

→ Mark your confusion.

→ Purposefully annotate the article (1-2 mature, thoughtful responses per page to what the author is saying)

→ Write a 250+ word response to the article.

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There's Only One Way For Humanity to Survive. Go To Mars.

By Simon Worrall for *National Geographic*, 3-2-18

Futurist Michio Kaku sees humans doing ballet on Mars and projecting their brains into the cosmos. And aliens? Oh, they're coming.

As a child in Palo Alto, California, he built an atom smasher in the garage. He later became one of the founders of string theory. Today, with his flowing mane of silver locks, Michio Kaku is one of the most recognizable faces of science, with several bestselling books and numerous television appearances, including on the Discovery Channel and the BBC.

In his new book, *The Future Of Humanity*, he argues passionately that our future lies not on Earth, but in the stars.

When National Geographic caught up with him by phone at his office at City College, in New York City, he explained how billionaires like Elon Musk are transforming space travel; why laser porting may be the best way to reach other galaxies; and how one day there may be ballet dancers on Mars.

Right at the beginning of the book, you make the shocking prediction: “Either we must leave the Earth or we will perish.” Are humanity’s prospects really that dire? And doesn’t this play into the nihilistic feeling that there is nothing we can do to save this planet?

If you take a look at evolution on Earth, 99.9 percent of all life forms have gone extinct. When things change, either you adapt or die. That’s the law of Mother Nature. We face various hazards. First of all, we have self-inflicted problems like global warming, nuclear proliferation and bio-engineered germ warfare. Plus, Mother Nature has hurled at the Earth a number of extinction cycles. The dinosaurs, for example, didn’t have a space program. And that’s why the dinosaurs are not here today.

On the other hand, we shouldn’t use this as an excuse to pollute the Earth, or let global warming run amok. We should cure these problems without having to leave for Mars or another planet, because it’s impossible to remove the entire population of Earth to Mars. We’re talking about an insurance policy—a backup plan in case something does happen to the Earth. I once talked to Carl Sagan about this, who said, “We live in the middle of a shooting gallery with thousands of asteroids in our path that we haven’t even discovered yet. So, let’s be at least a two-planet species, as a backup plan.”

One of the beautiful images you conjure is of ballet dancing on Mars. Explain why this may one day be less fanciful than it seems.

We have the Olympics, where we have athletes that understand the laws of gravity on Earth, but once we’re on the moon and Mars, we have a totally different set of physical constraints. Here, ice skaters can’t do anything more than a quad; four rotations in the air and that’s it! No one has ever done a quint. However, on Mars the gravity is only 30 percent of Earth, so one day we may have an Olympics on Mars where people could do four, five, six, seven rotations in the air, and ballet, or acrobatics, and gymnastics. A whole new set of athletes could be formed because they are adapted to a new environment where the gravity and air pressure is lower. The astronaut Alan Shepard was the first one to golf—golf—on the moon! He snuck on a pair of golf irons. NASA was horrified, yet in the Smithsonian Museum now, you can see a replica of the golf clubs he used, to prove that interstellar sports could become a real possibility.

You use the phrase “the fourth wave of science.” Explain what this means and how it could one day make it possible to terraform Mars.

We’ve had three waves of scientific innovation. The first wave, the Industrial Revolution, gave us the steam engine, the locomotive, and factories. The second wave was electricity and magnetism, whereby we had TV, internal combustion cars, a beginning of the space program. The third revolution is high tech: computers, lasers, the Internet.

Now we have the fourth wave of innovation: artificial intelligence, biotech, and nanotech. That's going to change the way we view Mars. Many people say Mars is cold and desolate, and there's nothing to grow there. We can genetically modify plants and algae to thrive in the Martian atmosphere. But who's going to do the heavy lifting? We all would like to see futuristic cities on Mars, but robots are going to become much more adapted to working in these harsh environments by the end of this century, so we expect to see robotic construction workers building the fantastic domed cities you see in science fiction novels.

Elon Musk recently launched his old Tesla sports car into space. Tell us about the “battle of the billionaires” and how they are shaping the future.

Space was very expensive back in the 1960s. That's why, after we went to the moon, we lost interest. Now we're talking about a new golden age of space exploration, in part because a whole fleet of Silicon Valley billionaires are fulfilling their childhood dreams, building spaceports on their own. The Falcon Heavy moon rocket launched by Space X was funded by Elon Musk's own pocket money. It was the most powerful rocket ever and taxpayers didn't pay one dime.

Both Musk and NASA are focused on Mars as the next challenge. Talk us through the problems we will face, and what solutions we might find.

We're going to have to be very careful sending our astronauts to Mars. Going to the moon took only three days. You could go to the moon on Monday and come back on Friday. Going to Mars is a whole other picture. It takes nine months just to get to Mars, then you have to wait a few months for the planets to realign and then another nine months to come back. So, it's a two-year journey where weightlessness, cosmic radiation, and micrometeorites will all be problems. Mars is also frozen, so we're going to have to heat up the surface, which is called terraforming.

Early settlers who came to the U.S. almost 400 years ago had game to shoot, plants to raise and topsoil on which to grow crops. But we will have to bring everything to Mars ourselves. That's why cost is so important and why we want robots to build things, genetically engineered crops to thrive in that environment, and nanotechnology to create lightweight, super-strong building materials that are pre-fabricated to create dome cities.

Travelling to distant stars will require new forms of transportation. Tell us about the Breakthrough Starshot project and other fantastical ideas being advanced.

Once again, Silicon Valley billionaires are opening up their checkbooks to the tune of \$100 million to build the first starship to go to the nearest star, Proxima Centauri. We've been brainwashed by Hollywood to think that you have to have a gigantic starship, like The Enterprise, with heroic captains, like Captain Kirk. But the first starship that goes to Proxima Centauri could be the size of a postage stamp—a computer chock full of sensors and cameras, with a parachute on it. You inflate the parachute by shooting a laser beam at it from Earth, maybe 800 megawatts of energy, which would shoot these tiny parachutes up to 20 percent the speed of light. That is doable, believe it or not. So in just 20 years some of them may reach the nearest star, using off-the-shelf technology. Looking further into the future, physicists are already dreaming about the post-chemical rocket era when we might use antimatter, fusion power, or ramjet reactors in order to travel at 50 percent the speed of light, which could take us to the stars.

Another problem with deep-space travel is that it may take hundreds of light-years to reach your destination. You suggest deep freezing astronauts, then thawing them out at the other end. To quote John McEnroe: You can't be serious, can you?

The stars are extremely far away, but one day we hope to use advanced physics to go faster than the speed of light—warp drive. Until we get warp drive, we're stuck with rockets that are below the speed of light and the planets we have discovered that are Earth-like would take hundreds of years to reach. This means we have to find the secret of extending the human lifespan or learn how to freeze ourselves. Some companies already offer to freeze your body so that when you are thawed out, there'll be cures for cancer and other diseases. Don't believe it. These companies, I think, are bogus. However, it's a possibility that has to be looked at.

We've discovered about 60 genes that seem to influence the lifespan of human beings and we know that certain genes allow animals to live for centuries. The Greenland shark, for example, lives to be over 400 years of age. So genetics may make it possible to slow down the aging process.

Your own preferred solution is what you call laser porting. Explain what this is—and how the Human Connectome Project may be laying the foundations.

The first big scientific project was the Manhattan Project, which gave us the atomic bomb. The second was the Human Genome Project, which gave us the human genome. The third could be the Connectome Project. Many nations, including the U.S., have said that the brain is the key to understanding mental health, depression, and suicide. All that could perhaps be unraveled if we understand the connectome, which is a map of the entire brain.

We expect to have this perhaps by the end of this century. But once we have it, what do we do with it? We could look at mental illness, but we could also put it on a laser beam and shoot it into outer space. In one second, you'd be on the moon; in 20 minutes you're on Mars; and in years you're on the nearest star. So laser porting is perhaps the most efficient way to explore the galaxy without booster rockets, radiation dangers, or problems from asteroid impacts. You just laser port yourself!

Let's end with the million-dollar question: Will we one day make contact with another civilization in outer space? If so, when? And do you agree with Stephen Hawking, who warned of the dangers of contact?

I definitely think we have to take his warning to heart because we will one day encounter other terrestrial life forms. They're probably going to be thousands of years more advanced than us. They're not going to want to plunder us for resources because there are a lot of uninhabited planets out there, like Mars, that they can plunder without having to deal with restive natives like us. The main threat is that we might be in the way. In the novel *The War of The Worlds*, the Martians wanted to take over the Earth not because they were evil or because they didn't like *Homo sapiens*. They had to remove us so Martians could thrive on Earth and terraform it so it looked like Mars.

We have discovered 4,000 planets so far in the galaxy, and we now know that on average every star in the galaxy has a planet of some kind. So I think it's inevitable that we're going to bump into one of these advanced civilizations and it will change world history. Not like Cortez meeting Montezuma and shattering Aztec civilization in a matter of months. The conquistadors had a hidden agenda. They wanted to plunder the gold of the Aztecs. I don't think the aliens will want that. And, hopefully, there'll be a mentor to show us the way to the future without having to go to war and resort to savagery and barbarism.

Response option(s):

- Michio Kaku is a famous futurist. (A futurist is someone who studies the future and makes predictions about it based on current trends.) What are some claims that Kaku makes about the future in this article? What evidence does he use to support his predictions?
- Select one claim about the future that Kaku makes that you disagree with. First, summarize his claim and the evidence he uses to support it. Then, disagree with his claims with reasons and evidence of your own.