**The Fermi Paradox Script**

Hi. Good morning everybody. Before we start today don't forget that you can find the script for this talk on my home page, stevenaskew.com. You can also find listening questions, sample answers, and you can download the mp3 if you want to practice at home, offline, or use it in your class. Also, if you have any topics you want me to talk about, please put them in the comments section below here.

Right. Today, I want to talk to you about something called the Fermi paradox. Before we talk about that though, we have to do a little bit of background. Now, where are we? We are on Earth, obviously. Why are we here? Well, what does life need? Life basically needs three things: we need water, we need a mix of chemicals, and we need a source of energy. Earth has all of those. The energy, of course, is the Sun. Now, why is there life on Earth? Is Earth special? Earth is in what's called the Goldilocks zone. If you know the Goldilocks story, it's about a young girl who finds a house in the forest and inside the forest there are three bowls of porridge left by the three bears. The first bowl of porridge is too cold, the third bowl of porridge is too hot, the bowl of porridge in the middle is absolutely perfect. The Goldilocks Zone is literally that. If a planet is too close to the sun it's too hot, life cannot survive. If a planet is too far away from its Sun, life is too cold and cannot survive. The Goldilocks Zone is the area that is just the right distance from the sun to have a climate that is survivable and Earth, of course, is in that Goldilocks Zone. Now, a lot of people think Earth is special. A lot of people think humans are here and Earth was created like this for us. But that, of course, is the wrong way of thinking. That is the wrong way round. The Earth is not like this for us, we are here because the Earth is like this. If the Earth was not like this we wouldn't be here and I wouldn't be talking to you as I am.

All right. Before we talk about the Fermi paradox we have to do a little bit of math. I'm not very good at math. I am an English teacher, I'm not a math teacher. I gave up math when I was sixteen years old. Let’s try. So, our galaxy, the Milky Way galaxy, has approximately two hundred billion stars. In the observable universe, there are approximately five hundred billion galaxies. There are probably more we don't know. Now, multiply two hundred billion by five hundred billion, you get, I think, one hundred trillion. So, in the known universe, there are one hundred trillion stars. Now, let’s say the average planet … sorry … now let's say the average star has four planets. Our sun, of course, has eight; Pluto is no longer a planet, some stars will have no planets, some stars will have many more. Let’s say the average is four. That means hundred trillion times four, there are four hundred trillion planets in the universe. Now, if we imagine that 0.1% of those planets are in the Goldilocks Zone, that makes four hundred billion planets. And, if we imagine that 0.1% of those planets have life, that's four hundred million planets with life. And, if we imagine that 0.1% of those planets with life have intelligent life, that's four hundred thousand planets. That means, potentially, four hundred thousand planets in this universe have intelligent life. It could be like us. It could be more intelligent, it could be less intelligent, I don't know, but approximately four hundred thousand planets could have life.

Now, here's where the Fermi paradox comes in. Enrico Fermi was an Italian American physicist. He lived from 1901 till 1954. He said, “If potentially there are four hundred thousand planets in the universe with life, and if, potentially, interstellar travel becomes possible, … we are getting close to that. I mean right now, we can travel to the moon, we're going to travel to Mars soon, it won't be long before we can travel to further planets, at least send probes to further planets, … and if, potentially, we could traverse our entire Milky Way galaxy in about a million years, at current speeds, where are they? Where are these aliens? We should have seen them or at least found traces of them.” The Fermi paradox is this: if aliens are there, why haven't we seen them? Therefore, there must not be aliens. Life must be special and life on this planet must be unique. That's the argument.

Now, I'm going to look at ten possible reasons why this is not a paradox. Why it's not a problem. Let's go through these in order. I'm going to go quite fast.

The first one: life is extremely rare. Maybe there are not four hundred thousand planets, maybe my calculations are wrong, maybe it's not 0.1% but it's 0.0000001%. who knows? If life is extremely rare that would explain why we haven't seen any. But, there is no logical reason to think that. The only reason you would think that is if you think this earth was created for us, but, logically, it's not. Humans are here because the planet is like this. If Earth had been created for us, we would have been here a lot sooner than we were. Why did we appear so late in the Earth’s history? So, that's obviously not possible.

The second one, now this is possible, intelligent life always destroys itself. This is very probable. If you look at our current civilization, how many times have we come close to our mutual destruction? Well, the First World War, the Second World War, a potential Third World War, which could be a nuclear war, could potentially destroy the entire civilization, the entire planet. We could wipe ourselves out and that's with the weapons we have now. In a hundred years, a thousand years, what kind of weapons are we going to have? It's very likely that any intelligent civilization, at a certain point, will destroy itself. Therefore, no intelligent civilization will reach the point where they can traverse the entire galaxy, which is why we cannot find them. But if that is true, we should possibly at least find traces of them. If we destroyed ourselves, traces of us would still be here on Earth. So, who knows?

The third reason, this is a little bit scary, possibly there is one super intelligent civilization that is traveling around the universe destroying all other civilizations it finds. If that is true, then we don't want to find them, because we would be destroyed. The physicist Stephen Hawking actually said this. He said we should be quiet. We shouldn't broadcast our presence.

Well, the fourth thing, and this is probably the most likely, they are too far apart. Think about the size of the universe. We say there are trillions of stars, and, of course, there are, but the stars are not that close together. Our closest star after the sun is 4.4 light years away. The next galaxy is 2.5 million light years. We cannot travel anywhere close to the speed of light. Our fastest rockets, our fastest spaceships would take longer to get there than we could possibly have. It would be impossible to do that, and if we did we wouldn't find any information until our civilization was far into the future. So, the vast sizes of the universe, of the galaxies, make it likely that even if there were civilizations out there, we would never see them. These civilizations could be islands in the sea of nothingness. It’s very possible that we wouldn't know they were there.

Reason five, now this is also extremely likely, we haven't been here long enough. If you think about humans … mankind's history on this earth, we have been here for 0.00013% of the Earth’s history. The Earth started, what, four and a half billion years ago. For the first few billion years it was a fiery ball. And then you had plankton, evolution started, and you have dinosaurs and then finally at the very end you have humankind. So, with the vast sizes of the universe, if a civilization on another planet did evolve and they did travel here what is the chance that they would arrive here when humans are here? Isn't it much more likely that they would arrive here at the time pre-humans, when the dinosaurs were here or when there was nothing here? For them to evolve at exactly the same time as us and for them to arrive here at exactly the time we are here is extremely unlikely. Probability alone would say that that wouldn't happen. So, these four hundred thousand worlds, they could all have evolved civilizations, but they wouldn't be at the same time. There is no reason why they would meet. That is very likely.

OK. Number six: we're not listening properly. We have satellites, we have telescopes, we have listening devices that are pointing into the sky, and they're listening for signals from foreign, alien worlds, but we don't have many of them, and they're not listening everywhere all the time. It's extremely likely that we would miss any signal coming from those worlds. So, even if they are there, we couldn't necessarily find them.

Number seven: we don't know how to listen. We only listen for the signals that we ourselves would send. We don't know what kind of signals the aliens would be sending.

Number eight: they don't want to communicate. Maybe they don't want to talk to us. Maybe they think there is a super intelligent civilization destroying society and they are staying silent. Who knows? Maybe they've already found us and they don't want to communicate to us. Who knows.

Number nine: they are too alien. Our logic, our physics, our biology, our laws would not apply to them. We wouldn't know them when we saw them. Maybe they're not physical beings. Maybe they're pure energy. How would we know if we saw? I’ve no idea. I mean we are carbon based life forms because carbon is one of the most common elements in the universe, but who's to say they are? Maybe they are silicon based. We've no idea.

And the last one, number ten: they are here, somewhere, undetected. Now that could be true. I mean there's no way to prove that. But, it's unlikely. I think the most likely reason is the vast distances of the universe and the fact that these civilizations do not evolve at the same time. Because of that, there is very little chance that they will ever meet.

Anyway, to finish, if we look back through human history. If we look back at when Europe was discovering other countries, other continents. If you think about our history, usually, when two civilizations meet the least technologically advanced civilization is destroyed by the most technologically advanced civilization. Europe and South America. Europe in Africa. Do we really want to meet a more advanced civilization? Would it be the end of our civilization? Who knows? Anyway, thanks for listening. Don't forget, go to my site and you can find the script and listening questions and sample answers and everything you might possibly want. Thank you for watching. See you next time. Bye.

**The Fermi Paradox Questions**

1. What is the Earth’s energy source?

A: Water

B: Chemicals

C: The sun

D: The other planets

2. What is the Goldilocks Zone

A: The distance from a star that is the perfect temperature

B: The amount of water and chemicals that a planet has

C: The distance between two stars or two galaxies

D: The amount of intelligent life that can develop on a planet

3. If Earth were not in the Goldilocks Zone, what would be different?

A: There would be more planets.

B: We would be able to travel across the whole galaxy.

C: There would be many alien civilizations.

D: Humans would not be here.

4. How many planets are there in the universe?

A: 400,000

B: 400,000,000

C: 400,000,000,000

D: 400,000,000,000,000

5. Which of these statements about the Fermi Paradox is not true?

A: Alien life should be able to travel across the whole galaxy in a million years.

B: We will be able to find intelligent life if we can travel as far as Mars.

C: There should be hundreds of thousands of planets with intelligent life.

D: We should be able to find trace of alien life.

6. Why did Professor Stephen Hawking say that we should be quiet?

A: So that we can travel around the universe and destroy all of the civilizations we find.

B: So that we do not end up destroying our own civilization.

C: So that a super-intelligent dangerous civilization does not find us.

D: So that we can make contact with any other civilizations that exist.

7. These civilizations could be islands in the sea of nothingness. In this statement, what do “islands” and the “sea of nothingness” refer to.

A: Stars – the ocean

B: Galaxies – the distances between them

C: Planets with intelligent life – space

D: the Milky Way Galaxy – the universe

8. Why does reason 5 suggest that intelligent civilizations wouldn’t meet.

A: Because humans have only been on Earth for a very short time

B: Because the distance between planets with intelligent life are just too big

C: Because our fastest space ships cannot travel that fast

D: Because the world was created for us

9. Why are we carbon based lifeforms?

A: Because alien life could be made of silicon

B: Because carbon is the most common element in the universe

C: Because our physics wouldn’t necessarily apply to alien life

D: Because we can only listen for the signals that we send out

10. What happened when Europeans went to South America and Africa?

A: They became part of the local civilizations.

B: The Europeans brought back many new things to Europe

C: They found it very difficult to communicate with each other

D: The local civilizations were destroyed

11. Summarize the Fermi Paradox.

12. When talking about the second reason Steven says, “It's very likely that any intelligent civilization, at a certain point, will destroy itself. Therefore, no intelligent civilization will reach the point where they can traverse the entire galaxy, which is why we cannot find them. But if that is true, we should possibly at least find traces of them. If we destroyed ourselves, traces of us would still be here on Earth.”

i) Do you agree that intelligent civilizations are doomed to destroy themselves?

ii) Should we be able to find traces of these civilizations?

13. At the end, Steven says, “If you think about our history, usually, when two civilizations meet the least technologically advanced civilization is destroyed by the most technologically advanced civilization.” Do you agree?

14. What would you do if you were the first human to meet an alien?

15. What do you think aliens would look like?

**The Fermi Paradox Answers**

1. C 2. A 3. D 4. D 5. B 6. C 7. C 8. A 9. B 10. D

11. Summarize the Fermi Paradox.

Enrico Fermi looked at the possibility of intelligent life in the universe. He calculated that there are most probably thousands of planets with intelligent life. His paradox says that if there is so much intelligent life in the universe, we should have found traces of it, or heard from it. The fact that we haven’t, must mean that we are alone in the universe.

12. When talking about the second reason Steven says, “It's very likely that any intelligent civilization, at a certain point, will destroy itself. Therefore, no intelligent civilization will reach the point where they can traverse the entire galaxy, which is why we cannot find them. But if that is true, we should possibly at least find traces of them. If we destroyed ourselves, traces of us would still be here on Earth.”

i) Do you agree that intelligent civilizations are doomed to destroy themselves?

 I do agree that some intelligent civilizations are doomed to destroy themselves, but I would argue that it is a small minority rather than a majority. You can see this to be true by considering our gradual move towards peace and the slow slide into globalization.

 If you look at the history of mankind, you can see that the amount of war, the sheer number of people killed in wars, has gradually declined. Yes, we obviously still have war, and, yes, people are obviously still killed in wars, but these figures are gradually declining. From a peak of millions of people in the Second World War, only 22,000 people were killed by war in 2007. That is still, obviously, a lot of people, but it does show that our world is becoming more peaceful. Wars are becoming more local, less global, and thereby fewer people are affected. One of the reasons for this is education. People who are highly educated are, with some exceptions, less likely to turn to war to solve problems. Most of the wars that are currently happening are in developing countries with low standards of education and are a direct result of colonization. Gradually, over time, these countries appear to settle down, educate their people and, as they become more prosperous, they become more peaceful. We are slowly growing out of war.

 Globalization is playing a large part in this. For all of its faults, and there are many, globalization can lead countries to abandon war. One of the effects of globalization is to give many different people a similar goal, which means they are less likely to fight. Also, globalization is amalgamating countries. Over the last hundred years, the physical borders between countries have stayed the same but the cultural borders have blurred. In the next hundred years, I predict that the number of countries in the world will decline as countries join together.

 However, I do think that some civilizations will bring about their own destruction. Even if a civilization is becoming peaceful, technology will lead their weapons to become more and more powerful. All you need is one terrorist with that weapon to bring about the end of that civilization. Unfortunately, even in a peaceful country, not everyone is happy.

ii) Should we be able to find traces of these civilizations?

 That entirely depends on when another intelligent life arrives. If we take our planet as the one where civilization has ended and look at an arriving intelligent life, we can say that traces would be obvious for a few thousand years, and then become increasingly more difficult to find.

 If humans disappeared, our buildings, roads and most of the things we have built would be destroyed by plants and erosion. You could probably find traces for a few thousand years. The pyramids have already been around for four thousand years and, because of their dense construction, will probably be around for another ten thousand. Jeff Bezos, of Amazon fame, is funding a 10,000 year clock that is being built inside a Texas mountain. (Research it if you have time, an extremely interesting idea). That will last for 10,000 years at a minimum. But, of course, the Earth has been here for 4.5 billion years. 10,000 years is just a blip. If the alien life arrives 100,000 years in the future then there is less chance they will find any traces. They may find fossils, possibly rock carvings that were sheltered, maybe a foundation. What about a million years in the future? The mountains will have changed, the continents will have moved. 10 million years? 100 million years? A billion years? If the universe is 13.5 billion years old and it is halfway through its lifecycle (I remember reading that somewhere) then intelligent civilizations could be traversing the universe billions of years into the future. In another 4 billion years the Earth will be burned to a crisp as the sun becomes a red giant, so there won’t even be a planet to find traces on. When we consider these vast time scales, it becomes increasingly easy to see why no two intelligent civilizations are likely to meet.

13. At the end, Steven says, “If you think about our history, usually, when two civilizations meet the least technologically advanced civilization is destroyed by the most technologically advanced civilization.” Do you agree?

 It does appear to be true, if you simply look at our history, but that doesn’t automatically mean it will be true in the future. The Europeans that went to South America went there with the goal of colonization. To colonize a place you need to subjugate its people. In doing so, many will be eradicated. That has been proven. However, were Europeans to find as yet unexplored places now, one would hope they would explore them with a different mindset. If we were to find a technologically disadvantaged people, we could improve their situation. We could bring them medicines, medical treatments, sanitation improvements, building improvements. We could vastly improve their lives. Rather than destroying them, we would help them. So, if a vastly superior intelligent race were to come to Earth, they could potentially make our civilization better. They could. If, though, they came here with the intent of conquer and colonize, then there would not be a single thing we could do to stop them.

14. What would you do if you were the first human to meet an alien?

 Wow. That’s quite a question. Depending on what the alien looked like, how they arrived and how I had come across them, my first reaction would probably be surprise. After I got over that kneejerk reaction, I would endeavor to communicate. My, and probably humankind’s, first goal would be to demonstrate that we are not a threat, have nothing but peaceful intentions and wish to learn. How I would do that I have no idea. Any gesture or word I made could be so alien to the alien that it could be construed as an act of war. I exaggerate, but you understand what I mean. I would keep my hands down in a nonthreatening posture and I would speak slowly and calmly. I would hope that these beings would be sufficiently advanced enough that they would understand what I was saying. I would try to explain as much as possible about mankind, and then I would take them to “our leader”. On the other hand, if these beings were here with malicious intent, then I, Steven Askew, would have the unfortunate honor of being the first human killed by aliens.

15. What do you think aliens would look like?

 There is no way to know, obviously, but I could guess. If we look at life on our planet, the majority of it is insect based, by an approximate ratio of 200 million insects to every one animal. We could therefore assume that the likelihood of alien life being insect based is 200,000,000 to one. However, any alien life will have evolved to fit the gravity and environment on its own planet. If it came from a cold, dark planet with high gravity, it would be short, stocky, thick skinned, hairy, with small or even no eyes. There is no way of knowing. The chances of them looking exactly the same as us, though, are extremely small.