar to Earth. MIDDLE: The habitable zone. BOTTOM: Light from exoplanets, if passed through a prism, can be spread out into a rainbow of colors called a spectrum. Different colors correspond to different wavelengths of light. Missing colors show up as black lines, indicating specific gases are present, because each gas absorbs light in a specific wavelength. Courtesy of NASA

Discovering thousands of planets beyond our solar system counts as a major breakthrough in human exploration. The biggest payoff is yet to come, though: capturing evidence of a distant world hospitable to life.

We begin the search on familiar ground. On this planet, currently our sole example of a life-bearing world, the need for water is non-negotiable, so astronomers search the cosmos for similar environments. Around almost every “normal” star, including our sun, we can draw a band of potential habitability: the right distance and temperature for liquid water to exist. On planets within this distance, scientists think, life might arise.

The key, of course, is a planetary surface where the water could pool. Stars and planets come in many types and sizes, and both of these factors affect the “habitable zone.” A giant, hot-burning star’s habitable zone would be at a much greater distance than that of a smaller, cooler stellar dwarf, for example.

Scientists' current plan is to start by looking for what we already know: planets that look like Earth. For the time being, small, rocky worlds are our best bet for finding evidence of life, and the ideal candidate is an Earth-sized, rocky world nestled comfortably within its star's habitable zone.



Wishing Upon The Right Kind Of Star

That's not the end of the story. While the size and composition of both planets and stars are critical to habitability, so is time. Big bright stars burn out far more quickly than their more modest counterparts. The brightest burn for only a few million years, then flame out. Meanwhile, our sun has been shining steadily for 4.5 billion years, with about another 5 billion years to go.

The first microscopic life-forms are thought to have emerged about a billion years after Earth's formation from the dust left over from our Sun's formation, but they might have emerged much sooner. It took roughly another 3 billion years for multi-celled, macroscopic creatures — that we have so far found as fossils — to appear.

A few hundred million years could be enough time to produce microbial life. It might be too short a time frame for large animals, however, especially the kind that begin talking to each other and building radio telescopes. Scratch big, hot stars off our list of likely candidates.

On the other hand, long-lived dwarf stars might be great places to look, even those with habitable zones so close to their suns that they are "tidally locked," revolving in a way that only one half ever faces the sun. Scientists once thought such worlds would be cooked on one side and frozen on the other, but they now believe that wind could even things out, providing some of these worlds with moderate climates.

The safest bet might be sun-like stars, with planets of comparable size and comparable orbits to Earth’s.

A Growing Handful Of Habitable Worlds

So how is the search going? In just over 20 years of exploration, ground and space-based observations have turned up more than 3,200 confirmed exoplanets in the few slices of our galaxy we’ve been able to search. Add unconfirmed planetary candidates and the number jumps to more than 5,600.

Many of the planets found so far are gas or ice giants, with little chance of a solid surface that could hold a warm little pond. But we’ve also found some rocky worlds in Earth’s size-range. Even with the expected advances in observing technology in years to come, we’re unlikely to know the precise nature of any life we might detect, be they crusts of algae or loping, six-legged giraffes. Still, among those rocky, Earth-like worlds, we could catch glimpses of the right conditions for life.

Looking For Signs Of Life

Planets in the hundreds of billions are likely caught up in the vast whirlpool of the Milky Way galaxy. From Earth, a lonely outpost on one of its spiral arms, we’ve begun to look out at the rest of the galaxy. We can already make out, dimly, the light from planets orbiting distant stars. We’ve even tasted a few of their atmospheres by dissecting those faint traces of light.

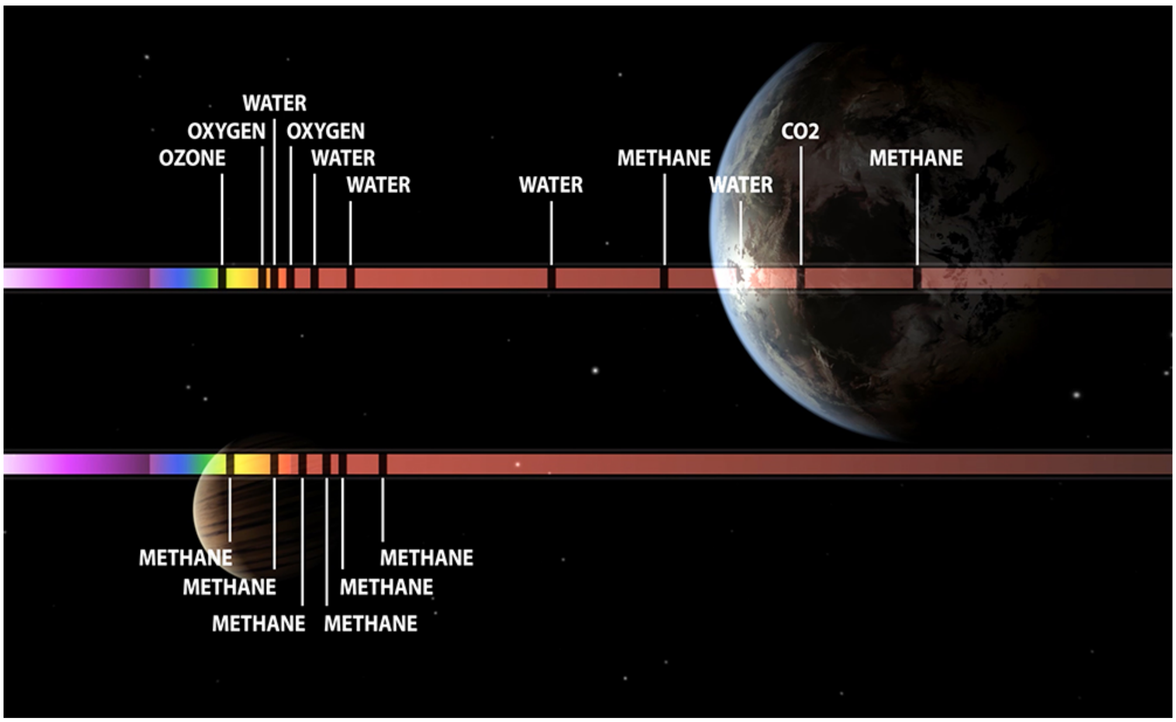
The ultimate goal of finding an exoplanet program is to find unmistakable signs of current life.

Planet finding missions using infrared telescopes could someday zero in on a distant planet’s reflected light. Just by looking at a planet's light, scientists can detect the signatures of oxygen, water vapor, or some other powerful indication of possible life.

When we find life, how will we know? The answer has a lot to do with rainbows. As Isaac Newton recognized, white light shot through a prism (or through curtains of mist seen with the sun at your back) is exposed for what it really is: a band of color spanning violet to red, characterized by “wavelength.” Chemicals and gases in the atmospheres of planets can absorb certain slices of this band, called a spectrum, and leave behind a narrow black gap.

When we analyze light shot by a star through the atmosphere of a distant planet, the effect looks like a bar code. The slices missing from the light spectrum tell us which elements are present in the alien atmosphere.

One pattern of black gaps might indicate methane gas, another, oxygen. Seeing those together could be a strong argument for the presence of life. Or we might read a bar code that shows the burning of hydrocarbons; in other words, smog. Even without listening in on their conversations, the aliens' reasonably advanced technology would be known to us by its pollution.



Quiz

1 Which of the following statements BEST represents scientists' approach toward finding exoplanets?

(A) They hope to eventually find exoplanets that support life.

(B) They are satisfied with locating unconfirmed exoplanets.

(C) They understand that finding a habitable exoplanet is unlikely.

(D) They assume that Earth is the only existing life-bearing world.

2 What is the MOST important reason WHY scientists are looking for planets similar to Earth?

(A) They are looking for planets with a similar light signature, climate and moon.

(B) They are looking for planets with a similar atmosphere, brightness and wind pattern.

(C) They are looking for planets with a similar temperature, orbit size and tidal lock.

(D) They are looking for planets with a similar size, atmosphere and distance from a star.

3 Which statement BEST explains WHY the middle graphic is included with the article?

(A) to show that a planet has to be the exact size of Earth to support life

(B) to show that a planet has to be the right size and distance from a star to support life

(C) to show that a giant, hot-burning star is most suited to creating larger habitable zones

(D) to show that Earth is surrounded by planets that are unable to support life

4 Which sentence from the article is BEST supported by the information in the bottom graphic?

(A) From Earth, a lonely outpost on one of its spiral arms, we've begun to look out at the rest of the galaxy.

(B) As Isaac Newton recognized, white light shot through a prism (or through curtains of mist seen with the sun at your back) is exposed for what it really is: a band of color spanning violet to red, characterized by "wavelength."

(C) Chemicals and gases in the atmospheres of planets can absorb certain slices of this band, called a spectrum, and leave behind a narrow black gap.

(D) Or we might read a bar code that shows the burning of hydrocarbons; in other words, smog.