Astrobiology
Exercise Class 9

The great divide between the astrobiological fields

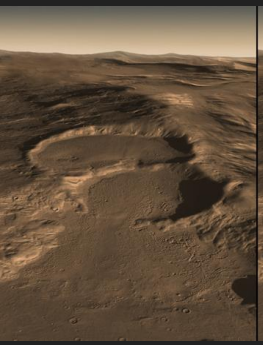
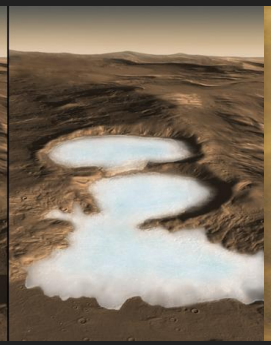
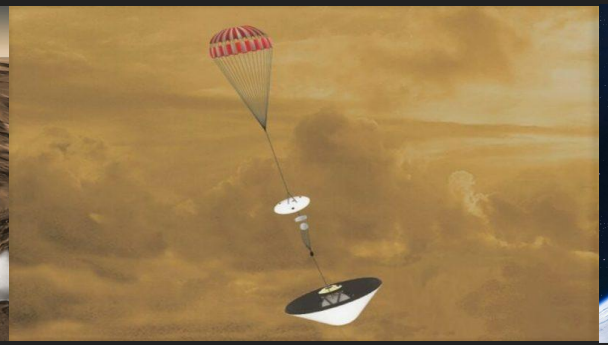
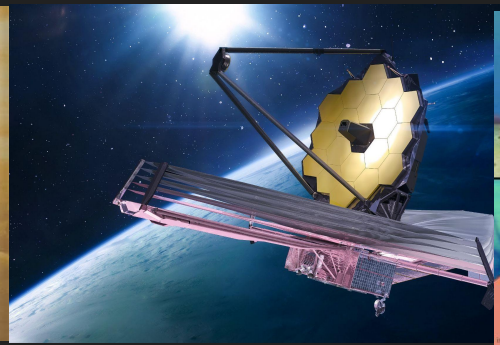
02-12-2023

1. I will talk a bit about astrobiology in the solar-system vs. for exoplanets
2. We will discuss together how different fields approach astrobiology
3. We play a small game
4. HW assignment nr. 5

Instruments

- Solar-system science can use in-situ missions.
- Solar-system science can use direct observations (e.g. take pictures of the surface of Mars).

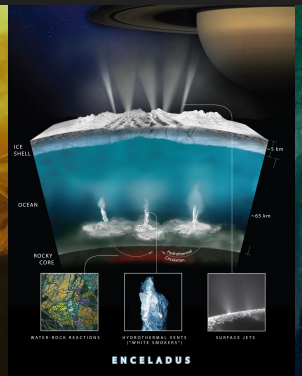
- Exoplanet research leans (currently) on indirect measurements.
- Need to think well about the biosignature
- Taking a direct image of an exoplanet is possible and will be further developed with future telescopes, but the data will not be as detailed.


Implications of finding life

- Finding life in the solar-system will give us more insight on the origin of life on Earth.
- We expect only simple, microbial life.
- If there were intelligent aliens in the solar-system, one could argue we would have had contact by now.

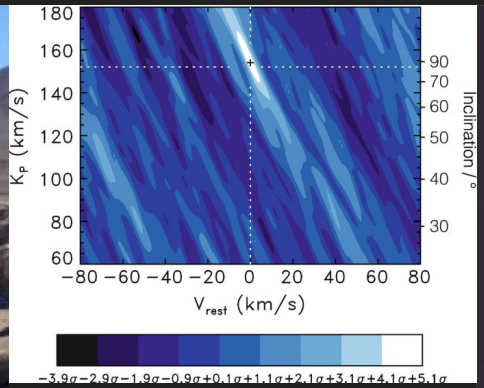
- Life on exoplanets could still be too far for exchanges.
- There are less constraints and thus more room for imagination.
- ‘Technosignature’ = sign of technology

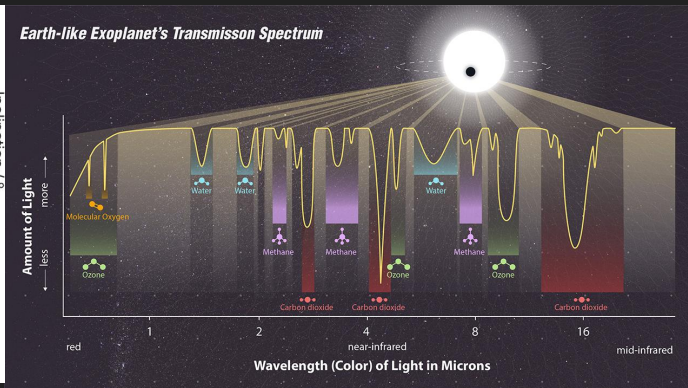


Scientific background

- Because of the in-situ measurements, solar-system astrobiologists tend to have more background in chemistry and biology
- Scientific studies often contain field work, where Earth's conditions are compared to e.g. those on Mars.

- Exoplanet scientists have more often a background in physics
- Studies are more theoretical and programming is fundamental

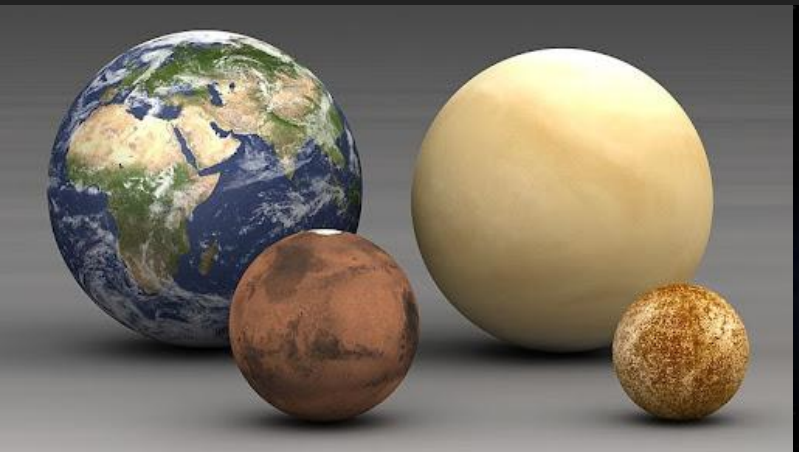


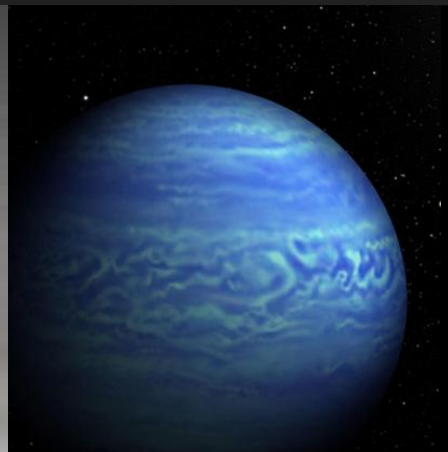


Planetary types

- The solar-system has a few more rocky planets, but these are of a very different composition.
- We can also study moons.

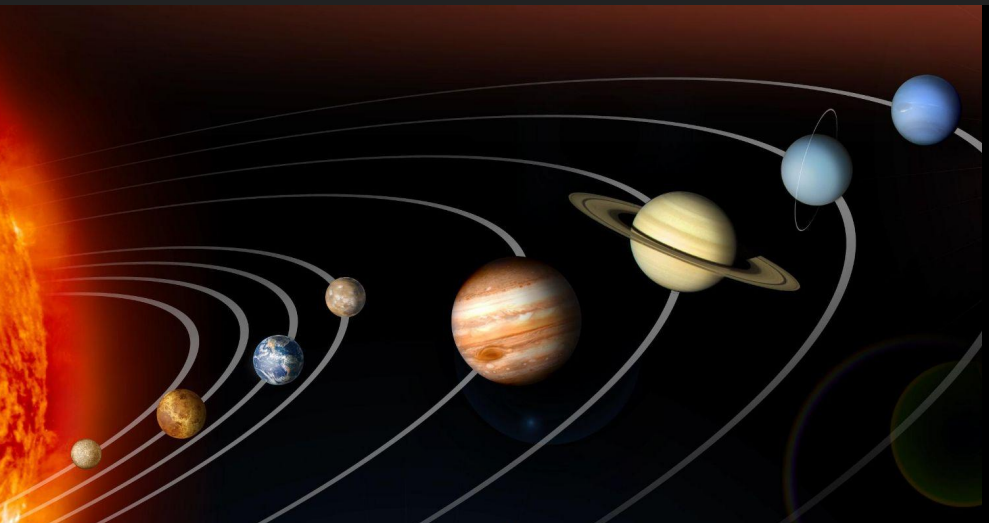
- Detected exoplanets are predominantly super-Earth and mini-Neptunes. These are not in the solar-system and if there is life it would be different.
- We know almost nothing about exomoons.

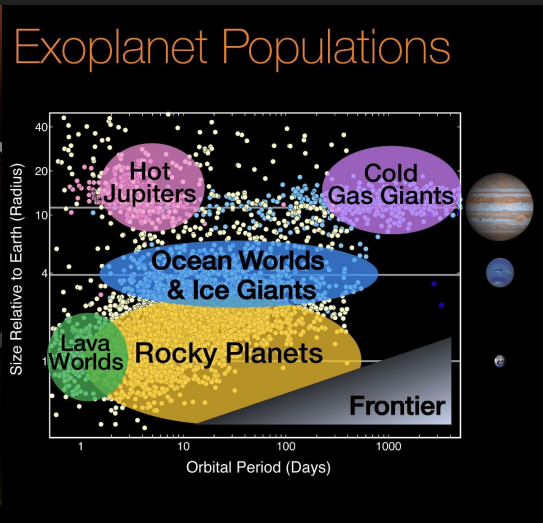


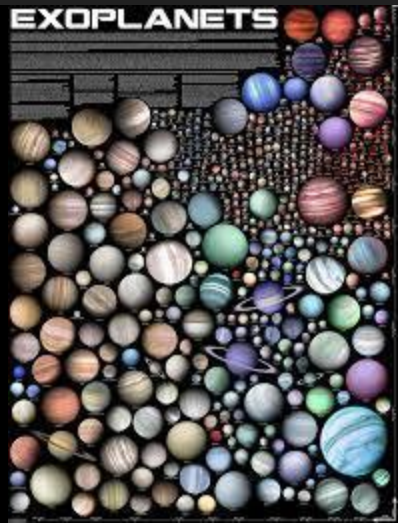


Sample size

- The amount of solar-system bodies is limited.
- Exoplanets go up in the 1000's, so we can do statistics.







At astrobiology related conferences or in the scientific literature there is often division between different ‘kind’ of astrobiologists

- Those studying planet formation (Physicists)
- Those studying the history of Earth (Geologists)
- Those studying the building blocks for life (Chemists)
- Those studying the evolution and complexity of life (Biologists)
- Those studying the nature of life (Statisticians and Philosophers)
- Those studying observational data from planets (Astronomers)

Also Computer scientists can play a role in these topics.

As people in this scientific field come from a wide range of backgrounds it can be difficult to ‘speak the same language’.

I’m asking you to fill out the next 8 slides together with me.

Pick which group you belong to best:

Geologist
Biologist
Chemist
(Astro) Physicist
Social Scientist
Mathematician / Statistician
Philosopher
Literature studies

Now write down an important scientific questions that approaches astrobiology from your field. Something that can (hopefully) be answered the next two decades or so.

I give you an example as a physicist:

How likely are planets to have liquid water by their formation process?

Astrobiology according to a Geologist

Astrobiology according to a Biologist

Astrobiology according to a Chemist

Astrobiology according to a (Astro) Physicist

Astrobiology according to a Social Scientist

Astrobiology according to a Mathematician / Statistician

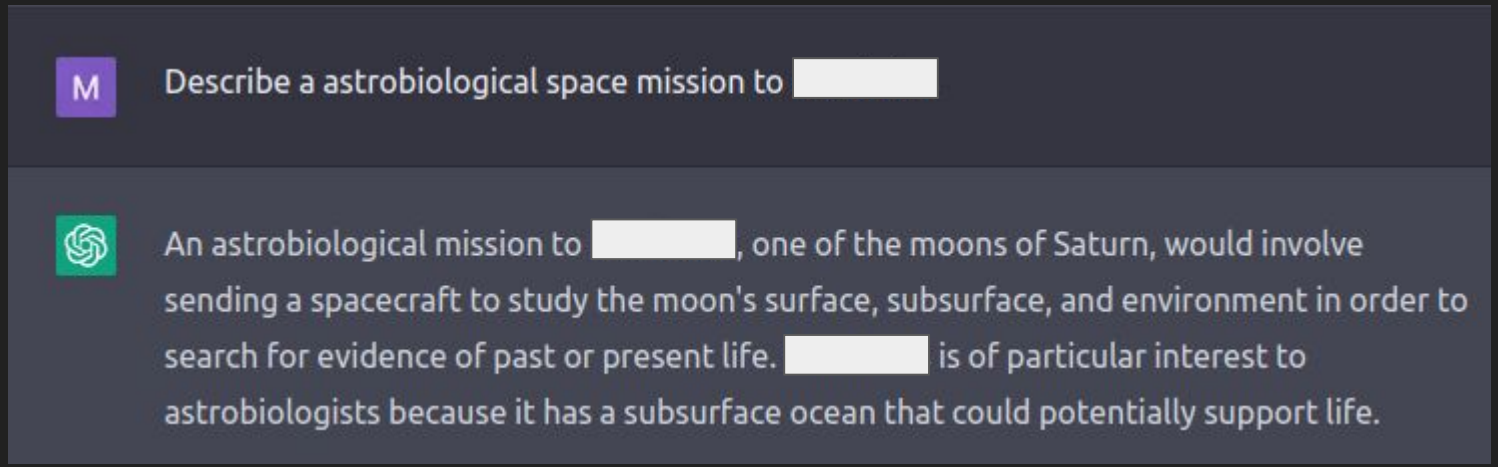
Astrobiology according to a Philosophers

Astrobiology according to a Literature scientist

Now we play a game

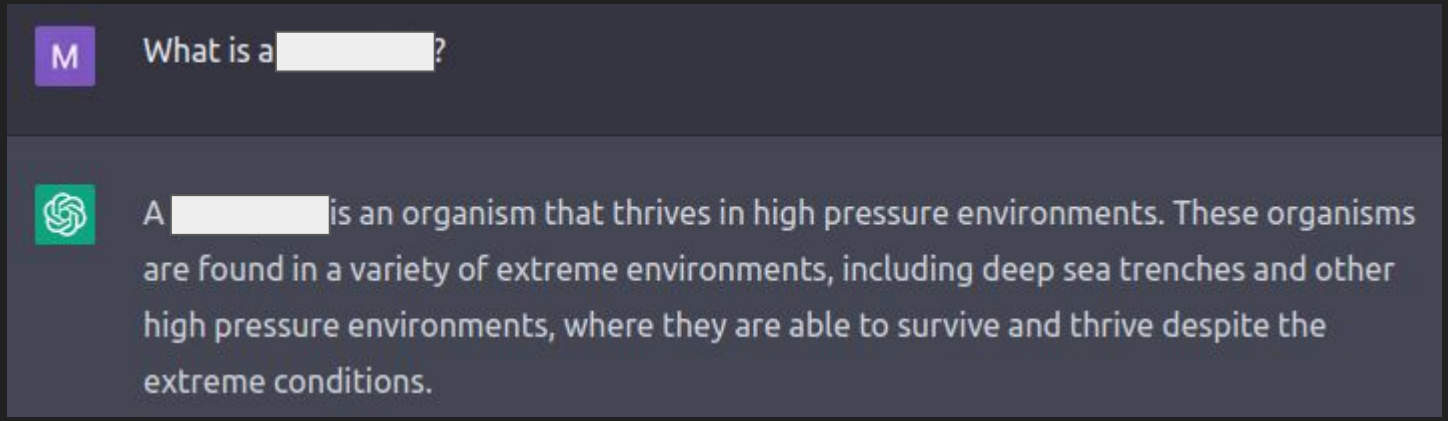
We all start standing up
Every question you can answer with (a) hands on your head or (b) hands on your shoulders.
If you got it wrong: game over :(sit down.
Last one to stand wins a Christmas cookie.

1. What did I ask the AI?



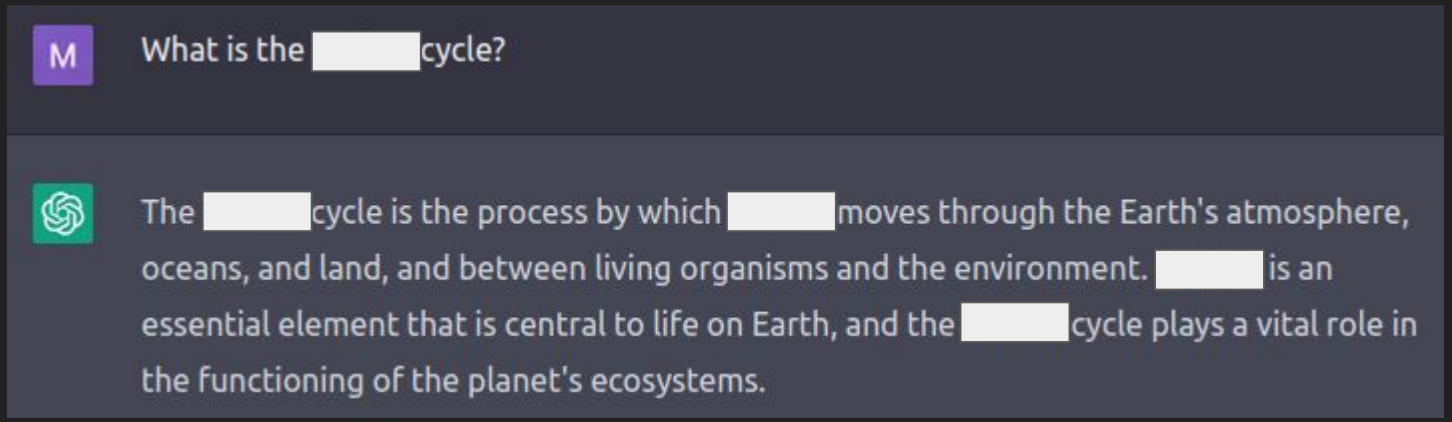
(a) Enceladus (hands on head)
(b) Europa (hands on shoulders)

2. What did I ask the AI?



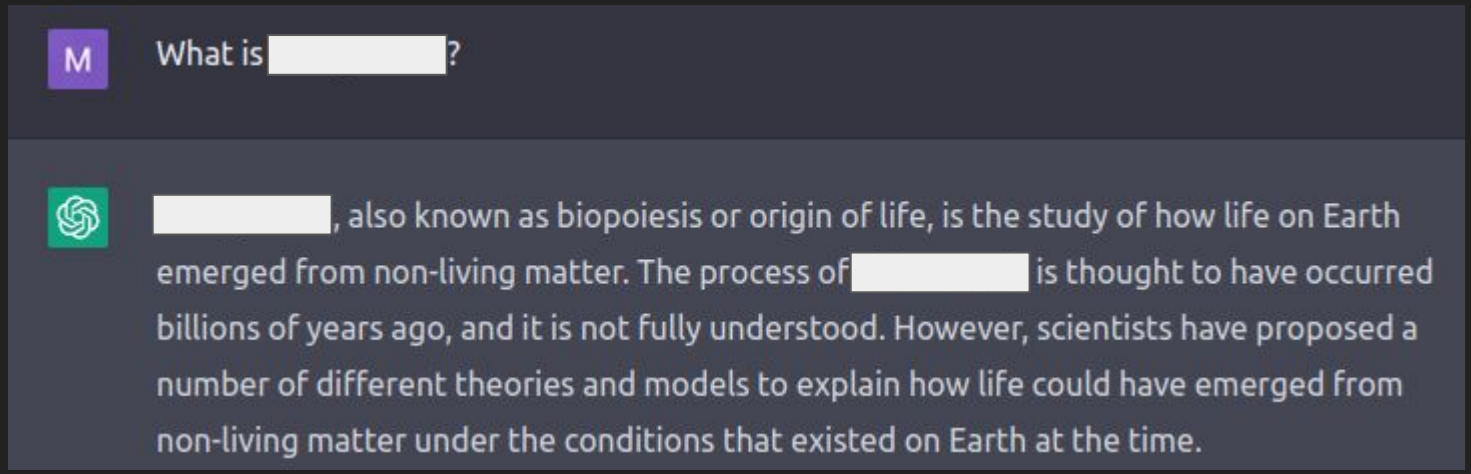
(a) Halophile (hands on head)
(b) Piezophile (hands on shoulders)

3. What did I ask the AI?



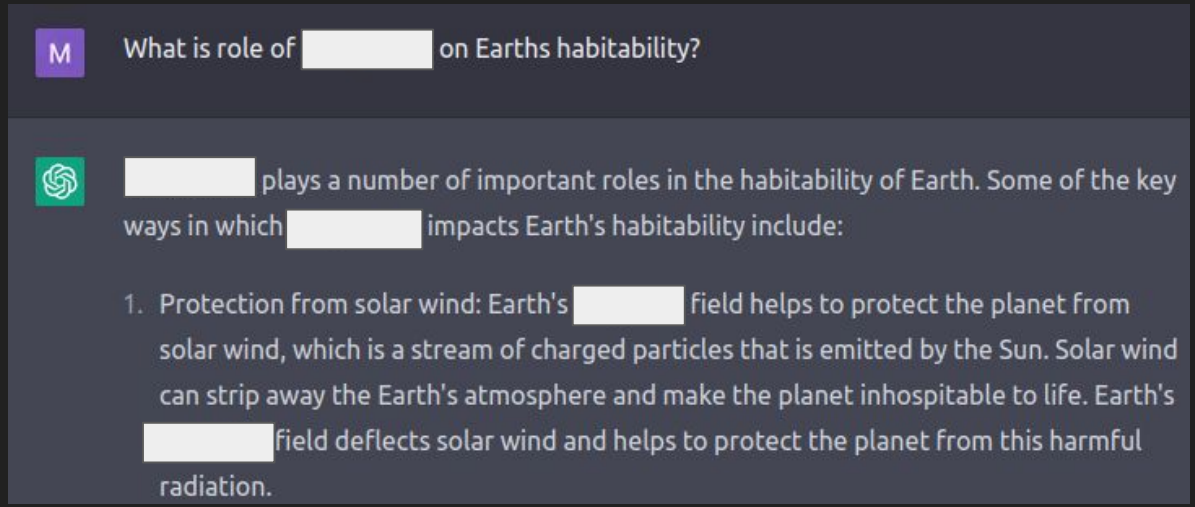
(a) Silicate (hands on head)
(b) Carbon (hands on shoulders)

4. What did I ask the AI?



(a) Pansperima (hands on head)
(b) Abiogenesis (hands on shoulders)

5. What did I ask the AI?



(a) Magnetism (hands on head)
(b) Gravitation (hands on shoulders)

Tie-breaker: how many exoplanets are as of now confirmed by NASA?

Homework 5
Questions from the media
Deadline 02.12.2023
Send them to marit@ics.uzh.ch

Scientists often have to answer short and sometimes difficult questions, either from the media or during debates. Below are some of the questions Ben Moore has been asked by journalists about life, the universe and everything.
Choose seven of these and answer them in one paragraph (each answer should roughly be between 60 and 160 words). There are no correct answers, you may have completely different opinions than Ben Moore or your colleagues. That is fine. It is a useful skill to be able to respond to such questions in a coherent manner expressing your opinions in a concise fashion and accurately.