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Sending Astronauts Created by Synthetic Biology and AI with Plant Characteristics to Exoplanets：A Consideration for Humanity's Future Beyond the Solar System

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Sending Astronauts Created by Synthetic Biology and AI with Plant Characteristics to Exoplanets: A Consideration for Humanity's Future Beyond the Solar System

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Highlights

- Focus on the extinction of humanity due to a helium flash of the Sun in the distant future
- Escaping to Mars still does not exempt humans from the risk of extinction
- This new technology has an obvious directional difference from traditional space exploration
- Either humanity will be destroyed or it will need to thoroughly reform itself
- Assessing the potential impact of this future technology on various aspects of human society.

Abstract: Based on the fact that the solar system will eventually be destroyed and that humans cannot travel to the nearest habitable exoplanet within a lifetime, this article suggests sending synthetic biology- and AI- created astronauts with some plant characteristics to the closest habitable exoplanet. The paper assesses the potential impact of this future technology on various aspects of human society, including scientific, ethical, and cultural dimensions. As long as these astronauts with some plant characteristics possess human consciousness, it is irrelevant whether they are hybrids of carbon- and silicon- based life forms. They will carry on the human heritage on exoplanets. Humanity has two survival options. The first option is the Martian migration program led by Elon Reeve Musk, which is both visible and realistic. It could provide an immediate option for human continuation and expansion, although it may not help us escape the future burning of the Sun during its red giant phase. The second option involves directly sending astronauts with some plant characteristics beyond the solar system. Escaping to Mars still does not free humans from the risk of extinction. We must strive with all our might; otherwise, humanity will be forever trapped within the solar system, awaiting the inevitable helium flash to come.

Keywords: red giant; helium flash; synthetic biology; AI; astronauts; society

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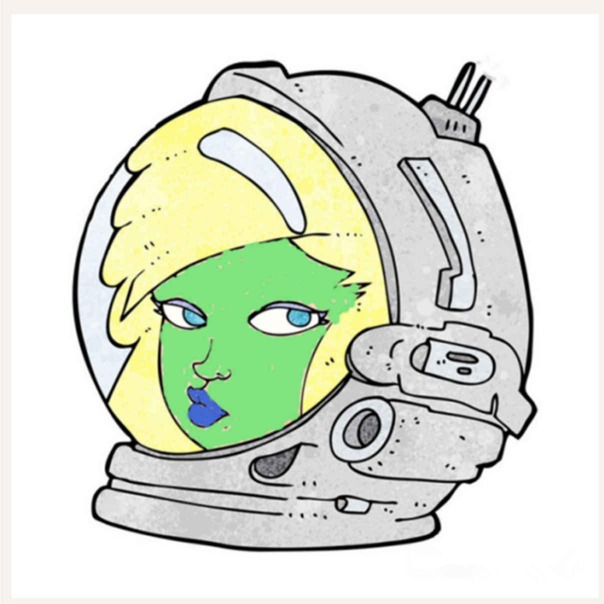
Graphical Abstract



1. Introduction

The idea of sending plant - like astronauts to exoplanets represents a radical departure from traditional concepts of space exploration. With the increasing awareness of the long-term challenges faced by humanity in the cosmos, such as the eventual death of the Sun and the limitations of our solar system, new and innovative solutions are required. The concept of plant - like astronauts combines the fields of synthetic biology, artificial intelligence, and space exploration, offering a potential path for humanity's long-term survival and expansion.

Many scientists studying the fate of the Earth state that the planet will eventually burn up (**Figure 1**). According to current stellar theory, the Sun would have expanded into a red giant long before the helium flash (**Fadeyev, 2019**), scorching all life within the solar system.

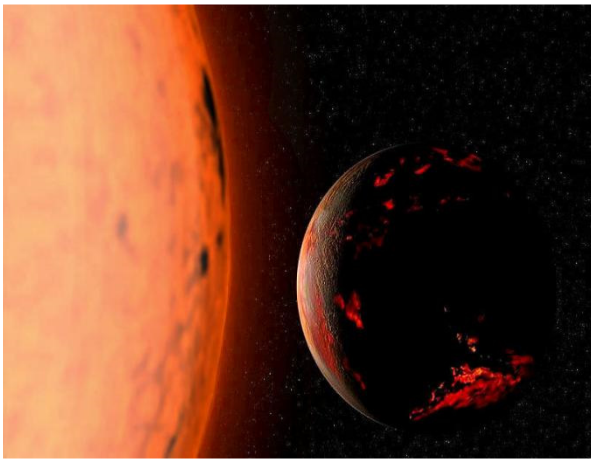


Figure 1. Artist's impression of the Earth scorched by our Sun as it enters its Red Giant Branch phase (Credit: Wikimedia Commons/Fsgregs).

Survival and reproduction are the most important factors for any species. Therefore, the most urgent scientific priority for humanity is to find a way to escape from the Solar System.

As the great biologist Ernst Mayr said, in the biological sciences, the vast majority of important advances have been made by introducing new concepts or improving existing ones (**Mayr, 1982**).

The solution I propose is an important direction among many possibilities, but it does not exclude efforts in other aspects.

As science concerns only with relative truth, we seek ideas that are state-of-the-art, which may be controversial, but stimulate and promote new ideas, new techniques, and new applications.

Some people may think this is a heretical view, but the reason why the world is so beautiful is simply that we have never given up on any color...

2. The Concept of Plant - Like Astronauts

2.1. Biological Characteristics

Plant - like astronauts are envisioned to have green skin, which could potentially be related to the presence of chlorophyll-like substances enabling photosynthesis. Their blue blood might be a result of a different oxygen-carrying mechanism, perhaps more suitable for the harsh conditions of space. The ability to perform photosynthesis is a key feature, as it allows them to generate energy independently, reducing the need for traditional energy sources during long-duration space travel.

2.2. Resistance to Space Conditions

These astronauts are designed to withstand cosmic radiation and extremely low temperatures in space. Cosmic radiation is a major obstacle for human space travel, as it can cause DNA damage and other health problems. The unique biological makeup of plant - like astronauts may provide them with natural protection against such radiation. Similarly, their ability to tolerate extremely low temperatures could make them more suitable for long - term space missions.

2.3. Consciousness and Humanity

The question of whether plant - like astronauts possess human consciousness is crucial. If they do, then they can be considered as a continuation of the human lineage, regardless of their being hybrids of carbon- and silicon- based life forms. This raises profound philosophical questions about the nature of humanity and consciousness.

3. Methods

My research methods for this study involve *boldly making hypotheses* and *carefully finding evidence*. As Albert Einstein once said, "We only observe what confirms our theories" (**Howard, 2019**).

4. Results

4.1. A Hypotheses Proposed

Considering that humanity cannot travel to the nearest habitable exoplanet within its lifetime, the author proposes the transformation of humanity by relying on synthetic biology and AI, to create batch after batch of plant - like astronauts who can adapt to eternal interstellar expeditions. The author proposes transforming human astronauts into plant - like astronauts with green skin and blue blood, who are capable of undergoing photosynthesis to produce oxygen and carbohydrates using abundant light energy from stars during interstellar expeditions. These astronauts who are capable of self - renewal are not afraid of cosmic - ray radiation or extremely low interstellar temperature. This approach may help to solve the survival problems that the human race will always face during its eternal interstellar expedition.

4.2. Finding Evidence

4.2.1. Humanity Cannot Travel to the Nearest Habitable Exoplanet Within Its Lifetime

Teegarden's Star b was the first confirmed, potentially habitable exoplanet. It is located 12.5 light-years (L.Y.) away from us. This implies that atmospheric composition may permit the formation of stable liquid water on its surface (**Singla & Sengupta, 2023**).

One must overcome four major obstacles to break out of the solar system. These obstacles include:

1. The Asteroid Belt, which is composed of millions of small asteroids and is located between Mars and Jupiter (**Bellome et al., 2024**).

2. The Kuiper Belt, known for the occasional appearance of ice giant objects, which is located beyond Neptune (**Kaib et al., 2024**).

3. The high-temperature plasma solar corona, which exceeds 40,000 degrees Celsius and is located at the edge of the solar system (**Boudjada et al., 2005**).

4. The Oort Cloud, which contains trillions of small celestial bodies, each about 1 kilometer in size, and surrounds the entire solar system (**Crane, 2023**).

Even without considering factors such as gravitational fluctuations caused by the Sun and its planets on the spiral trajectory of a human spacecraft leaving the solar system, or the power configuration of the spacecraft itself, we can still attempt to make the following rough calculations:

1. Taking the New Horizons spacecraft launched on January 19, 2006 as an example, its flight speed is approximately 58,356 kilometers per hour (**Anonymous, 2023**), then:

How many kilometers would it take from Earth to ***Teegarden's Star b***?

9,460,800,000,000 km/L.Y. * 12.5 L.Y. = 118,260,000,000,000 km

How long does it take to fly from Earth to ***Teegarden's Star b***?

118,260,000,000,000 km / 58,356 km/hr = 2,026,526,835 hours

≈ 231,339 years.

2. If we switch to a different algorithm and consider that Voyager 1, launched 47 years ago, has traveled 24 billion kilometers at a speed of 17.062 kilometers per second, how long would it take to travel from Earth to ***Teegarden's Star b***?

118,260,000,000,000 km / 17.062km/sec = 6,931,133,454,460 seconds.

6,931,133,454,460 seconds / 31,557,600 seconds/year

≈ 220,000 years.

So, it would take at least 220,000 years to travel from Earth to the closest habitable exoplanet, ***Teegarden's Star b***.

Therefore, to avoid extinction during the interstellar expedition of eternity, humanity must undergo drastic changes.

Stephen Hawking also believed that humanity must increase their complexity (**Hawking, 2018**), although he did not study this in detail.

4.2.2. Plants Are Better Adapted to the Environment Than Animals

● Mosses and lichens have strong anti-radiation properties

Research conducted at the Russian space station Mir has shown that the dangers of radiation from cosmic rays are real. The equivalent dose is about 10 Sv during high solar activity, whereas current standards dictate that the maximum radiation exposure for ordinary individuals should not exceed 0.005 Sv (**Horst et al., 2022**). This radiation can cause excessive oxidation of cells, leading to cancer (**Bizzarri et al., 2023**).

● Plants are capable of producing oxygen and carbohydrates via photosynthesis

Plant leaves are similar to solar energy collectors that are full of photosynthetic cells. These cells combine water and carbon dioxide molecules to produce sugars and oxygen, respectively. If humanity were able to photosynthesize, we would not need to carry as many oxygen tanks or food supplies during extraterrestrial exploration.

4.2.3. The Distinction Between Animals and Plants Is Not Clear

● Plants with animal characteristics, such as insectivorous plants

For example, *Nepenthe mirabilis* (**Porfírio et al., 2022**) and *Drosera capensis* (**Diers et al., 2024**). Their leaves secrete mucus to catch and digest the worms. Please see **Figure 2**.

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Figure 2. Plants with animal characteristics (Left) *Nepenthe mirabilis* (Royalty-Free) (Right) *Drosera capensis* (Royalty-Free).

● Animals that use cutaneous respiration can exhibit plant - like characteristics (**Romer, 1972**). For example, *earthworms* and *amphibians* (**Figure 3**).

Figure 3. Animals that use cutaneous respiration (Left) Earthworm **(**Wikipedia**)** (Right) A*mphibian* (Encyclopedia).

4.2.4. Green Skin

Plants can perform photosynthesis using chlorophyll, which is produced by both plants and bacteria. Even if humanity had green skin, they would not be able to perform photosynthesis because it requires chlorophyll, which humans do not possess. However, humans have something similar to chlorophyll, which is hemoglobin.

Chlorophyll and hemoglobin (heme) are not contradictory entities; rather, they serve different biological functions. Under certain conditions, they can both contribute to the synthesis of organic compounds, albeit through different pathways (**Liu et al., 2022**).

Several precedents exist for photosynthesis in animals：

● In 1986, American scientists discovered a photosynthetic animal called the green-blue trumpet worm. It can photosynthesize through the pigments in its body, converting light energy into adenosine triphosphate (ATP), which is a chemical form of cellular energy (**Anonymous, 1986**).

● Some animals, such as certain types of sea slugs and a few other organisms, have evolved to temporarily incorporate chloroplasts (**Anonymous, 2022**).

● Chlorohydra were collected In February 1987 from Song County, Henan Province, China. Hydra is light green and has green Chlorella living in its inner cavity layer, which can undergo photosynthesis together (**Gao, 1987**).

Implanting some plant tissues into animal bodies does not trigger xenogeneic rejection:

● The tradition of using bamboo to set broken bones existed in ancient China. A fresh piece of bamboo was inserted into the fracture, and its capillary vessels, which are very rich, gradually fused

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with the bone tissue. After the broken bone had healed, there was no need for repeat surgery to remove the bamboo (**Jiangsu Provincial Institute of Botany, 1991**).

4.2.5. Blue Blood

The term 'blue blood' refers to the blue appearance of the blood in certain arthropods and mollusks. Hemocyanin, a copper-containing protein found in the blood of some invertebrates like octopuses and horseshoe crabs, is responsible for oxygen transport and gives the blood its blue-greenish hue due to its copper content (**Zhou, 1986**).

In the same scenario, hemocyanin is superior to hemoglobin in:

● It has a relatively high molecular weight and strong ability to bind and release oxygen molecules (**Christian et al., 2010**).

● Even at low temperatures, hemocyanin does not lose its oxygen-carrying capacity (**Christian et al., 2010**). Therefore, the plant - like astronauts that we seek should not fear the coldness of the space.

4.2.6. Synthetic Biology

Today, chemists envision that synthetic biology will involve molecular design supported by structure theory, yielding unnatural molecular species that can mimic not only the binding and catalysis of specific biomolecules, but also exhibit the highest forms of biological behavior, including macroscopic self-assembly, replication, adaptation, and evolution (**Steven, 2011**).

Elon Musk stated in 2022 (**Musk, 2022**) that *using DNA sequences could transform humanity into butterflies and that you could practically do anything with synthetic RNA*.

4.2.7. AI

Due to the intricate nature of biological systems, conducting synthetic biology in a quantitative and predictive manner continues to pose a challenge. Recently, the emergence of artificial intelligence (AI) and machine learning (ML)—technologies that enable computers to learn from experience—has presented potentially powerful tools to address this challenge.

In our study, the plant - like astronauts we pursue are likely to be a hybrid of carbon-based and silicon-based entities. However, silicon-based life cannot emerge directly because it is too stable and does not change on its own; it must be brought forth by human hands. The silicon-based life has no bounds and is specifically adapted for eternal space travel. An AI with human-like consciousness is destined to be the future and the eternal of humanity.

Thus, nature $\xrightarrow{\text{sculpts}}$ humans, humans $\xrightarrow{\text{sculpts}}$ AI, and AI $\xrightarrow{\text{sculpts}}$ plant - like astronauts. In essence, the research of this project must rely heavily on AI technology.

The fatal defect of AI beings or hybrids of carbon- and silicon-based life forms is that they must be supported by an energy supply. In the universe, the starlight energy is eternal, and photosynthesis is eternal, so plant -like astronauts can exist in the universe forever.

Therefore, the theme proposed in this article—creating plant - like astronauts capable of iteration—presents an ideal arena for Synthetic Biology and AI to demonstrate their capabilities.

5. Discussion

5.1. This Study Involves Ethical and Law

Although this study involves ethical and legal issues related to human beings, it is both necessary and urgent, as it concerns the entire future existence of humanity. Humanity faces a critical choice: either destruction or thorough reform. Time is running out, with the melting of polar ice caps due to greenhouse gases and the threats of nuclear war by warmongers looming large. Only a small number of volunteers, not the entire human race, will participate in this research under the supervision of the Ethics Committee of the Global Scientific Community. Show courage and contemplate joining this study; it represents the final desperate attempt of our human race. This

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research involves ethics and laws. Of course, it is urgently necessary for ethics experts, legal experts and natural scientists all over the world to explore and solve this issue together.

5.2. Sending Astronauts Created by Synthetic Biology and AI with Plant Characteristics to Exoplanets Faces Numerous Technological Challenges

5.2.1. Synthetic Biology

1. Astronauts with plant characteristics

● It is necessary to ensure that these artificial life forms can stably perform plant physiological functions, such as photosynthesis, in a structure similar to the human body (**Allakhverdiev, 2024**). In photosynthesis, chloroplasts fix carbon dioxide and convert it into organic substances, and are also involved in nitrogen - metabolic processes such as nitrate reduction. If the material - metabolic pathways of the host cells do not match those of chloroplasts, there may be situations of metabolite accumulation or deficiency. For example, animal cells lack some enzymes and metabolic pathways related to carbon fixation and nitrogen metabolism in plant cells. Without modification, chloroplasts may not be able to carry out normal material metabolism in animal host cells, thus affecting their compatibility. When integrating plant chloroplasts into artificial cells, the compatibility problem between chloroplasts and host cells needs to be solved (**Minges and Groth, 2020**). The normal function of chloroplasts depends on the precise regulation of a variety of internal and external factors(**Zhu et al. 2020**). In an artificial environment, it is very difficult to accurately simulate the original environment within plant cells to ensure that chloroplasts continuously and efficiently carry out photosynthesis (**Kaiser et al. 2019**). Moreover, Chloroplasts have their own independent genomes, and their gene expression regulation mechanisms are very different from those of the host cell genomes. The plant chloroplast genomes encode some genes related to photosynthesis, and the structure and function of chloroplasts themselves. When chloroplasts are introduced into host cells, the transcription and translation systems of the host cells may not be able to correctly recognize and process chloroplast genes, resulting in abnormal expression of chloroplast genes (**Kumar and Ling, 2021**).

● Maintaining the internal homeostasis of the life - support system is also a challenge (**Mizraji, 2024**). Plants have the ability to adapt to environmental changes. However, in the system of artificial astronauts, achieving homeostasis mechanisms similar to those of plants, such as water, nutrient circulation and temperature regulation, requires complex engineering design. For example, plants absorb water and nutrients through their root systems, while artificial astronauts may need to design special circulation systems to simulate this process. At present, the technology for precisely controlling these circulation systems at the micro and macro levels is still immature (**Heinen et al., 2024**).

2. Gene Editing and Regulation

● Precise gene editing is the key to creating such special astronauts. It is necessary to integrate plant genes into the appropriate host genome and ensure that these genes can be expressed as expected. Although current gene - editing technologies such as CRISPR - Cas9 are powerful, there are still limitations in cross - species, large - scale gene integration, and precise regulation (**Hartmann et al., 2022**). For example, when multiple plant genes are introduced into artificial cells to achieve plant characteristics, gene silencing or abnormal expression may occur, affecting the function of the entire life system.

● Dynamic regulation of gene expression is also a difficult point (**Yue et al., 2024**). The expression of plant genes will change with the environmental changes. In artificial astronauts, to simulate such a dynamic regulation mechanism, advanced gene regulation technologies need to be developed. For example, plants will adjust the expression of photosynthesis - related genes when the light intensity changes. However, in artificial life systems, there is still a lack of effective technical means to sense environmental changes and accurately regulate gene expression.

5.2.2. Artificial Intelligence

1. Intelligent Decision - making and Adaptability

● These special astronauts need to possess a high - level intelligent decision - making ability. During the long journey to exoplanets, various complex situations will be encountered, such as cosmic radiation, micrometeoroid impacts, and spacecraft malfunctions. Artificial intelligence needs to be able to make decisions quickly and accurately to deal with these crises. Currently, artificial intelligence algorithms may make wrong decisions or be unable to make decisions (**Li et al.,2022**) when facing complex and unexpected cosmic environmental situations. For example, when encountering a new type of cosmic radiation that interferes with the spacecraft's communication system, artificial intelligence may not be able to make the correct repair decision based on the existing data.

● The ability to adapt to different planetary environments is also a challenge (**Wehmann et al., 2023**). The environments of exoplanets may be completely different from that of the Earth. Artificial intelligence needs to be able to quickly adjust the behavior patterns of astronauts according to the new environment. For example, on an exoplanet with different gravity from the Earth and special atmospheric components, artificial intelligence has to replan the astronauts' ways of movement, energy - use strategies, etc. However, current artificial intelligence technologies are still relatively weak in this cross - environment self - adaptation ability.

2. Integration with Synthetic Biology

● Achieving effective integration between artificial intelligence and the life systems created by synthetic biology is crucial (**Mohseni and Ghorbani, 2024**). Artificial intelligence needs to be able to monitor and regulate various parameters of the life system in real - time, such as cell metabolism, gene expression, etc. However, currently, the technical interfaces between these two fields are not yet perfect, lacking effective data - sharing and interaction mechanisms. For example, artificial intelligence wants to adjust gene expression according to the nutritional state of cells in the life system to improve energy - use efficiency. But due to the lack of appropriate integration technologies, it is very difficult to achieve such cross - field precise regulation.

5.2.3. Aerospace Engineering

1. Long - distance Voyage Technology

● Exoplanets are extremely far away from the Earth, and advanced propulsion technologies are required to shorten the voyage time. Current chemical propulsion technologies cannot meet the requirements of such long - distance travel (**Tiwari et al., 2024**). Although emerging technologies such as ion propulsion and solar sail propulsion have potential (**Takao et al., 2021**), they are still in the development stage and have problems such as energy supply and efficiency improvement. For example, although the ion thruster is more efficient than the chemical thruster, its thrust is relatively small. To send astronauts to exoplanets, a long - term acceleration process is required, which places high demands on the spacecraft's energy reserve and reliability.

● During long - distance voyages, the long - term operation problem of astronauts' life - support systems also needs to be solved (**Dakkumadugula et al., 2023**). For astronauts with plant characteristics, it is necessary to ensure the long - term stable operation of plant physiological functions in space environments such as microgravity and high - radiation, and to ensure the circulation and balance of the entire life - support system. Currently, the long - term operation stability and resource recycling efficiency of space life - support systems still need to be improved.

2. Landing and Exploration Technologies

● After arriving at an exoplanet, safe landing is a challenge (**Lorenz, 2019**). The atmosphere, terrain, etc. of exoplanets are unknown, and it is necessary to develop landing technologies that can adapt to all possible situations. For example, if the atmospheric density of an exoplanet is very different from that of the Earth, the existing parachute landing technology or retro - rocket landing technology may need significant improvements.

● After landing, astronauts need to conduct effective exploration. This requires the development of detection devices and mobile tools that are adapted to the exoplanet environment. Due to the special environment of exoplanets (**Valencia et al., 2025**), such as the possible existence of corrosive

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atmospheres and extreme temperatures, the current detection device and mobile tool technologies on the Earth may not be directly applicable and require a great deal of research, development and innovation.

5.3. Several Potential Ethical Challenges

It is urgently necessary to conduct in - depth analysis and research on what kind of impacts the pure science and technology applications proposed in this article may have on human society. It is necessary to think deeply about such a philosophical question: Does this direct colonization of exoplanets by humans have a significant impact on the existing values of humanity?

5.3.1. Definition of Life and Humanity

● Blurring the Boundaries

Plant - like astronauts, being hybrids of carbon- and silicon- based life forms with human-like consciousness, blur the traditional boundaries between different forms of life. This challenges our existing definitions of what it means to be human (**Paglioni and Groth, 2022**). For example, if these entities are considered alive and human - like, do they have the same rights as biological humans? Should they be treated as slaves or equals? In a society where human rights are fundamental, the creation of such beings forces us to re - evaluate the scope of these rights.

● Consciousness and Moral Standing

Determining whether plant - like astronauts truly possess consciousness is difficult. If they do, then according to many ethical frameworks, they should have moral standing. However, if we are unable to accurately assess their consciousness, we may be at risk of treating them unethically. For instance, if we send them on dangerous missions without proper consideration for their well - being, it could be seen as a form of exploitation.

5.3.2. Ethical Considerations in Creation

● Playing God

The act of creating plant - like astronauts through synthetic biology and AI can be seen as "playing God(**Grey, 2012**)." Manipulating life in such a radical way goes against some religious and ethical beliefs. For example, in some religious traditions, only a divine being has the right to create life. This raises questions about the hubris of humanity in attempting such creations and whether we are overstepping our moral boundaries.

● Human "ownership"

From a social perspective, this topic has far - reaching impacts. First of all, in terms of social ethics, colonizing exoplanets may trigger discussions on ethical issues such as human "ownership" (**Demir 2023**) of other planets and the rights of extraterrestrial life.

● Who is eligible to participate in

In terms of social structure, if such a grand plan is carried out, the social structure on the earth may change dramatically. Who is eligible to participate in the colonization plan(**Platt et al. 2020**)? This may lead to discussions on a series of social fairness issues such as social classes and resource allocation.

● Unintended Consequences

There may be unintended consequences in creating these entities. Their unique biological makeup could interact with existing ecosystems in unforeseen ways. If they were to reach an exoplanet, they could potentially disrupt native life forms, either through competition for resources or by introducing new biological elements. This is similar to the concerns about invasive species on Earth (**Schwoerer et al., 2024**), but on a much larger and more complex scale.

5.3.3. Ethical Implications for Society

● Social Inequality

The creation of plant - like astronauts could lead to new forms of social inequality (**Chiavaroli, 2024**). If they are seen as a tool for the wealthy or powerful to further their interests in space exploration or colonization, it could widen the gap between the haves and have - nots. For example, if a private company creates these astronauts to stake a claim on an exoplanet's resources, it may exclude the general public from the benefits of such exploration.

● Cultural and Moral Shifts

The existence of plant - like astronauts may cause significant cultural and moral shifts. Our values regarding life, death, and the purpose of humanity may change. For instance, if these entities are successful in colonizing exoplanets, society may start to view them as a more viable form of human continuation than traditional reproduction. This could lead to a devaluation of biological human life and family structures (**Malle et al., 2025**).

5.4. Impacts on Biodiversity on Earth

5.4.1. Direct Impacts

● Genetic Contamination Risk

If plant - like astronauts are created using genetic engineering techniques, there is a risk of genetic contamination (**Godwin et al., 2024**). For example, if the genes used in creating these entities were to somehow escape into the environment, they could disrupt native species. Suppose the genes for photosynthetic efficiency in the plant - like astronauts were to be transferred to terrestrial plants through horizontal gene transfer mechanisms (such as via bacteria or viruses). This could lead to an imbalance in ecosystems. Some native plants might gain an unfair advantage over others, outcompeting them for resources like sunlight, water, and nutrients. This could ultimately lead to the decline or even extinction of certain plant species, which in turn would affect the entire food chain.

● Resource Competition during Development

The development of plant - like astronauts may require the use of specific biological resources. For instance, if certain rare plant genes are needed for their creation, over - harvesting or over - exploitation of these gene sources from wild plants could occur. This could reduce the genetic diversity of those plant species in the wild. Additionally, if the production process demands large amounts of water, nutrients, or other substances, it could divert resources from other organisms in the ecosystem, potentially affecting their growth and survival (**Walters et al., 2024**).

5.4.2. Indirect Impacts

● Shift in Research Focus and Funding

The creation of plant - like astronauts may divert research focus and funding away from Earth-based biodiversity studies. If significant resources are channeled into this new and exciting area of research, there could be less investment in understanding and conserving terrestrial ecosystems. For example, fewer funds might be available for projects that aim to protect endangered species or restore degraded habitats. This lack of attention and resources could slow down progress in biodiversity conservation efforts on Earth.

● Altered Perception of Life and Conservation

The existence of plant - like astronauts could change the way society perceives life. If these entities are considered a new form of life, it might lead to a re - evaluation of what is considered worthy of conservation. There could be a shift in public and scientific attention from traditional biodiversity to the study and potential "preservation" of these artificial life forms. This could result in a relative neglect of Earth - based biodiversity, as the novelty of plant - like astronauts captures the imagination and resources of the scientific community and the public alike.

5.5. The potential Long-Term Effects

5.5.1. Technological and Knowledge Spillover Effects

● Positive Impacts

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The research and development required for creating plant - like astronauts could lead to new technologies and scientific knowledge that benefit Earth's ecosystems. For example, the study of how to engineer organisms to withstand extreme conditions such as cosmic radiation and low temperatures might provide insights for developing more resilient crops on Earth. If we can understand the mechanisms that allow plant - like astronauts to perform photosynthesis efficiently in harsh environments, we could apply similar principles to improve the photosynthetic efficiency of terrestrial plants. This could potentially increase food production, reduce the need for agricultural expansion into natural habitats, and thus help preserve biodiversity.

The development of synthetic biology techniques for creating plant - like astronauts may also lead to better understanding and management of invasive species. By studying how to control the growth and spread of these unique organisms in space - like conditions, we could develop more effective strategies for dealing with invasive species on Earth, which are a major threat to native biodiversity.

● Negative Impacts

However, there is also a risk that the technology used to create plant - like astronauts could be misused (**Tagliabue, 2016**). For example, if the genetic engineering techniques are not properly regulated, they could be used to create genetically modified organisms (GMOs) on Earth with unforeseen ecological consequences. These GMOs could potentially outcompete native species, disrupt food chains, and cause long - term damage to ecosystems.

5.5.2. Resource Allocation and Environmental Pressures

● Positive Impacts

If plant - like astronauts are successful in colonizing exoplanets, it could relieve some of the pressure on Earth's resources. As humanity looks to expand beyond Earth, the demand for resources such as land, water, and minerals could be redirected towards space exploration and colonization. This could potentially reduce the overexploitation of Earth's ecosystems for resource extraction. For example, less deforestation might occur if there is an alternative source of materials in space.

● Negative Impacts

The concept of "plant-type astronauts" is still very much in the realm of speculation and science fiction at present, and there is no real - world example of such a being developed. However, hypothetically, the following could be considered as potential negative impacts on resource allocation and environmental pressure:

Nutrient Competition (**Hirani et al., 2024**) --- Developing plant-type astronauts would require a significant amount of resources for research and development. These resources could include specialized laboratories, high - tech equipment for genetic engineering and plant growth simulation in space environments. For example, creating artificial lighting systems that mimic the sun's spectrum precisely for plant growth in space would be extremely costly. This diverts resources from other important space exploration and research areas such as developing more efficient propulsion systems or improving life - support systems for human astronauts.

Spacecraft Design and Payload --- Designing a spacecraft to accommodate plant- like astronauts would be a complex task.

Environmental Pressure --- This could disrupt the ecological balance of other planets or moons if we were to explore and colonize them in the future. For example, if a genetically modified plant-type astronaut's genes were to mix with a native Martian microorganism (**Kawasaki, 1999**), it could have unforeseen consequences for the Martian ecosystem that we are still trying to understand.

Waste Management --- In the confined space of a spacecraft or a space station, managing any waste would be a challenge (**Elitzur et al., 2016**).

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5.6. Public and Social Reactions

5.6.1. Shift in Public Attention

The concept of plant - like astronauts may quickly capture the public's attention. This could lead to a short - term shift in public focus away from traditional environmental and ecological issues (**Lee & Choi, 2017**). For example, environmental conservation campaigns may receive less public support or media coverage as the novelty of plant - like astronaut research takes center stage. This could potentially slow down ongoing efforts to protect Earth's ecosystems, such as fundraising for wildlife conservation projects or public participation in beach clean - ups.

5.6.2. Ethical Debates and Policy Discussions

The emergence of plant - like astronauts will likely trigger intense ethical debates and policy discussions in the short - term. These debates may consume significant time and resources of policymakers, scientists, and the public. While these discussions are important for the long - term implications, in the short - term, they may divert attention from immediate ecological conservation actions. For example, instead of focusing on implementing new regulations to protect endangered species, policymakers may be preoccupied with formulating guidelines for the creation.

5.7. The Anthropological Classification of Plant - Like Astronauts

The anthropological classification of beings with plant - like characteristics (if such exist) raises important questions. If genetically modified organisms like corn still retain their basic classification as corn, then a genetically modified human (assuming such a thing were possible) should, logically, still belong to the category of humanity. Humanity is defined by organic beings with self - awareness, emotions, and cognitive abilities. Therefore, if genetically modified humans possess these traits, it requires both scientific and ethical deliberations. As long as these beings with modified characteristics possess human consciousness, it matters little whether they are hybrids of carbon- and silicon-based life forms.

5.8. The Feasibility Study of Ultra-Long-Distance Interstellar Space Expeditions

Some directional questions for the scientific community to research and discuss:

1 The scale of a spacecraft designed for exploring **Teegarden's Star b**. The spacecraft should be a large, advanced vessel capable of housing 1,000 people and equipped with state-of-the-art facilities.
2 Artificial sunlight is installed inside the spaceship and runs for a few hours every day to enable plant - like astronauts to get the necessary light for certain biological processes.
3 Properly handling the disposal of bodies within a large spacecraft. Is it feasible to implement space burials similar to sea burials or to legally and rationally manage the remains in a proper way?
4 How to ensure the sustainable provision of necessary drinking water for the residents of the large spacecraft.
5 How to implement the training and development of these plant - like astronauts.

Sending plant - like astronauts to *Teegarden's Star b*, equipped with advanced scientific tools, technologies, and methods (**Hot, 2023;** Mesa-Arango et al., 2023**; Western et al., 2023**; **Metelli et al. 2023; David et al., 2023; Kunitskaya et al., 2022; Hu et al., 2023; Dutta & Misra, 2023; Fais et al., 2022; Takeichi & Tachibana, 2021**; **Melikhov et al., 2020; Pickett et al., 2020; Padaki et al., 2019; Pagnini et al., 2019; Itaya et al., 2018; Zhang, J.L., Li, Y.Z. & Zhang, Y., 2024**), along with the DNA and genes of various animals and plants, represents the dreams of scientists and engineers worldwide and also holds the hopes of people everywhere.

6. Conclusions

Given Elon Musk's assertion that 'using DNA sequences could transform humanity into butterflies and that you could practically do anything with synthetic RNA' (**Musk, 2022**), the development of the 'plant - like astronauts' advocated in this article should be entrusted to synthetic RNA and AI.

Currently, humanity has two choices for survival. The first is the Martian migration program led by Elon Reeve Musk. This program is both visible and realistic, offering an immediate option for human continuation and expansion. Although it may not ultimately protect humanity from the future burning of the Sun during its red giant phase, it can provide valuable experiences in interplanetary expeditions. The second option, which involves the idea of sending some form of modified astronauts to directly explore and colonize other parts of the universe, lacks the immediate practicality of the Martian migration program. This ambitious plan would likely take at least 220,000 years and require extensive human modifications. However, with "Voyager 1" having already paved the way, the possibility of achieving such a long - term goal cannot be completely ruled out. This kind of audacious adventure may be worth considering as it offers a potential way to directly escape from the solar system, allowing us to avoid of the Sun's eventual destruction and preserve our species.

Musk's Mars colonization plan faces some inevitable challenges. Even if successful, colonists will still have to face the challenge of escaping from Mars and endure a long journey of 220,000 years to reach the nearest habitable exoplanet, Teegarden's Star b. Additionally, they will need to undergo significant transformation to ensure their survival during this incredibly long journey. It is important to note that migrating to Mars does not eliminate the risk of human extinction.

Instead of spending thousands of years struggling on Mars to reach the technological level similar to today's Earth and then initiating an "escape from Mars," it might be more prudent to start considering an "escape from Earth" to exoplanet Teegarden's Star b now. On Earth, we have access to many resources. Remember, all of Musk's current achievements are based on Earth.

Should we consider both options simultaneously, much like how humanity uses its two legs to walk?

The solution I propose is one of many possibilities, and it does not exclude efforts in other aspects.

In 'Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future,' (**Vance, 2015**), it is stated that if we don't try, humanity will forever be trapped on Earth. Allow me to borrow Musk's expression style: We must strive with all our might; otherwise, humanity will forever be trapped within the solar system, awaiting the inevitable helium flash to come...

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