

Questions from Rosholt Middle School

Answers by Dr. Harold A. Geller

1. Could there be another star system with a planet like ours?

I would have to ask what you mean by “a planet like ours?” If you mean to ask if there is another planet similar in size, mass, and atmosphere, then I would say yes. However, I do believe that the Earth is unique, not necessarily in size, mass, or atmosphere, but in its history, both geological and chronological; and, we will never find a planet EXACTLY like Earth, anywhere in space or time.

2. Could life evolve on a gas planet?

While it is not physically impossible for life to evolve in the atmosphere of a gas planet; it is highly unlikely. A common characteristic of all life we know is the need to carry on metabolism within a confined area, what we call a cell. A majority of a living cell is called cytoplasm; that is where all the functions of life take place. Water in the liquid form, or some substance like it, is needed to support the cell’s life functions; and, thus, it is unlikely that life would evolve in a gaseous environment.

3. We know that chemicals found in our DNA are found on Mars, what can that tell us about the possibility that life was/is there?

Most biologists would say that there are, at a minimum, three key ingredients to life. It is true that one of these ingredients is the proper chemical elements. But that is only one ingredient for life. The other two main ingredients are a source of energy; and, a mechanism for protection from harmful radiation. The source of energy on Mars, like the Earth, is the Sun. Unfortunately, that third ingredient for life is not found on Mars. Unlike Earth, Mars does not possess a global magnetic field.

Therefore, it does not have the protection of a magnetosphere. This allows for high energy charged particles and cosmic radiation to penetrate to the surface. This is damaging to complex molecules, and tends to prevent their formation. Mars also lacks an ozone layer, thus allowing for the penetration of solar ultraviolet radiation.

4. Could there be another solar system just like ours, with a planet that has life?

It depends upon what you mean when you say “just like ours.” We have already discovered close to 4,000 other star systems in our galaxy. None are just like ours in terms of the number and size of planets that they contain. While it is possible that we someday may discover a star system with planets that are similar in composition and size; it is extremely unlikely that the star system would be identical to our own Solar System. Our Solar System, and we ourselves, are quite unique.

5. Have we found anything that is similar to bacteria on other planets?

As of today, we have yet to find anything like bacteria on any other planet in our Solar System. The only life we know of in the entire Solar System is life that evolved here on Earth.

6. Are you, or were you ever interested in space travel?

Of course I was interested in travelling in space. In fact, when I was your age, I thought that someday I might walk on the surface of Mars. That is a dream that I will never see come true. I am afraid that I will not see it in my life time.

7. Is there a plan or procedures made for what to do if intelligent life is discovered somewhere?

Yes indeed, there is a procedure that we are to follow if we do believe that we have detected a signal from intelligent life in the universe. There is in fact an international treaty that lays out a set of procedures in such a case. It was signed by members of the United Nations and drawn up in concert with the International Astronomical Union.

8. Have you ever worked with any space probes?

Again, I would have to ask what is meant by “working with any space probes?” For my master’s thesis I worked with scientists and the data derived from the Viking mission to Mars in the 1970s. I have also worked with data from numerous space probes, both those that have orbited the Earth, and those that have gone out into the far reaches of our Solar System. My good friend and colleague, Dr. Michael Summers is an investigator on the New Horizons mission to Pluto and the Kuiper Belt.

9. What kind of telescope do you use? What other tools do you use in your work?

I have used many kinds of telescopes. This has included reflectors and refractors in the optical portion of the electromagnetic spectrum. However, I have also used radio telescopes as well as optical telescopes on Earth. And I have used data from spacecraft both orbiting the Earth and spacecraft that have left our Solar System.

10. What are your degrees from college?

I have two undergraduate degrees; one in mathematics and one in general science. I also have a master degree in astronomy and information technology. My doctorate degree is in education.

11. What got you interested in astrobiology?

I first got interested in science when my father gave me, and demonstrated a couple of powerful magnets. I was about 4 years old and I was fascinated by how hard it was to push like pole together, yet there was nothing in between the two magnets. I first got interested in astronomy when my parents took me to the Hayden Planetarium in the American Museum of Natural History in New York City.

12. Is there a thing or a person that influenced you in your choice of a career?

There are many people who have influenced me in my choice of a career. They include a number of my teachers; people who I have worked with even before I had a career; and, a fascination with the life and times of one Albert Einstein.

13. What is the weirdest type of life have we found on Earth and where is it?

There are many “weird” types of life that have been discovered on Earth. Perhaps the most unusual of them all is the tardigrade. The media has also called these creatures water bears and moss piglets. While they have received a lot of media coverage of late, they were actually first discovered by a German scientist named Johann August Ephraim Goeze. A fully grown tardigrade is only about 2/100 inch in length. So you need a microscope to see one. These creatures are amazing in the environments within which they are able to survive. In fact, they were

flown on a space craft and exposed to space for 10 days. About 2/3rds of the creatures were able to survive the elements.

14. Do you mostly study how life started on Earth or looking for life in other places?

In the waning years of my career, I spend most of my time writing and teaching. I have graduate students who do research with our telescope and data from various spacecraft. My most recent interests are in the search for life in the universe; and, the use of energy right here on Earth. Just this January I co-authored a book on the use of energy resources. I have written books on astronomy, astrobiology and even one children's book about Pluto.

15. If I am interested in astrobiology as a career, what could I do now to learn more?

If you think you might be interested in a career in astrobiology, I would tell you to do the same as I tell anyone interested in science, technology, engineering and mathematics; what is called STEM. That is, study hard and read all you can read. Do well in school. Find a college that has a major in the field you are most interested in; and then, after graduating college, you can focus on a specific field in a graduate school. If you do well in your coursework in general, you will be able to get into a graduate school that will allow you to study that which you are most interested in studying.

16. What happens to stars when they die?

The end of a star depends most on the mass of the star it starts out as being. A star like our Sun will end its life as a white dwarf. There is no production of energy in a white dwarf it just dissipates its heat to the rest

of the universe. Now after a very long time, much greater than 100 billion years, a white dwarf will dissipate its energy and become a black dwarf. Basically a cold black lump of carbon. However, stars that are much more massive than the Sun will end their lives as neutron stars or black holes.

17. Do you believe in the big bang theory of the universe?

The Big Bang Theory of the formation of the universe is the best theory we have for the origin of the universe. There are three main pieces of evidence that support this theory. The first is the expansion of the universe first discovered by Ed Hubble in 1929. The second is the cosmic microwave background radiation first discovered in 1965 by Nobel Laureates Penzias and Wilson. The third is the cosmic abundance of chemical elements. It is best to recall that when you look out into space you are looking back into time. For example, the starlight we see from the Sirius is really light that left Sirius about 8.6 years ago, because Sirius is about 8.6 light years distant. Thus, some galaxy we see that is two million light years distant is really the light from that galaxy which left its origin some two million years ago. Thus, we can tell composition from the spectroscopy of light from distant objects, or light that is millions of years old.

18. Do you believe in multiple universes?

I believe that you are referring to the multiple universe theory proposed as part of string theory. Science is an evidenced based process, and right now we have no evidence of any other universes in existence. String theorists have hypothesized that there might be multiple universes, what they call the bulk; however, as of now there is no evidence whatsoever that such multiple universes exist.

19. If we find intelligent life elsewhere in the galaxy do you think it would look like us?

There is probably very good reasons why we have certain characteristics. We have two eyes, which is the minimal number of eyes needed to be able to see stereoscopically, which allows us to estimate distances to objects. We have two ears for similar reasons, allowing us to determine direction of sounds that we hear. Thus, there are good reason for any extraterrestrial to have some similar features to our own, namely they are the minimal number to have to suit a purpose. While an extraterrestrial may have two eyes and ears for similar reasons, they may look quite different otherwise.

20. How will the universe end?

In the late 1990s, a team of astrophysicists modeled the end of the universe by running a computer model that extrapolated the future from the universe as it is today. They concluded that in the end, the universe would be dominated by black holes after all other components were merged with black holes after random motion through time. Thus the entire universe may end as a single black hole. Some believe that this would actually cause the creation of another universe. We do not know exactly, we can only model the future using what we know today and extrapolate how that pans out in the future. There are other possibilities, but all must use the laws of physics as their basis in the future occurrences.