Hey, science aficionados, this is interesting…and it needs a little critical thinkinga
This is a story of a nearby star and its planet. Here is the basic story; I've imbedded links to one of our websites that give more detail, mostly mathematical.

Recently, astronomers using the European Southern Observatory telescope in northern Chile, detected a planet orbiting the star nearest to our solar system, Proxima Centauri. The way they detected the planet, by the tiny wobble it causes the star along our direction of view, is very interesting, though not the topic I'm following up here. The star and its planet are 4.25 light-years away, so, still an extreme distance for any probe to reach that can hit even the highest speeds our spacecraft attain. Nonetheless, astronomers and their biology/physics colleagues are wondering if this planet can sustain life. (The bio/physics people call themselves "exobiologists," with "exo" meaning "outside," as in considering what's "outside our planet Earth.")

It's a weird star and a weird planet. The star is cool, about ½ the temperature of the Sun, and very small, about 1/6 the diameter of the Sun. The planet is very close to the star, about 24 times as close as our Earth is to the Sun. This helps make up for the weak radiation from the star that otherwise would provide little warmth and little light that life (as bacteria) could use for photosynthesis…and, of course, photosynthesis by bacteria and plants keeps any higher forms of life alive, providing food.

We can calculate how much energy gets to the surface of the planet, thanks to the discoveries of physicists Max Planck, Albert Einstein, Josef Stefan, Ludwig Boltzmann, and others. We consider the star as a "black body," odd, perhaps for a bright body, but it means that it emits electromagnetic radiation (light, infrared, radio waves, etc.) as we may say without preference for which kind. The intensity of radiation as energy emitted per area of the star's surface per time is proportional to the 4^{th} power (square of the square) of the temperature. For one, it means that the star emits only about 7.5% as much radiation as our Sun does, per area. Now, the energy density falls off with distance, as if we divide by the square of the distance. The short answer is that the intensity of raw energy in starlight at the planet is almost as much as that of our Sun's energy reaching the Earth – about 90% as much. I've written up some details in a link.

Calculating how much light the planet gets that can be used for photosynthesis is trickier. We have to assume that life is carbon-based, from a wide array of arguments based on chemistry. Consequently, the radiation usable in photosynthesis has to be pretty energetic, with wavelengths similar to visible light. I assume that bacteria on Proxima Centauri b can use light with wavelengths as long at 850 nanometers, nm (our green plants on Earth need more energetic light, with wavelengths of 700 nm or less). To my surprise, I estimate that there's light about 32% as abundant as on Earth, enough for a vibrant ecosystem if all other conditions are right.

A couple of problems: First, the planet is so close to the star that it is likely "tidally locked" by the star's gravity. The star pulls a bulge on the planet and then tugs the planet as if on a handle. The Earth does the same thing to our Moon, so that we only see one side of the Moon. If it's true for Proxima Centauri b, then one side constantly faces the star, getting very hot, and the other side faces away, getting extremely cold. This doesn't happen on Earth, so that the average area on Earth gets only ¼ as much energy as an area directly facing the Sun (the Earth, with radius *r*, is nearly spherical and occludes an area of πr^2 but the energy gets spread over its total surface area, $4\ \pi r^2$). Also, the Earth doesn't absorb all the energy streaming in from the Sun. The Earth, then, viewed from space, has an average temperature of -18 degrees Celsius (^oC) or about zero degrees Fahrenheit. It's warmer, on average, by 33^oC or nearly 60^oF, thanks to our greenhouse effect from CO_2, water vapor, and more. On Proxima

Centauri b, the area directly facing the star fries, but, at areas angled away from the star the temperatures might be modest. This is a proposal from the exobiologists. This requires some special conditions on how heat moves around the planet, much as it moves around the Earth through the atmosphere and oceans. I've estimated a range of angles and of corresponding land areas where temperatures might range from just above freezing to about 80°C, toasty but livable for some extremophile bacteria as you might find in hot pools in Yellowstone National Park. The zones cover about 13% of the surface.

Second, Proxima Centauri flares up massively, which can blow away the atmosphere on the planet. This could drive off the water as vapor, reducing the medium in which life exists. Loss of water would also severely reduce the greenhouse effect needed to keep the planet warm enough to avoid freezing solid; we'll look at that a bit more, later. The flares could also cause heating problems, periodically scalding the surface. Solar flares reaching Earth do negligible heating but do bombard our surface life with some nasty radiation in the form of charged particles. This is even more of a problem.

There are some other big ifs. Can the planet maintain its own magnetic field to protect life from cosmic rays and solar flares, as on Earth? Earth has a nice spin, helping with its interior dynamo making our magnetic field. Proxima Centauri b might rotate relative to the stars fast enough around its star to maintain a dynamo; after all, it appears to orbit the planet in only 12 days.

Overall, let's say that Proxima Centauri b is an interesting find. Don't count on life being there, nor on visiting it, but think about how life might evolve elsewhere…and, more so, think about how we might keep our planet livable with our unique physics, chemistry, and biology that we are changing a lot! Oh, and by the way, the star is pretty dim; you need a telescope to gather about 100 times as much light as the naked eye does.

The active links in this essay lead to detailed discussions that extend to many topics, even Snowball Earth, LEDs, geothermal energy, and the discovery of the photon.

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