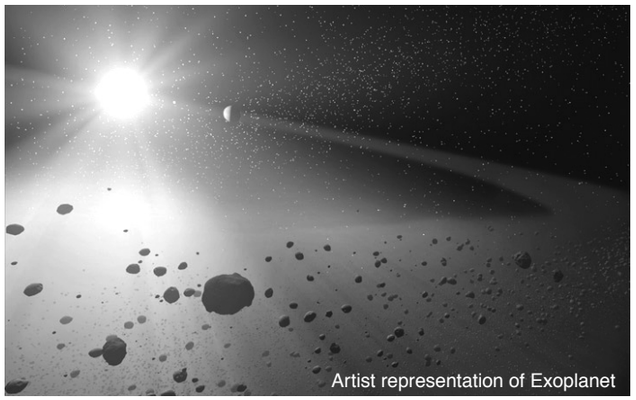
This Rare Earth and the Search for Life Elsewhere

Mankind is very much intrigued at the possibility that some form of intelligent life exists beyond planet Earth and our solar system. Knowing, one way or the other, would have the most profound implications for man's view of his place in the Cosmos. Objective scientific evidence does not support a definitive conclusion, and professionals in the field are generally divided between those who are convinced there is intelligent life beyond Earth and those who are just as convinced that there is not. This article briefly summarizes the scientifically based arguments for each point of view.

The Rare Earth Hypothesis contends that life originated and evolved on Earth the way it has as a result of a very long series of critically important circumstances and occurrences, most so highly improbable that the chances of anything comparable happening elsewhere are virtually nil.

Our view of conditions required for life to have evolved on other planets is biased by the only example we know of and an incomplete understanding of how it originated. First of all, a planet must orbit in the habitable zone of its parent star. Liquid water must be present at the surface and the habitable zones are quite narrow – too close it's too hot, too far away it's too cold. Ours is not an ordinary star. 95% of all stars are less massive than our Sun. The habitable zones are so close that gravity will induce synchronous rotation (the same side of a planet always faces the star as it orbits). The result, one side (the dark side) of the planet remains extremely cold and any atmosphere is frozen off. Stars just 50% more massive than the Sun are too short-lived for complex life to evolve. Also, two-thirds of the stars in our region of the Galaxy are members of binary or multiple star systems. Any planets in such a system are likely in very unstable orbits resulting in such extreme climate variation as to preclude complex life.


Artist representation of Exoplanet

The Galaxy itself is considered to have a fairly narrow habitable zone as well. Our Sun orbits about 30,000 light-years from the galactic centre in a region where star density is quite low compared to the crowed interior. Intense radiation in the central region would most likely prevent life from evolving. In the Galaxy's outermost regions, up to another 20,000 light-years beyond our solar system, the rate of star formation, in which heavier elements essential for life are produced, is low and the abundance of heavier elements is too low for terrestrial planets as large as Earth to form.

In the late stages of Earth's formation it collided with a smaller planet forming at the same time. These merged and the Moon formed from material splattered into space. As moons go, ours is quite large in relation to Earth's size. This and the fact it is so close are responsible for slowing the Earth's rate of rotation, its tides and stabilizing of the Earth's tilt of its spin axis – all critically important to long-term climate stability. The only other terrestrial planet with a moon is Mars, which has two that were asteroids captured by its gravity.

Despite its great distance, Jupiter is also largely responsible for Earth's long-term habitability. It is the most massive of all the planets (318 times Earth's mass) and its gravity purged the mid-region of the solar system of Earth-shattering asteroids. Without Jupiter the incidence of impact with a 10-kilometer body would have been once every 10,000 years instead of every 100 million years; and advanced life would likely not have evolved or survived.

Earth is also unique in being the only planet in our solar system with plate tectonics. This feature of Earth's geology is responsible for the formation of continents, transfer of heat from the core and in moderating surface temperature variation by regulating the level of carbon dioxide in the atmosphere. A planet with plate tectonics is also more likely to have a strong magnetic field necessary to protect life from solar and cosmic radiation.

Even with all of the foregoing lucky breaks, evolution of complex life here on Earth was by no means a sure thing. Simple microbial life was established early on but evolution of more complex life forms occurred only during the very recent part of Earth's 4.5 billion year history. Earth has undergone a very long series of complex and dramatic environmental changes that were necessary before animal life could evolve. We are the best example of intelligent beings that evolution here on Earth has produced thus far. The pathway leading to the appearance of humans years ago involved so many vital branches and twists of fate that our being here at all is an extremely low probability occurrence. For example, one in a series of mass extinctions that have occurred over the course of evolution followed an asteroid impact 65 million years ago. It wiped out the dinosaurs along with half the other species present at the time, but it allowed mammals to flourish and, eventually, us to evolve.

The Principle of Mediocrity and belief in life beyond Earth and our solar system are based essentially on the fact that there are several hundred billion stars in the Milky Way Galaxy alone. There are also several hundred billion galaxies in the very tiny portion of the Universe observable from Earth. With the contention that there are so many potentially habitable planets, it is probable that extraterrestrial life is common. Everything in our Universe had the same origin and the processes that result in the formation of stars with orbiting planets, as well as the raw materials of life, are common throughout.

Whether intelligent beings of some kind inhabit the Moon, other planets or star systems has been debated from earliest times. The search within our solar system began with the invention of the telescope. Although the possibility of advanced life forms has been ruled out, the search for primitive life, comparable possibly to forms inhabiting extreme environments on Earth, is a component of ongoing space exploration. But, the search for life in the form of technologically advanced civilizations goes well beyond the solar system. Reasoning that alien intelligence would also be searching and sending signals, SETI (Search for Extraterrestrial Intelligence) began in 1960 using a radio telescope to systematically search for alien transmissions. In 1974 we sent our first, largely symbolic, message aimed at the Great Cluster in Hercules, 25,000 light-years away. A response will take a very long time unless it is detected by someone in a much closer star system. There have been some false alarms, but so far the search has been unsuccessful. Today the search involves the use of sophisticated and extremely sensitive telescopes around the world to detect and send directed radio and laser signals.

Since the first one in 1995, hundreds of planets have been discovered orbiting stars other than our Sun. Most are many times more massive than Earth, but a number of possible terrestrial planets have been found relatively close by. There are presently satellites in orbit dedicated to searching for Earth-like exoplanets (Planets orbiting stars other than our Sun), and others will follow to conduct spectral analyses of their atmospheres for tell-tale signs of life.

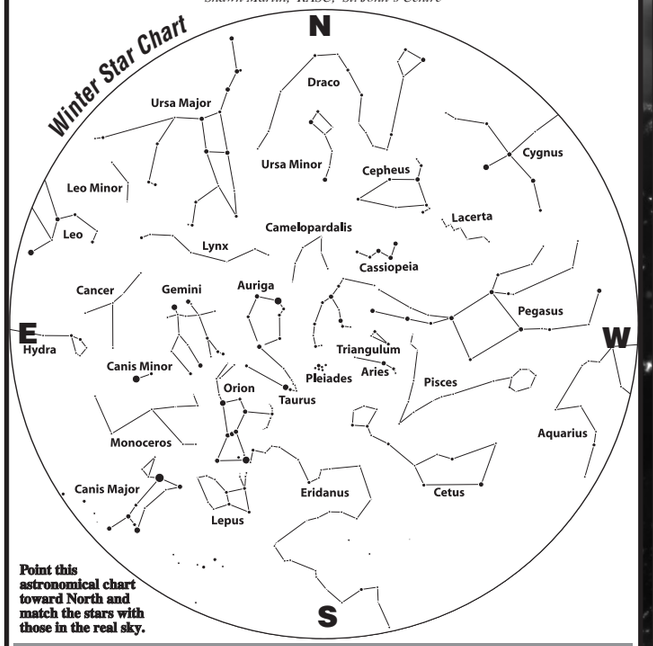
Jerry Ennis RASC, St. John's Centre

For more activities go to ***www.thetelegram.com*** and click on Our NIE Program

What's Up

Jan 15 - Mid February

Shawn Martin, RASC, St. John's Centre



Point this astronomical chart toward North and match the stars with those in the real sky.

Planets

Viewable in a pair of binoculars or small telescope

Mercury - low at dawn in the southeast.

Venus - is hidden behind the glare of the Sun.

Mars - (magnitude –1.0) is in the east-northeast at the Leo-Cancer border.

Jupiter - (magnitude –2.1) in the southwest at twilight.

Saturn - (magnitude +0.9) rises in the east around 11 p.m. and stands highest in the south before the first light of dawn.

Uranus - (magnitude 5.9) is still in view right after dark well to the upper left of Jupiter.

Neptune - (magnitude 8.0) is lower right of Jupiter, sinking away into the twilight.

Pluto (dwarf planet) - is behind the glare of the Sun.

Moon

Waxing	First Quarter	Full	Last Quarter	Waning	New
Jan. 21	Jan. 23	Jan. 30	Feb. 5	Feb. 7	Jan. 15

You can contact the Royal Astronomical Society of Canada, St. John's Centre, at www.rasc.ca/stjohns/

WARNING! When using a telescope or binoculars, always be sure NEVER TO LOOK AT THE SUN! This can cause serious and permanent eye damage. To be safe, always make sure the Sun is fully set below the horizon before going outside with your telescope or binoculars.

ACTIVITIES

1. Are there any reports in The Telegram about efforts to find extraterrestrial life?
2. Can you find any reports in The Telegram on exoplanets?
3. Look in The Telegram for information about other planets in our our solar system?