The Search for Extraterrestrial Life  
  
  
If extraterrestrial life exists, will we recognize it?  
  
Mankind has been in awe of the sky from the beginning of life on Earth. Questions were raised by the transitions from day to night, the sun, and the moon. In these early times, man also searched for other humans. The concerns about other living forms must have started as the population increased and man encountered other peoples. Who were they, if there were beings other than humans? What is their origin? How do they appear? Do they pose a danger to us? Today, this issue is more important than ever.  
  
  
The mixture of gases in the atmospheres of Earth-sized exoplanets could be seen for the first time by the James Webb Space Telescope, which will launch in 2021. Webb or a future spacecraft of a comparable design might be able to detect oxygen, carbon dioxide, and methane, which are components of our atmosphere. A strong indication of possible life. The conversion of light into chemical energy by plants is known as photosynthesis. Future telescopes may also detect gases or chemicals that indicate the presence of biological life.   
  
As it does on our planet, intelligent, sophisticated life may likewise produce air pollution that can be seen from a distance. Of course, a probability estimate is the most we might be able to do. However, the discovery of an exoplanet with, say, a 95% possibility of life would be a historic turning point.  
  
How can we discover life?  
  
The Martian surface or Europa, Jupiter's moon, might both contain life, as could the deep, underground oceans of Europa. Or perhaps the age-old desire will come true and we'll be able to listen in on alien civilizations' communications. We may even find "technosignatures," or remnants of technology (think smog). But even with these lucky breaks, the task will be far more difficult.  
  
Light, divided up into a rainbow spectrum that can be read like a bar code by us, will be the key. This light will come from the atmospheres of exoplanets. These planets' skies would contain a variety of gases and compounds, including those related to life, according to a technique known as transit spectroscopy.  
  
It's not life as we know it.  
  
They live in the hot vents on the ocean floor, the arid valleys of Antarctica, and the caustic chemical pools of Yellowstone National Park. They are members of life forms that diverged from our billions of years ago. Extremophiles are types of life that thrive in situations that would kill other types of life. They might also serve as analogs for the unusual life seen on other planets.  
  
Where do we need to look?  
  
Exoplanets, or planets that orbit other stars, have been counted at about 4,900 in our galaxy, but there are undoubtedly trillions more. The idea of the "livable zone" is one of the best resources scientists have to start focusing their search for habitable planets.  
  
It is the distance from a star at which temperatures would permit liquid water to occur on the surface of a planet. A steady star that is not prone to erupting in sterilizing flares would also be necessary, along with a planet of the right size and atmosphere. The habitable zone is only a way to narrow the field and focus on the planets most likely to have favorable circumstances for life.  
  
In 1990, a year into the journey to Jupiter of an American spacecraft called Galileo, Carl Sagan, a well-known astronomer, turned the probe’s instruments back towards Earth. He wanted to find out whether it was possible to detect evidence of life on the planet from a distance.  
  
Galileo used spectrography to analyze sunlight passing through the atmosphere of the planet and discovered the presence of methane and oxygen, both of which are signs of biological activity. The spacecraft also captured images of Earth at various wavelengths, revealing a phenomenon known as the "red edge"—a significant shift in the planet's reflectance at red wavelengths, which Sagan attributed to the existence of photosynthetic plant life on the surface.  
  
They look for life on other planets  
  
Exobiology, the study of just alien life and hence criticized as "a science without a subject matter," has been superseded by astrobiology, a word coined for the study of all life wherever in the cosmos (including Earth). Astrobiology, as opposed to exobiology, accepts the scientific possibility that life may never be discovered outside of Earth. No proof of life outside of Earth has been adduced.   
  
The design of astrobiological studies, however, compels a careful assessment of the applicability of generalizations drawn from Earth life.  
  
  
There is a wide range of potential outcomes for life on distant planets. A planet can be devoid of all organic remains and fossils. It could also be dead but still contain organic material or fossils.  
  
Life could have biochemistry, physiology, and behavior that are very simple or very complex. With a technological civilization, sentient existence is conceivable. Any of these possibilities would need confirmation, which is crucial for science.  
  
The best way to understand the quest for extraterrestrial life is to picture it in reverse. For instance, if there were people on Mars, they might examine Earth for life using all of the available scientific instruments and expertise. Testing could be done on-site and remotely.  
  
Any wavelength of light emitted or reflected by the target planet can be analyzed during remote testing. Remote sensing techniques look for thermodynamic disequilibrium, particularly in the planet's liquid phases (atmosphere and hydrosphere). In situ experiments utilize samples of a planet that must be acquired by instrumentation that lands there and performs experiments.  
  
The discovery of any other living things anyplace else in the cosmos would be of the utmost scientific relevance, even though there is only a negligible chance that human-like beings will be found in space (to serve as a cosmic example of convergent evolution). Furthermore, it would be of immense scientific significance if, after a thorough search, absolutely no proof of life elsewhere in the universe was discovered.   
  
It would be even more important to safeguard the diversity of life in our biosphere, which includes that priceless, cosmically delicate, and relatively recent growth form known as human civilization if there were no changing matter-energy flow systems known as life.