Scientific research is urgently needed for a sound expansion of man in outer space

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Avoiding “philosophical arguments” it is time for man to look for resources out of his planet. WHY?

Simply because:

Our ecological foot print is now in between 1.6-2 times the productive area of the surface of the biosphere, this means that the biosphere isn’t able to restore itself. A so fast Global Warming is an evident indicator that the biosphere is under stress.

For the expansion in the space we should be interested in a very large class of organisms to bring with us: the AUTOTROPHS

An **autotroph** or **primary producer** is an organism that produces complex **organic compounds** (such as **carbohydrates, fats**, and **proteins**) by using **carbon** from simple substances such as **carbon dioxide,** and **energy from light (photosynthesis) or by inorganic chemical reactions (chemosynthesis**).

The chemical equation for the process of photosynthesis is:

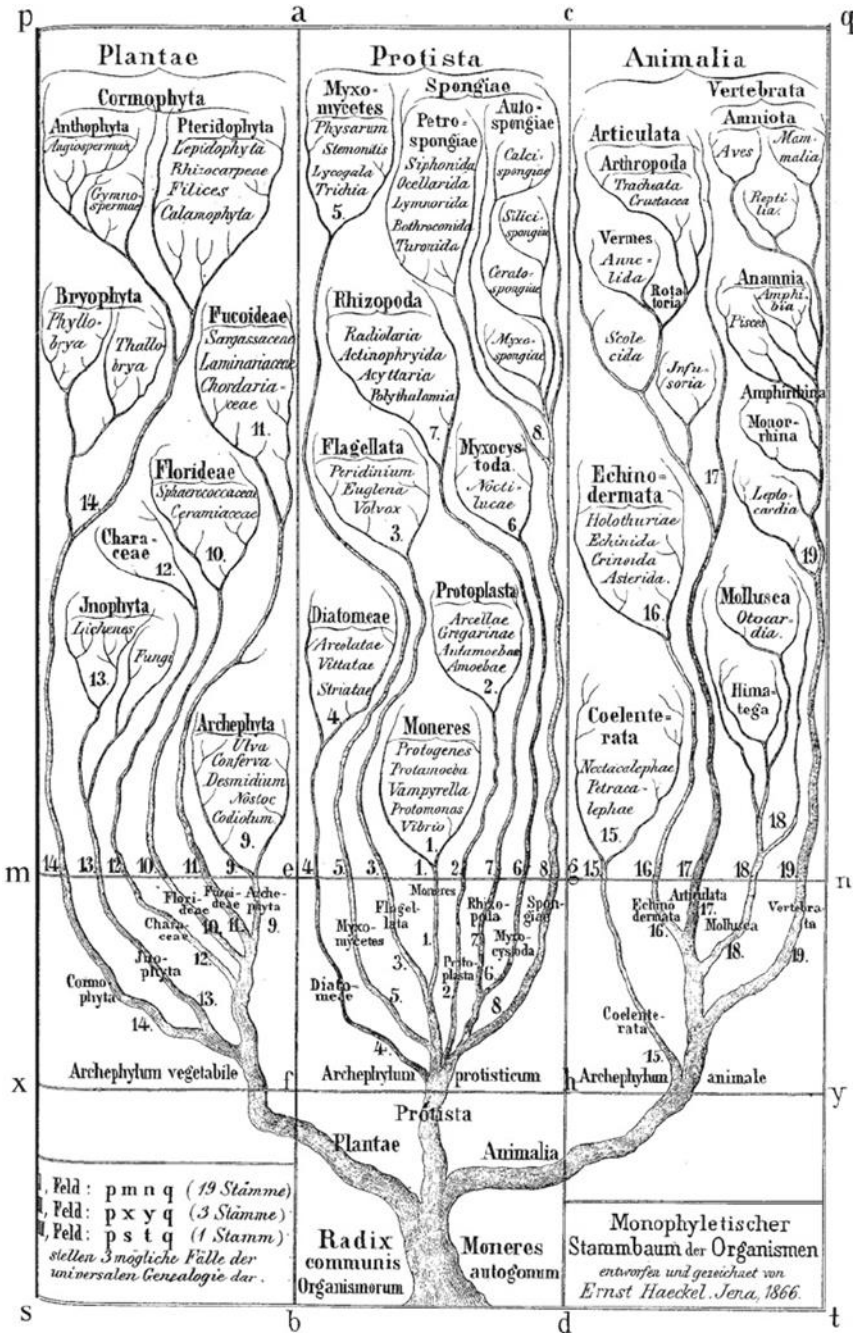
$$6CO_2 + 12H_2O + \text{light} \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

The chemical equation for chemosynthesis is, for example that of the hydrogen sulfide chemosynthesis:

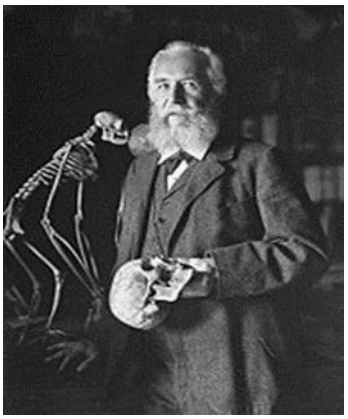
$$6CO2 + 18H_2S + 3O2 \rightarrow C6H12O6 + 12H2O + 18S$$

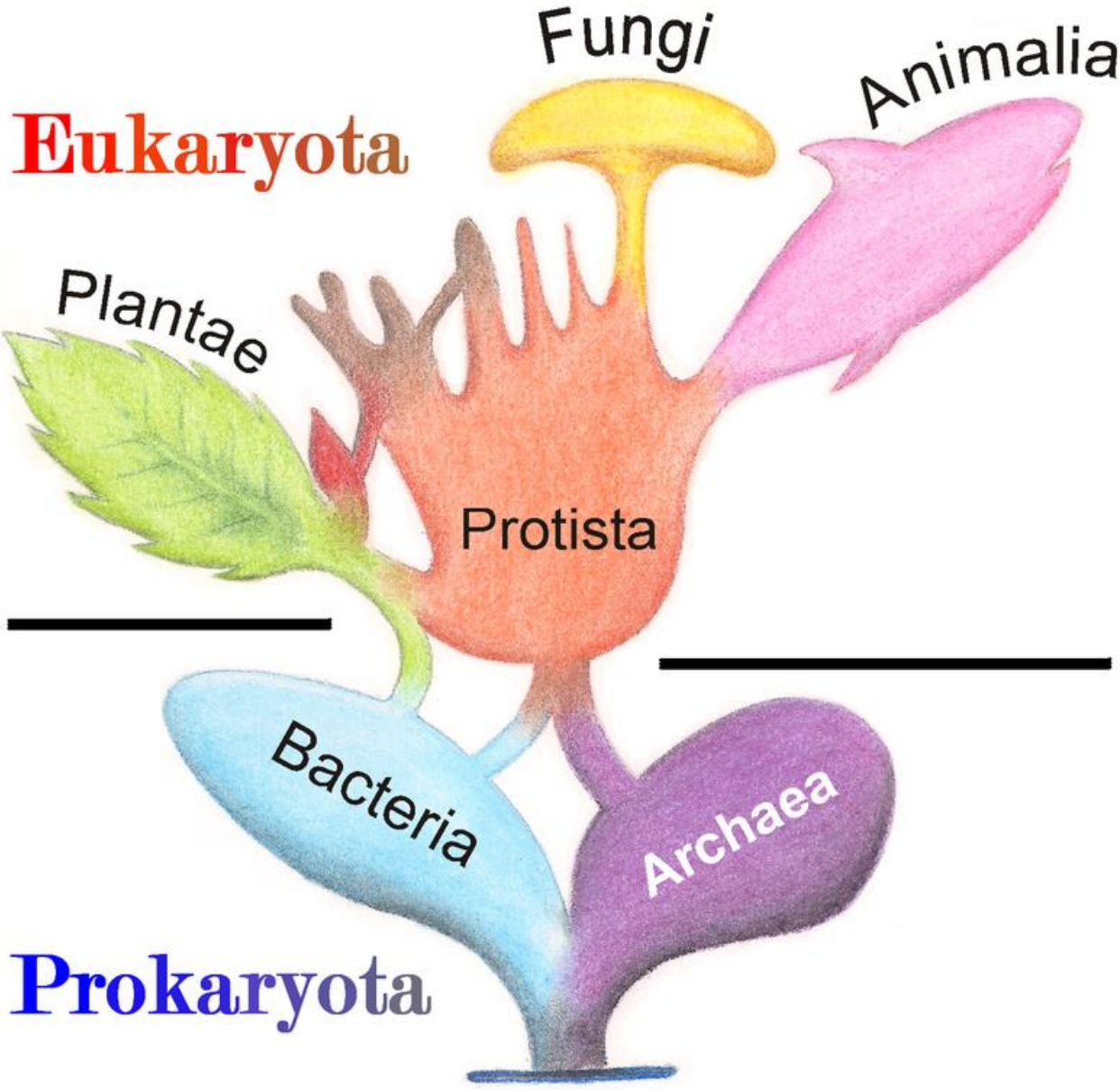
The first process is characterizing the organisms that we call PLANTS the second those that we call BACTERIA

Earth is plenty of biodiversity: A CONSEQUENCE THAT DIVERSITY IS AN INTRINSIC PROPERTY OF THE UNIVERSE (We are estimating a total of 8.74 million eukaryote species on Earth)



Ernst Haeckel the founder of Ecology




Fungi
Animalia
Eukaryota
Plantae
Protista
Bacteria
Archaea
Prokaryota


Lichens by Haeckel 1907, there are about 35000 species in the world

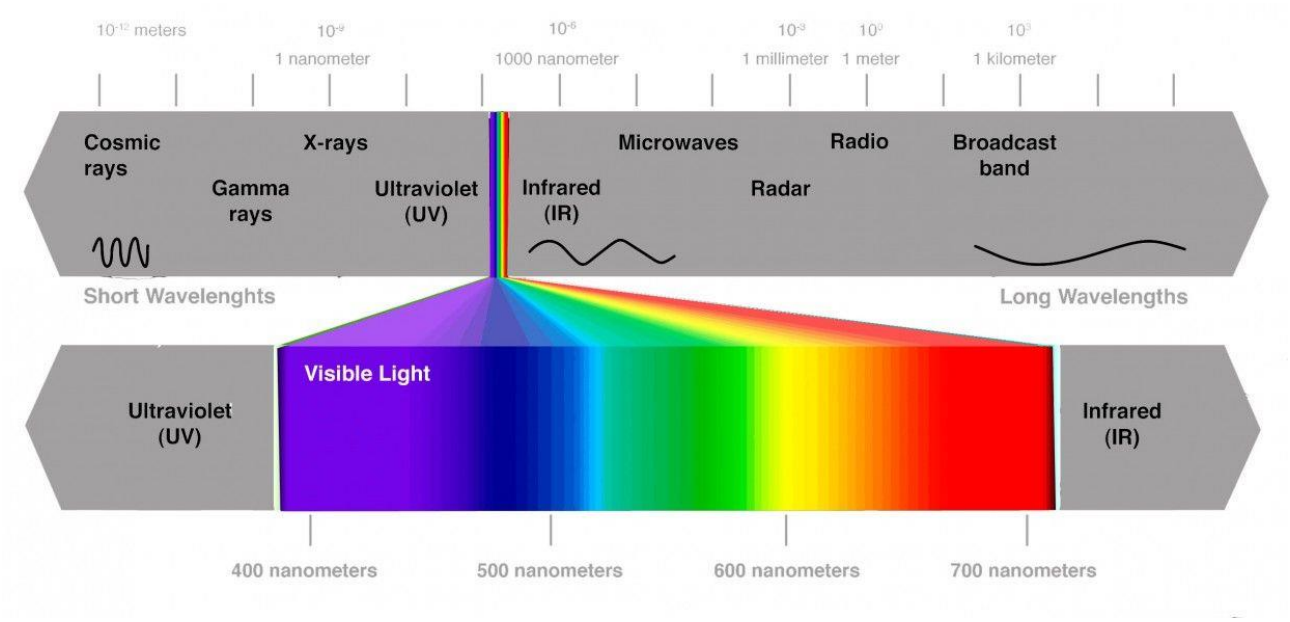
1. ~298,000 species of plants (of which 215,644 have been described and cataloged)
2. ~611,000 species of fungi (moulds, mushrooms) (of which 43,271 have been described and cataloged)
3. ~27,500 species of chromista (including, eg. brown algae, diatoms, water moulds, of which 13,033 have been described and cataloged)

Important for us who want to leave the Earth (to live forever :-))**, is the concept of ecological niche: " a portion of the hyperspace given by vital factors (Temperature, Water, Light, Pressure, pH, Salinity, Nutrients, and ionizing radiation)**

Going back to photosynthesis :

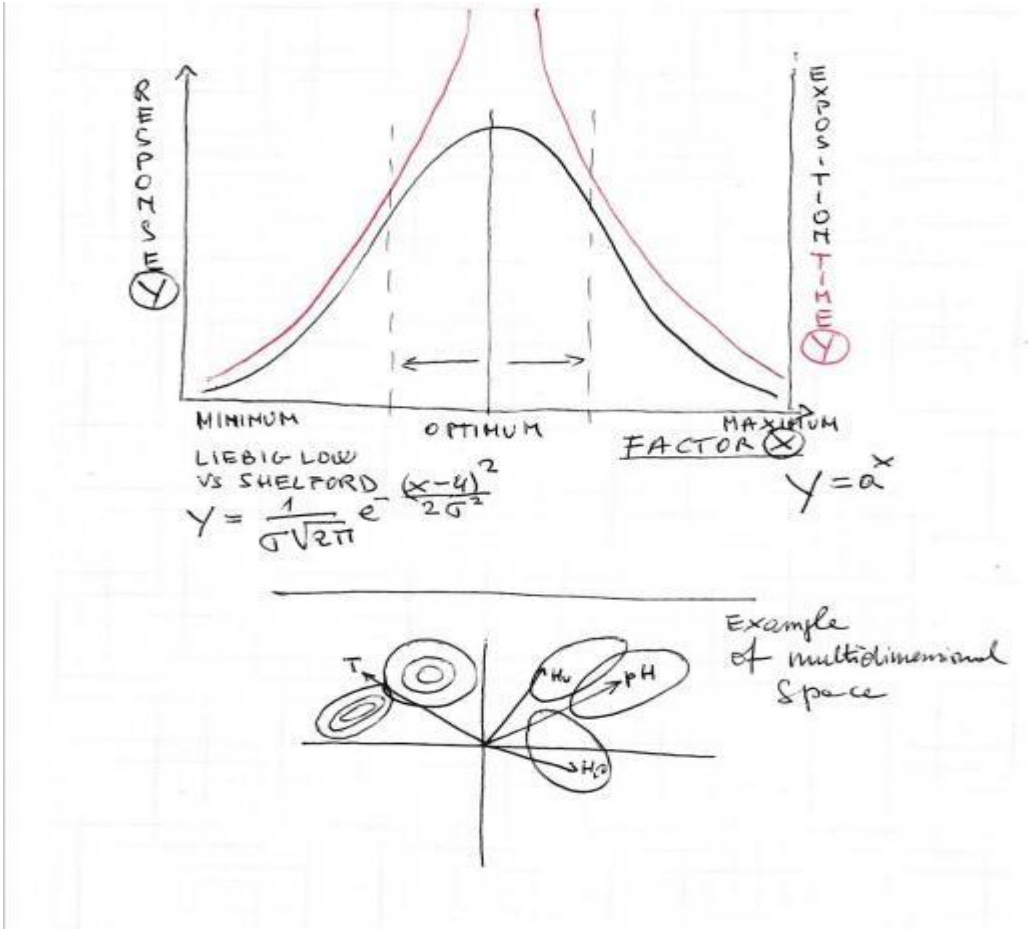
$$6CO_2 + 12H_2O + light \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

We can see that in the equation there are not all the mentioned factors, besides CO2, H2O and the visible light,

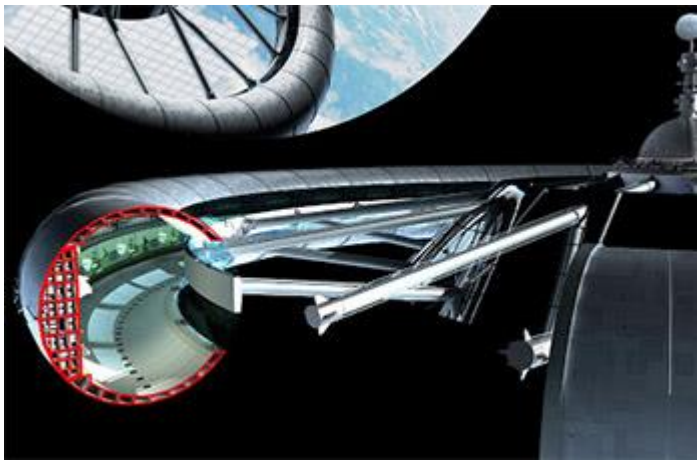


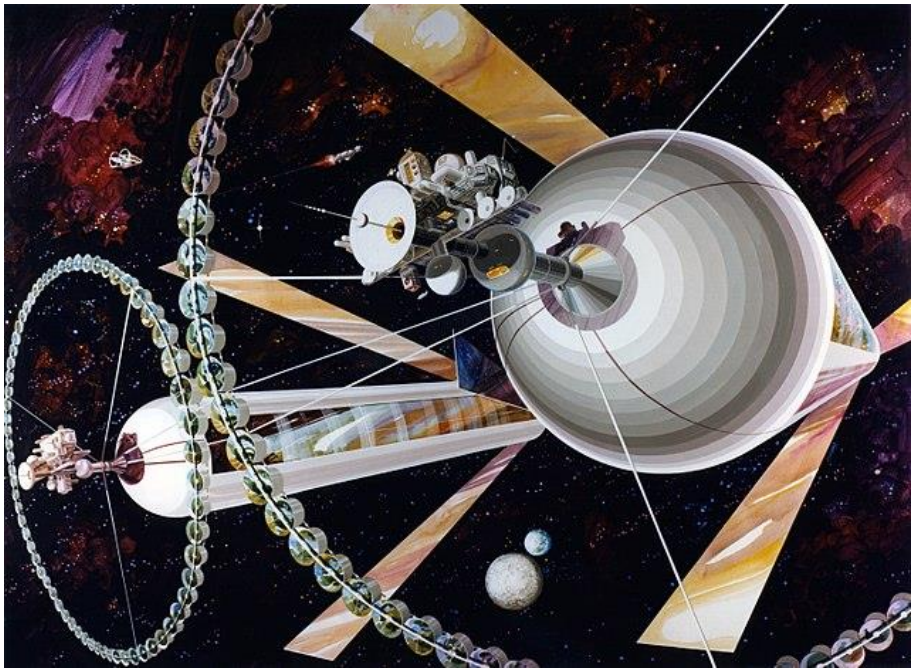
but they must to be taken into consideration when we want to breed plants and animals out of the Earth

in the ecological niche model



“Greening the Solar System” does not mean to build green houses only on the Moon and on Mars or in orbital stations (and/ or stationary?) such those called Cylinders of O’Neill or Stanford bull (NASA **Summer Study** of 1975, https://gundamverse.blogspot.com/2020/05/il-toro-di-stanford-un-suggestivo.html) **BUT IN ALL OF THEM AND ALSO ON THE EARTH.**





https://www.facebook.com/AgenziaSpazialePubblicaItalianaAspi/posts/2430694293607439/

https://it.wikipedia.org/wiki/Cilindro_di_O%27Neill

To start with a so ambitious program it is paramount to study all the conditions which can threat photosynthesis and in particular the mechanisms that may induce the threats.

There are ongoing programs such as NASA Mars-Lunar greenhouse prototype, South pole food growth chamber (Spfgc) and similar initiative that are promoting:

"basic research has allowed NASA scientists to grow edible plants in space that could be used as a source of fresh food by the crew on the ISS. Considering that every single thing that astronauts eat is freeze-dried and comes out of a shrink-wrapped package, being able to enjoy a fresh vegetable provides a healthy and much welcomed break from this routine. Already, edible romaine lettuce and cabbage has successfully been grown on the ISS. Soon, Mizuna and tomatoes will join the list of edible plants gown in pace.

Credits: NASA

In the next year Space Biology will fly experiments to the ISS designed to test the growth of a variety of new plants its crew can eventually eat as they fly to the moon and Mars. To ensure the health of our astronauts, we'll be examining the nutritional composition of plants grown in space, and looking at the microbiome of plants in orbit. This work may eventually lead to the production of a sustainable source of healthy food on long-duration space flights, which will help astronauts get the nutrition they need… As we examine the impacts of spaceflight on plant biology, we ask the following:

- How does gravity affect plant growth, development & metabolism (e.g. photosynthesis, re- production, lignin formation, plant defense mechanisms)?

- Does the spaceflight environment cause alterations in plant/microbe interactions?
- How can horticultural approaches for sustained production of edible crops in space be both improved and implemented (especially as related to water and nutrient provision in the root zone)?
- What are the effects of chronic exposure to cosmic radiation on plants?
- How do plants sense and react to gravity and what are the molecular mechanisms involved?

Plant Biology Program | Science Mission Directorate (nasa.gov)

Scienziati europei sperimentano la crescita di piante nello spazio esterno | News | CORDIS | European Commission (europa.eu)

ESA - Shape the future of European biology research in space

BUT IT IS NOT ENOUGH. In Summary what we need is to start to promote a strong acceleration in the study of the responses of photosynthetic process of plants, terrestrial and aquatic, in the presence of:

1) **low atmospheric pressures,**
2) **reduced gravity,**

3) **low CO2 concentrations,**

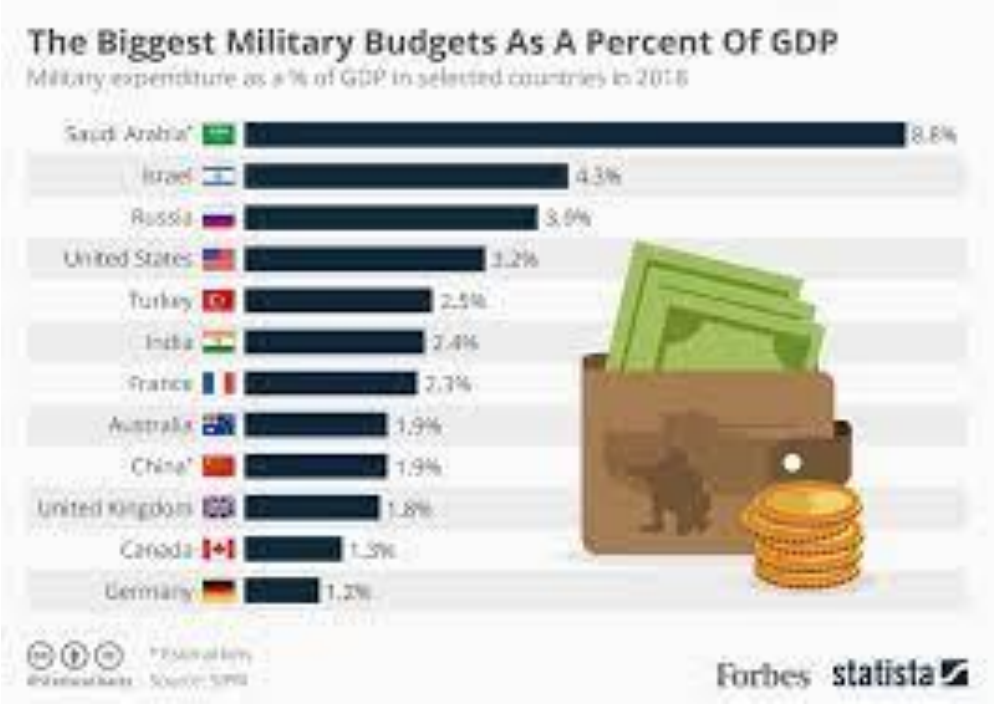
4) **ultraviolet radiation and other radiation beyond the visible, where the process would take place.**

the research needs a worldwide interdisciplinary cooperation and a network of terrestrial, and extra-terrestrial laboratories (on the Moon Mars and orbital space stations such as ISS) where to study also:

5) **mutations and genetic-phenetic interactions and**

6) **the possibility to create new plants (GMO) adapted to extreme environment that would fit and /or create new ecological niches.".**

To pursue the realization of such a network is a cultural-socio-economic-political problem: Where to find the financial resources? I put only this graph and I let you the answer:



And I stress that it is only up to us the way we are building the economy!

Conclusion

There are a lot of resistances against the “Space Renaissance” many persons are thinking that before to go out in the space we should solve the problems we have on the Earth…. but I think that a lot of problems have been solved on the Earth by looking at the space: “the modern science started with Galileo, Leibniz, Newton , Kepler…”

I am only an ecologist who thinks that to expand the life in "the space" is a way to understand better the

life itself and to create the conditions for its continuity and evolution.

We have a great responsibility toward the life, this requires hard work in research issues!

Thank YOU!