HPS208 – How we think about life

Key Terms

- Planetary seeding
- Biosignatures
- Biocentrism

The Ethics of Planetary Seeding

- Our central question this week is:

  Should we send microorganisms to space to kickstart life on other planets?

The Favourable and Unfavourable Cases

- Our reading for this week by Sivula will argue that no, we shouldn't
- At least, not yet!
- Sivula argues that there are both practical and ethical reasons why it's premature to attempt planetary seeding
- First he goes through the case for doing so, then the case against

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ARTICLE

The Cosmic Significance of Directed Panspermia: Should Humanity Spread Life to Other Solar Systems?

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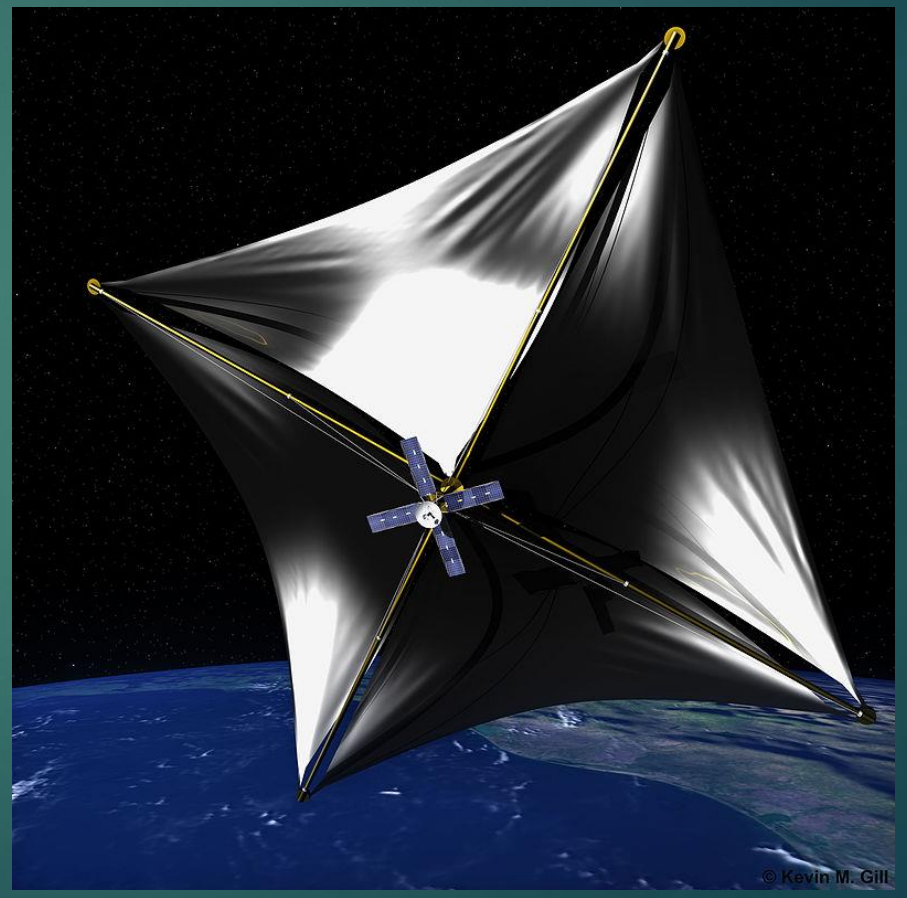
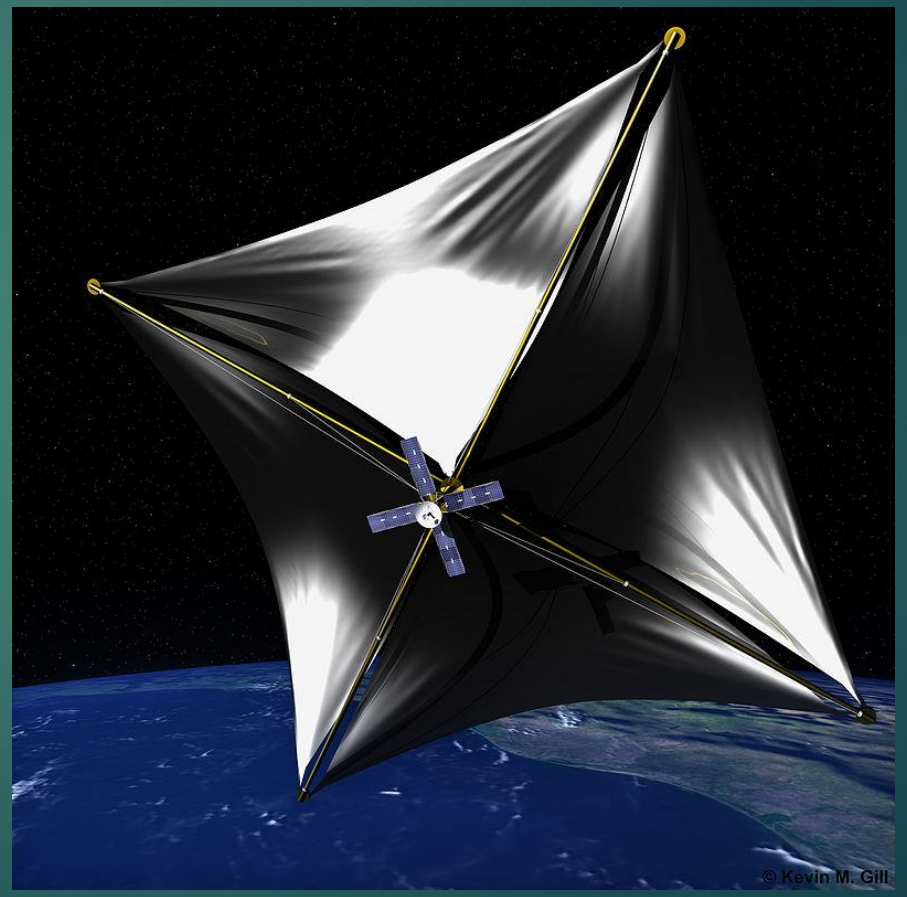
Can we do that??

- First, Sivula argues that this is something worth talking about because it's not that far off technologically
- Sending humans to space is expensive and dangerous, and trips to other stars is not currently possible
- But sending microorganisms could be a lot easier, and may only be a few decades away technologically (if we work at it)



Can we do that??

- The Breakthrough Starshot program is working on tech that could get us close to planetary seeding capabilities
- The idea would be to send probes weighing only a few grams into space with these sails about 5m wide
- Ground based lasers would accelerate the probe to a significant fraction of the speed of light



The Favourable Case

- Sivula first looks at the favourable case for planetary seeding (p.185)

1. Earth can sustain life for 1 to 3.5 billion years more. However, life could continue to exist in our galaxy for a much longer time if it exists in a new solar system.
2. Life is valuable in itself. Or, it is better that life exists than not.
3. Life is possibly rare in our galaxy.
4. Existential risks threaten the future of humanity, and hence, the possibility of directed panspermia.

Conclusion: humanity has a *prima facie* duty to spread life to other solar systems.

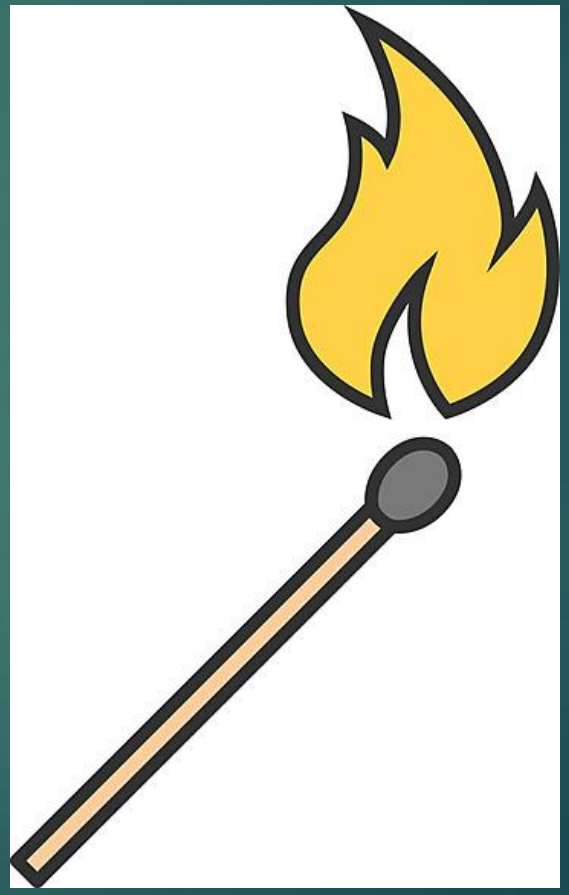
2. Life is valuable in itself.

- Suppose humans have no hope of ever travelling to distant stars
- Planetary seeding would then have no practical benefit for us, and significant practical costs
- Yet lots of people find the prospect appealing, because they think that all life has some value

The Last Man

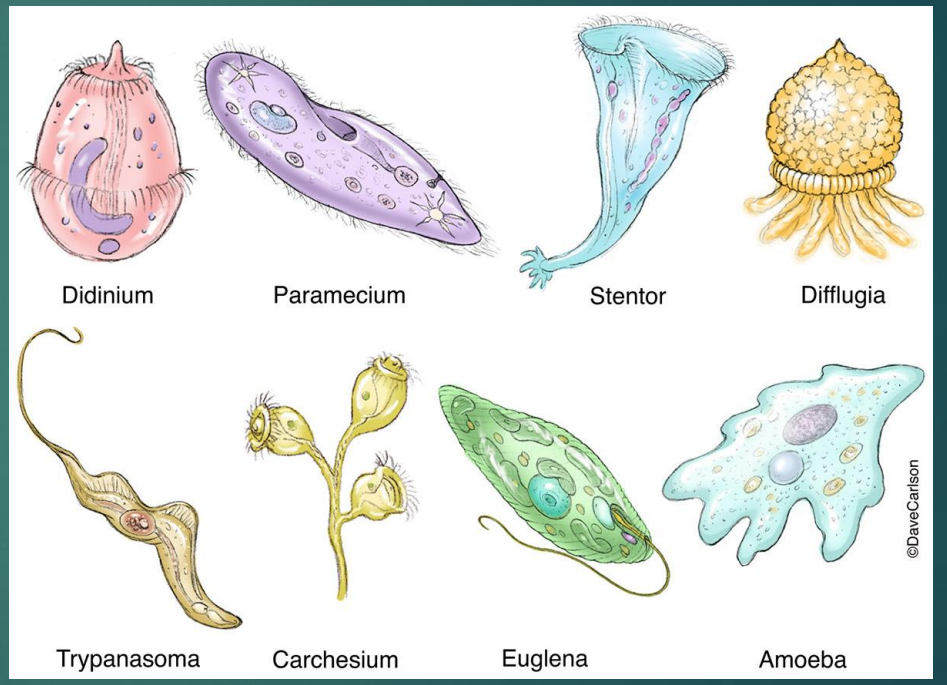
Recall the Last Man thought experiment:

"The last man (or person) surviving the collapse of the world system lays about him, eliminating, as far as he can, every living thing, animal or plant (but painlessly if you like, as at the best abattoirs). What he does is quite permissible according to basic chauvinism [that is, anthropocentrism], but on environmental grounds what he does is wrong. Moreover one does not have to be committed to esoteric values to regard Mr. Last Man as behaving badly."(Routley, 1973, p. 207)



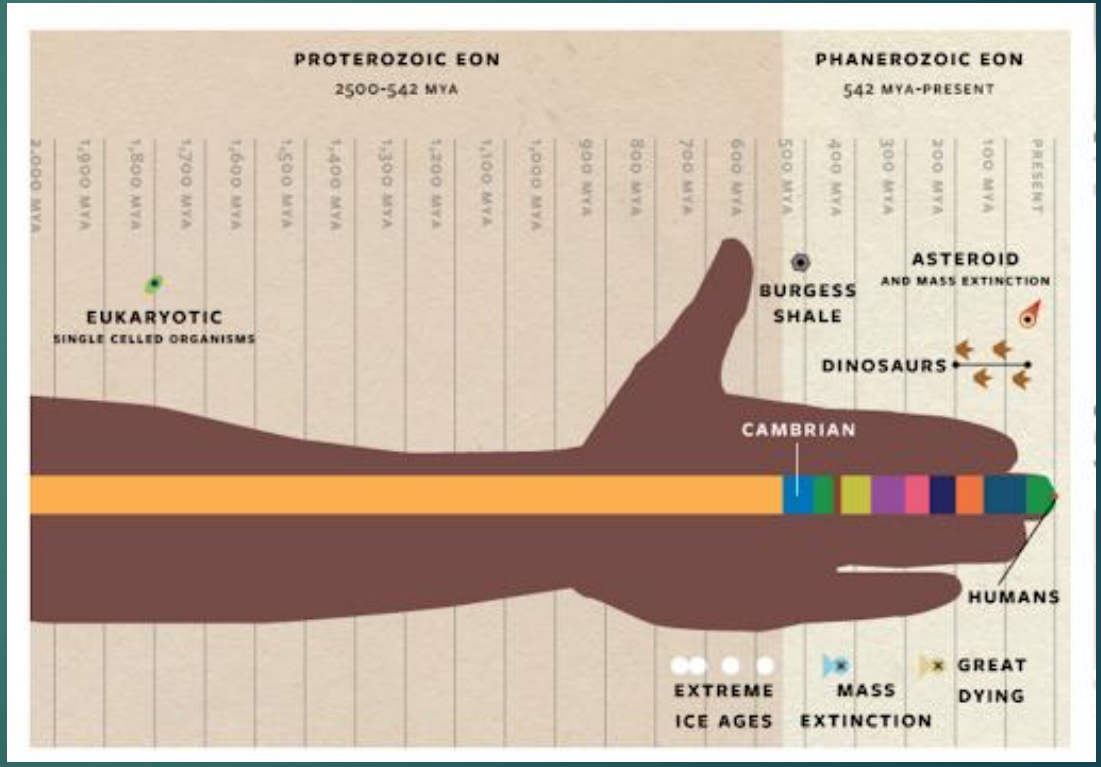
Biocentrism

- In environmental ethics, biocentrism is the idea that all living things have intrinsic value
- This comes in a variety of types
- Strong biocentrism says all life is equally valuable
- Weak biocentrism says all life has some value, but maybe not all life is equally valuable



Longtermism

- Another essential piece of the favourable case is longtermism
- This is the idea that ethical outcomes in the distant future matter, possibly as much as near-term ethical outcomes
- The argument for this view is just that there is no principled reason to prefer short term outcomes
- Is there any reason to doubt this?

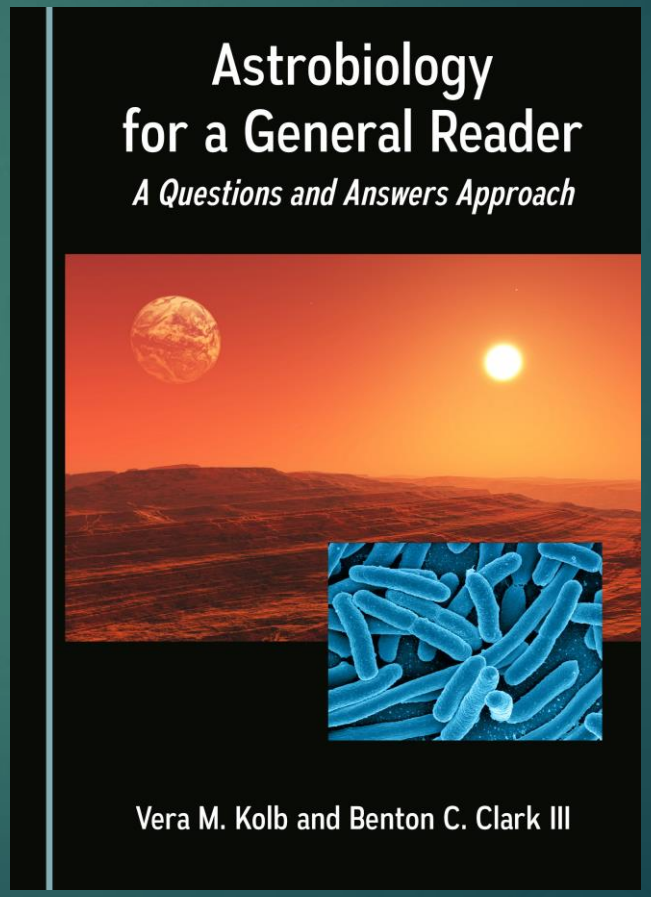


3. Life is possibly rare in our galaxy.

- So far, we have not detected signs of life anywhere other than earth
- It could be that the emergence of life on earth is a fantastically unlikely event
- Assuming that life has some intrinsic value, this makes preserving (and expanding) the existence of life pretty important

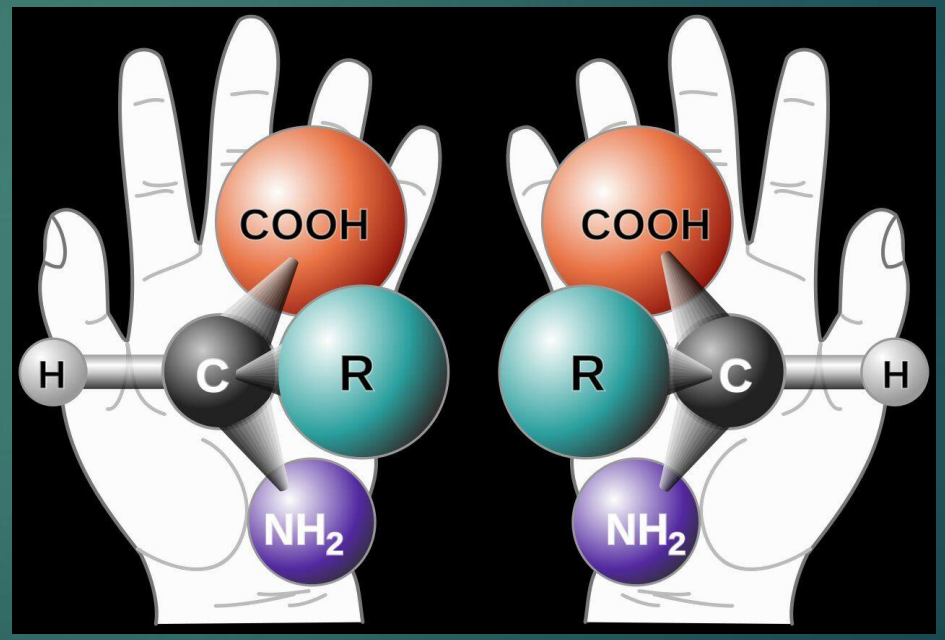
Biosignatures

- The field of astrobiology deals with a number of interrelated questions about the conditions for life elsewhere in the universe
- One important question in that field is what counts as a ‘biosignature’, a marker of life on a planet
- If you wanted to look for life on, say, Mars, what would you look for?



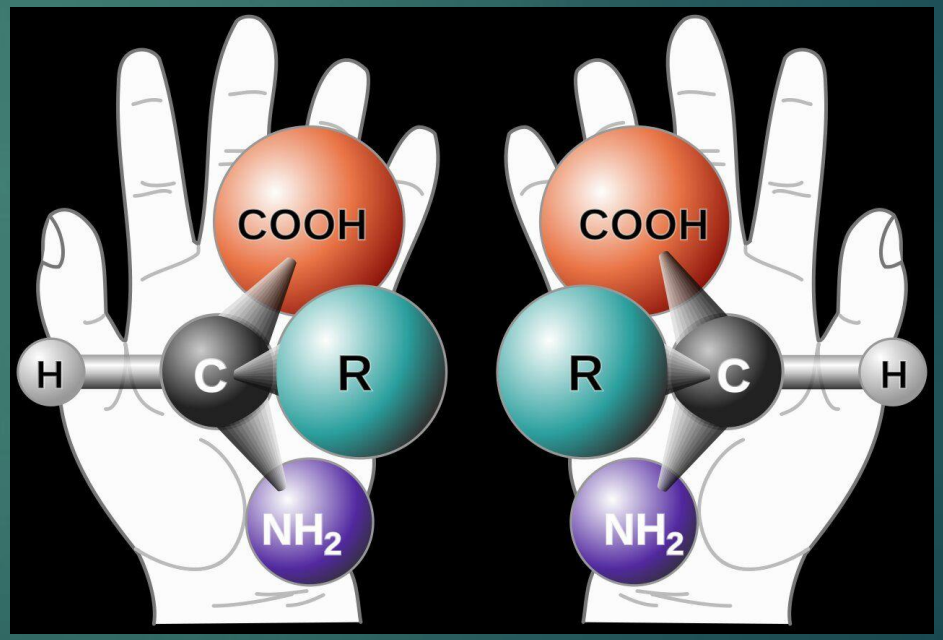
Enantiomeric Excess

- Life on earth operates almost exclusively (with some minor exceptions) using left handed amino acids
- But if you produce those amino acids in a test tube, you get about equal quantities of left and right handed versions
- One potential biosignature is then an enantiomeric excess (difference in amount of a given handedness of a compound)



Enantiomeric Excess

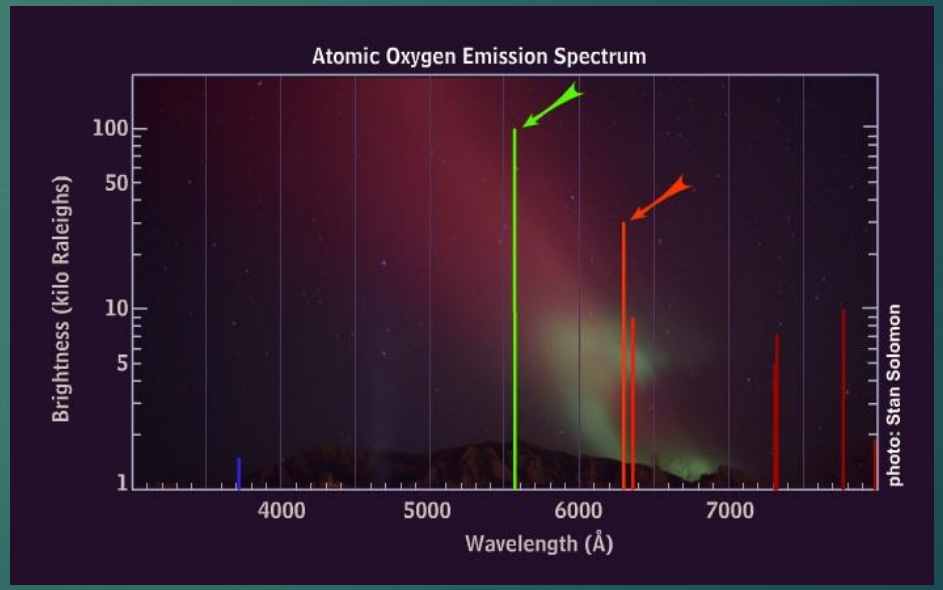
- This is complicated somewhat by the fact that some non-living processes can produce an enantiomeric excess
- Glavin et al. (2019) suggest that the most telling biosignature would be a large excess of amino acids with the opposite handedness as the ones common in life on earth



- Glavin, D. P., Burton, A. S., Elsila, J. E., Aponte, J. C., & Dworkin, J. P. (2019). The search for chiral asymmetry as a potential biosignature in our solar system. Chemical reviews, 120(11), 4660-4689.

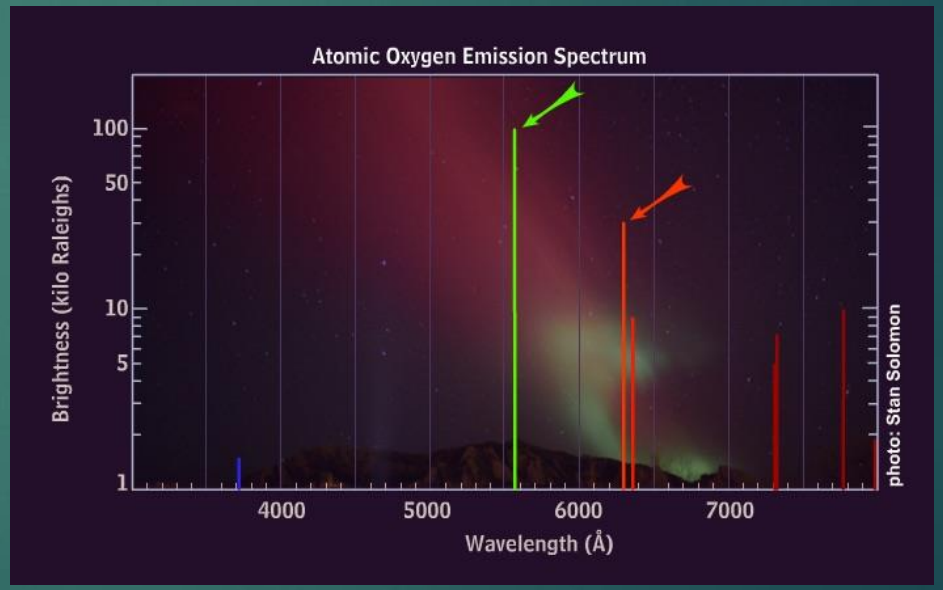
Oxygen

- Another promising biosignature is just an abundance of oxygen on a planet
- Oxygen on Earth is almost all produced by photosynthesis by plants, algae, etc.
- And oxygen is pretty reactive, so if plants stopped making it, it would be removed from the atmosphere by oxidation
- So maybe if we detect another planet with an oxygen rich atmosphere, that means life did it?



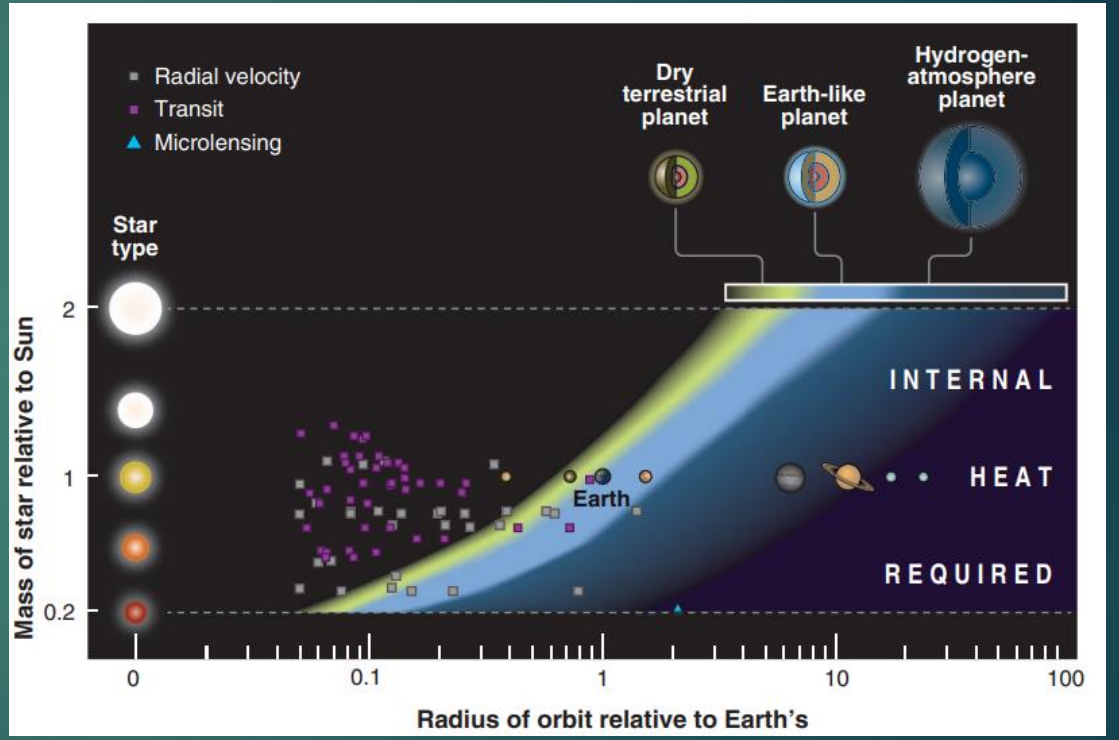
Oxygen

- It turns out to be not quite that simple, since oxygen can in fact be produced by a number of different geological processes
- That doesn't make oxygen unimportant here, just not a definite sign of life
- This also shows how our understanding of biosignatures is tied up with our understanding of the variety of possible geological processes that can take place on a planet



Habitable Planets

- This is not a biosignature, but another factor to consider when thinking about how common life is in the universe
- What needs to be the case for a planet to be 'habitable' in the sense of a potential place where life could exist?
- Usually we assume it needs liquid water, since all life on earth needs that
- Other liquids could conceivably work, but water is the most common and likely solvent for life



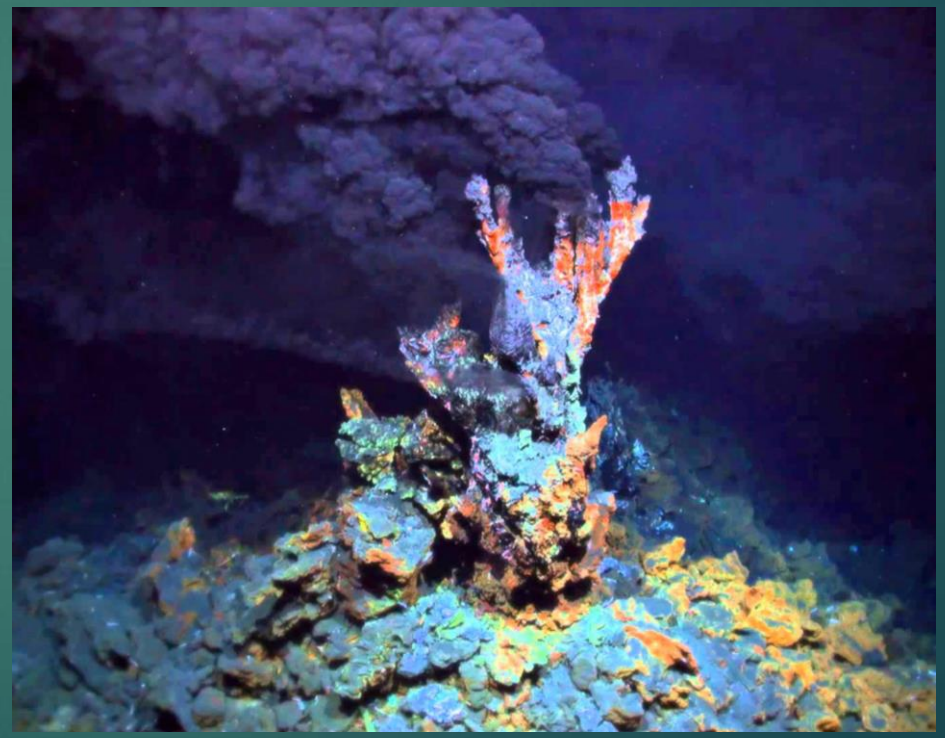
Seager, S. (2013). Exoplanet habitability. Science, 340(6132), 577-581.

Our strange moon

- The current leading theory is that our moon was formed by a gigantic collision between earth and a Mars sized object in the early solar system
- This did things like tilt the earth (creating our seasons), speeding up its rotation (regulating the temperature at a given spot), increasing our magnetic field (protecting early life from radiation), driving tides (which enrich the ocean with minerals) and so on.

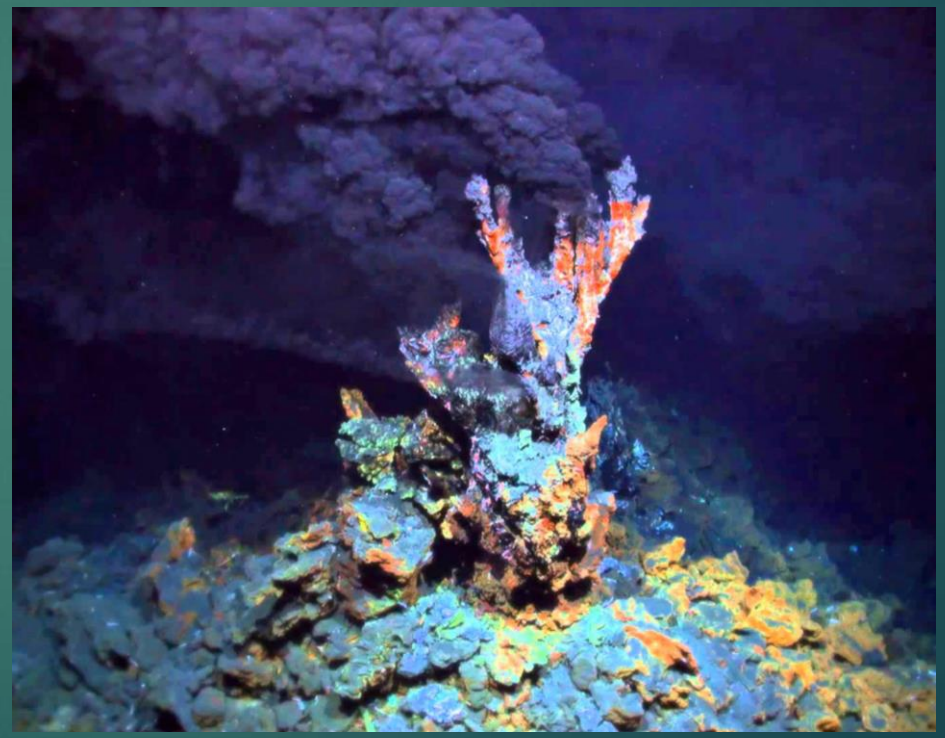
Extremophiles

- When trying to decide what counts as ‘habitable’, we need to know about the range of conditions where life could possibly thrive
- As it turns out, that range is pretty wide!
- Practically every environment on earth, short of actual magma, seems to have life in it



Extremophiles

- *Pyrolobus fumarii* lives near hydrothermal vents at the bottom of the ocean, at temperatures above 100C
- They are chemolithoautotrophs, meaning they eat neither light nor other living things
- Rather, they derive energy from inorganic compounds (i.e. rocks)

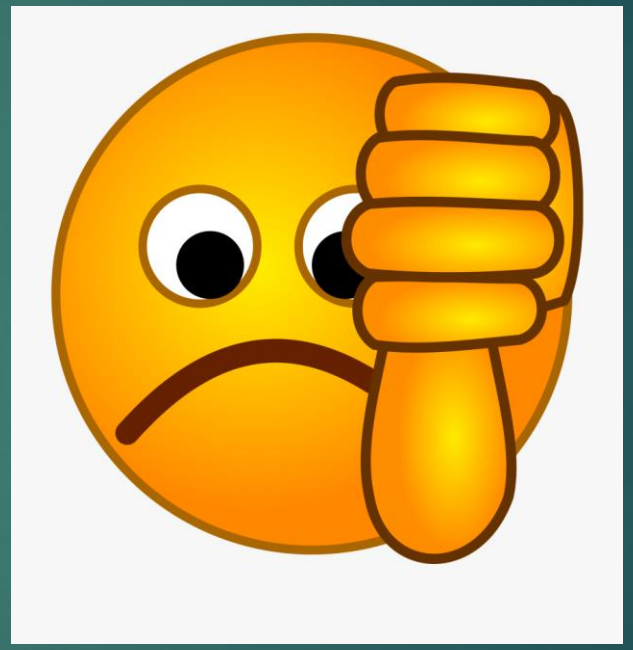


3. Life is possibly rare in our galaxy.

- So there are serious open questions about this premise
- If simple life is pretty common out there, then the argument that we should spread life to other stars to preserve life itself fails
- But could we care about earth life specifically?

The Unfavourable Case

- One of the main points of the unfavourable case rests on the uncertainty about how widely distributed life is
- We'll talk about that concern, and then another about animal suffering

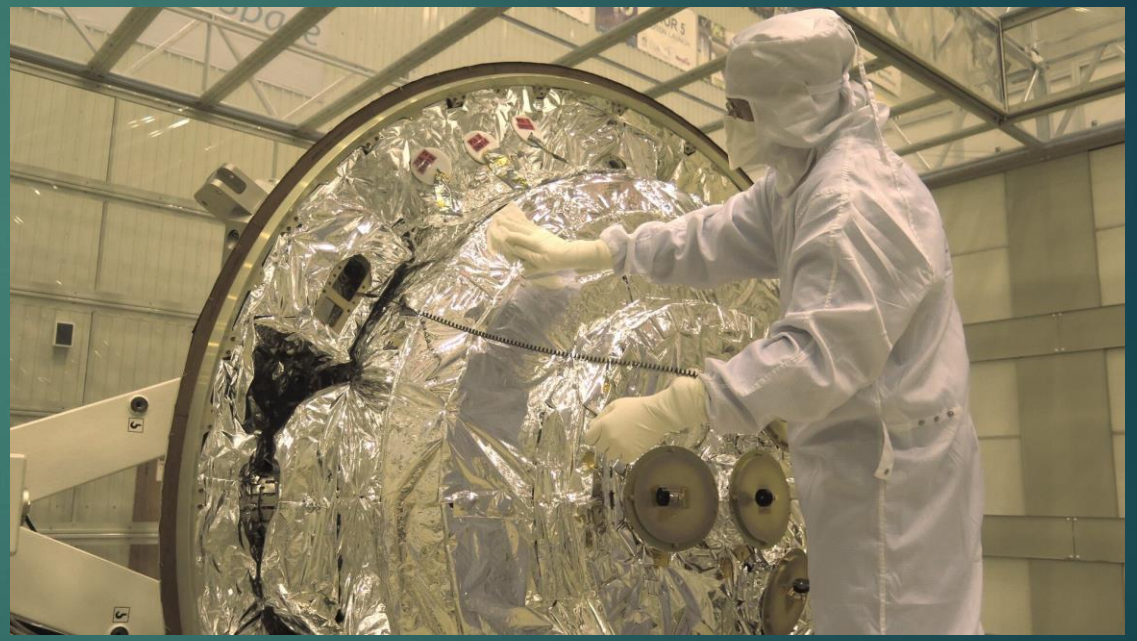


Life is possibly abundant in our galaxy!

- We haven't detected intelligent life, but that could be for a variety of reasons
- And it could easily be the case that simple life is abundant in the universe
- We have no reasonable assurance at this point

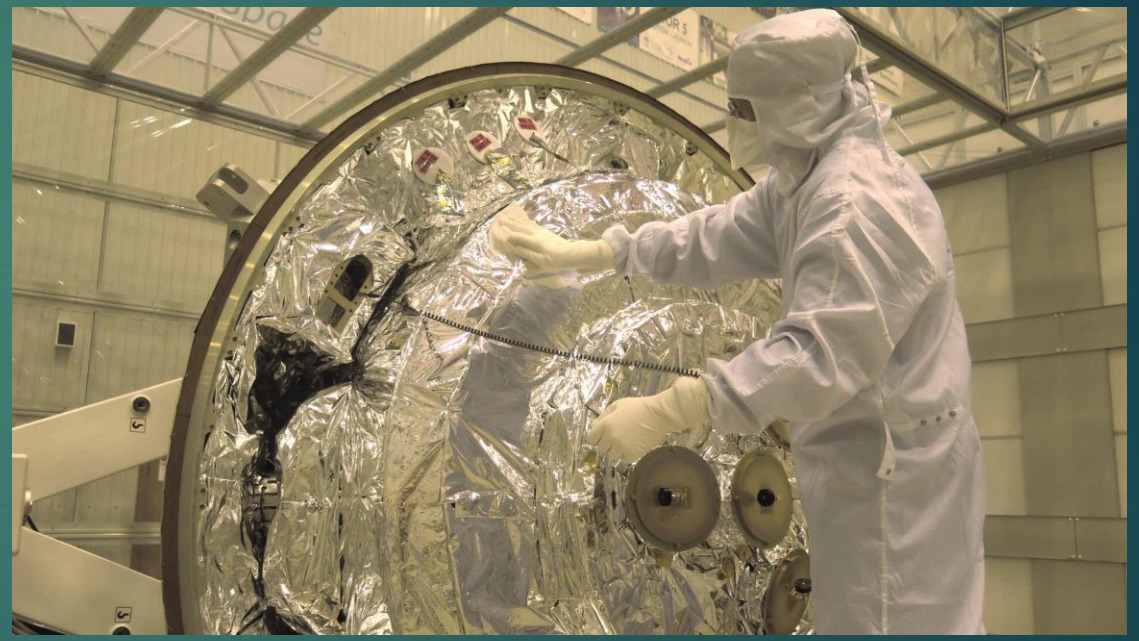
Interference with Other Biota

- The Outer Space Treaty (signed by all nations currently pursuing space programs) dictates that anything sent to another planet needs to be carefully sterilized
- Currently, the main reason is that we don't want microorganisms from earth contaminating say, Mars, and wrecking our chance to study the planet undisturbed



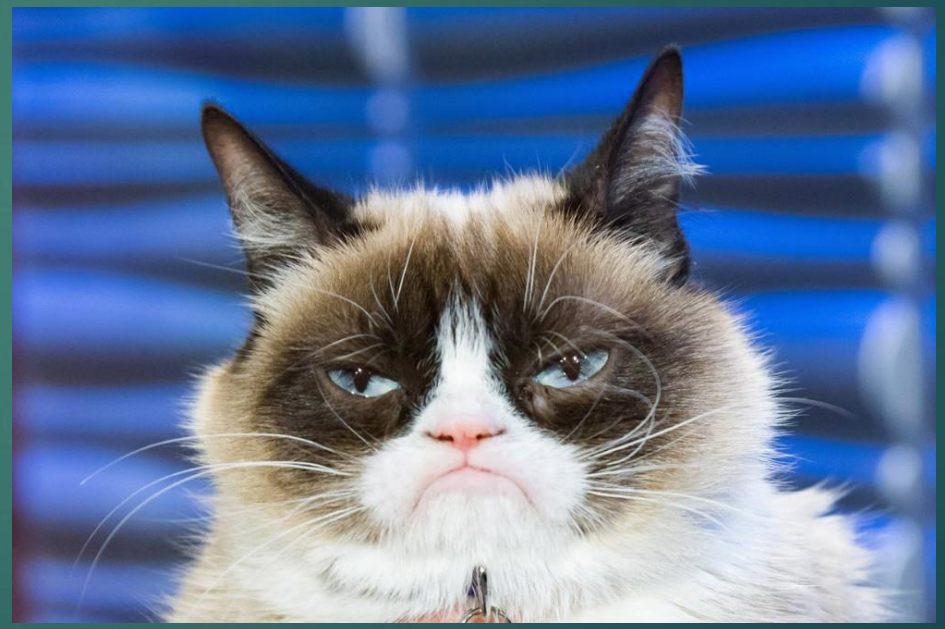
Interference with Other Biota

- But if planetary seeding is meant to be a grand altruistic project, there are even more important reasons for caution
- What if we try to seed life, but end up massively disrupting the ecosystem of other planets?
- Given that we have no credible evidence that other habitable planets don't house life, this is a risk we can't rule out



Animal Suffering

- The other concern Sivula raises is an ethical one
- What if seeding life in the galaxy leads to an increase in the overall suffering in the universe?
- Even if we think there is something intrinsically valuable about life, that doesn't mean that any life whatsoever is a net good
- If a living thing is condemned to horrible suffering, that may outweigh the positive value of their living at all



R-Strategists

- Many species reproduce by producing huge numbers of offspring, and kind of hoping that some of them make it (r-strategists)
- This contrasts with the human strategy of relatively few offspring that we (often or usually) invest heavily in
- Animal welfare theorists have suggested that for r-strategy species, perhaps suffering massively outweighs flourishing

Predation, illness, etc.

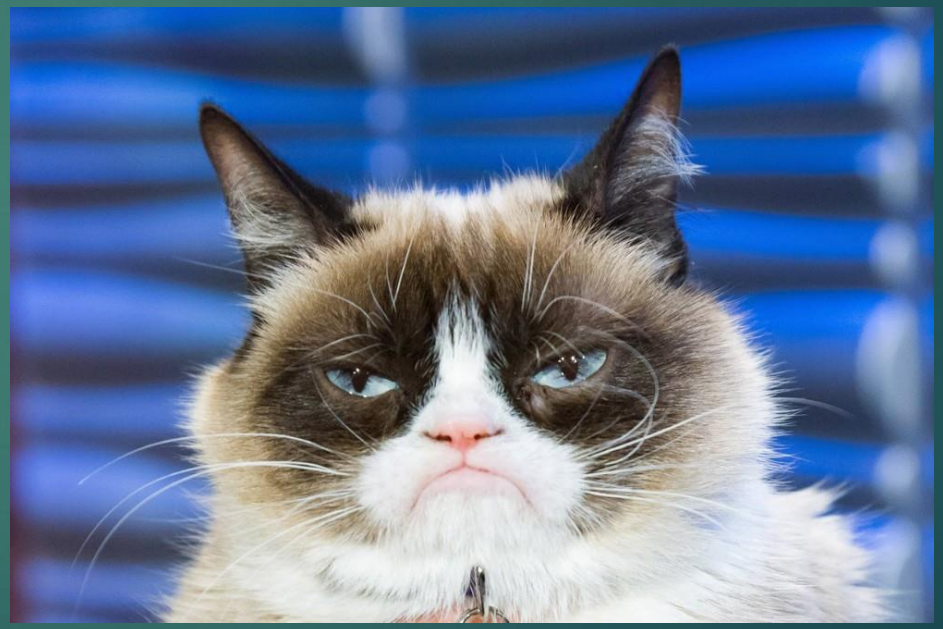
- Further, for those living things that make it to adulthood, life can be pretty tough
- Illness kills many
- Huge numbers are killed by predators, including many predators themselves
- Some animal welfare theorists have suggested letting predatory species die off to prevent this!

Octopus Reproduction

- The reproductive cycle of octopuses is a particularly grim example
- Once a mother has laid some eggs, she stays with them, protecting them
- She stops actively hunting, and after a while, stops eating at all
- The mother will care for the eggs until she dies

Animal Suffering

- Not everyone agrees that suffering outweighs happiness in animals
- E.g., Browning and Veit argue that it's an entirely open question, and we must know a lot more about how animals experience the world to say
- Being eaten by a predator is no fun, surely, but if an animal has had a generally happy life they think this could easily outweigh that



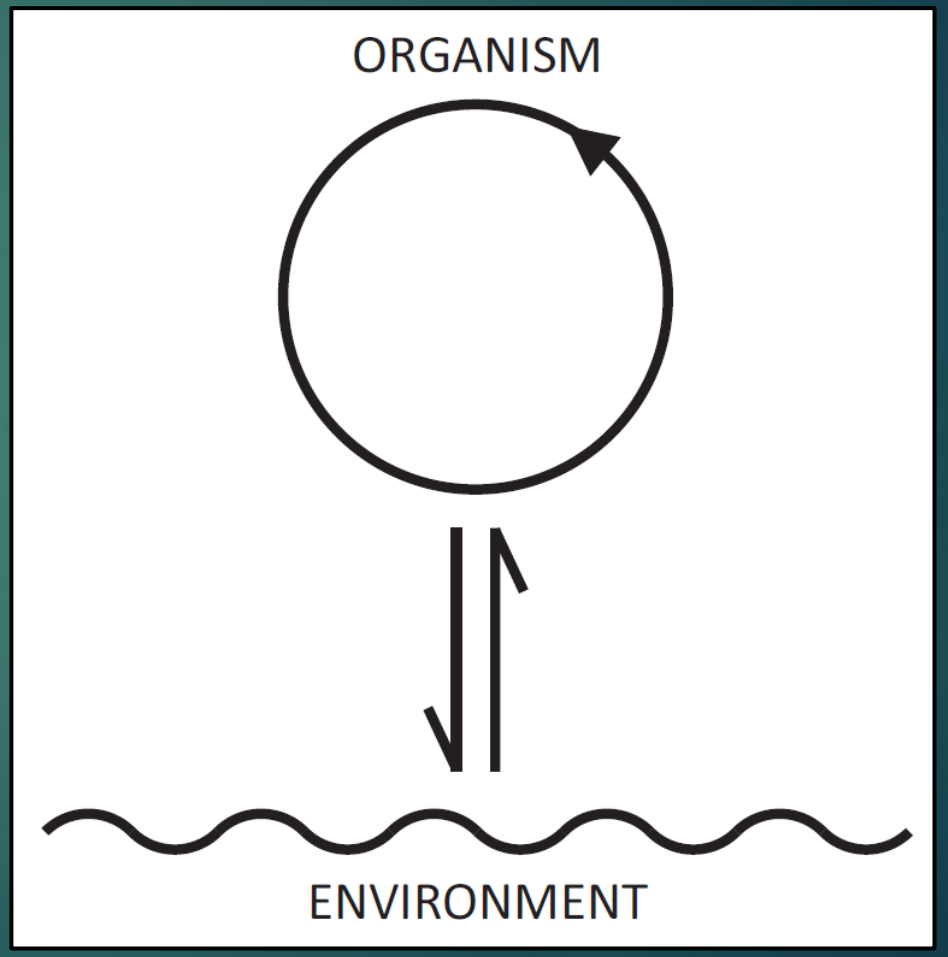
- Browning, H., & Veit, W. (2023). Positive wild animal welfare. Biology & Philosophy, 38(2), 14.

Life is valuable in itself.

- It's worth revisiting this premise, and asking whether evaluating it is really a matter of doing arithmetic on positive and negative experiences
- Perhaps the value of life is not that it's fun (it is often not) but simply that it exists

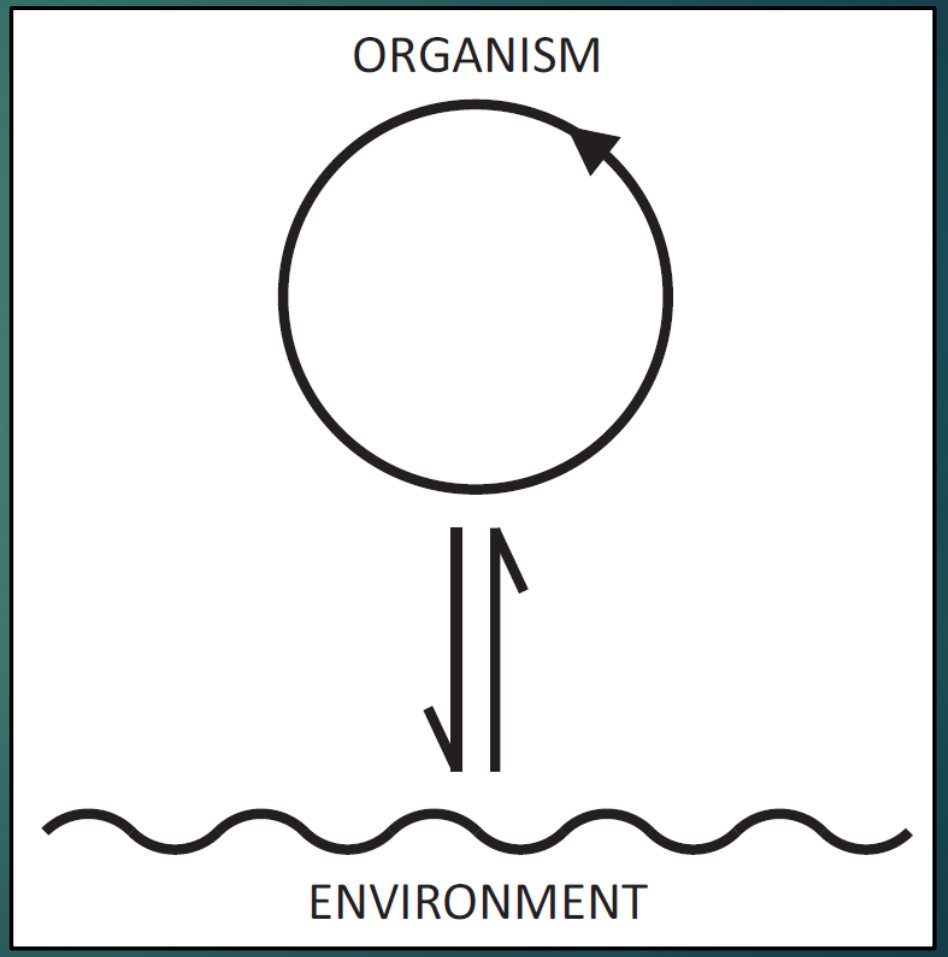
Autopoiesis

- One proposed definition of life is in terms of autopoiesis
- That is, roughly, the capacity of a living thing to continuously make and re-make a self-other boundary
- This self-other boundary is dynamically maintained while coupled with a changing environment



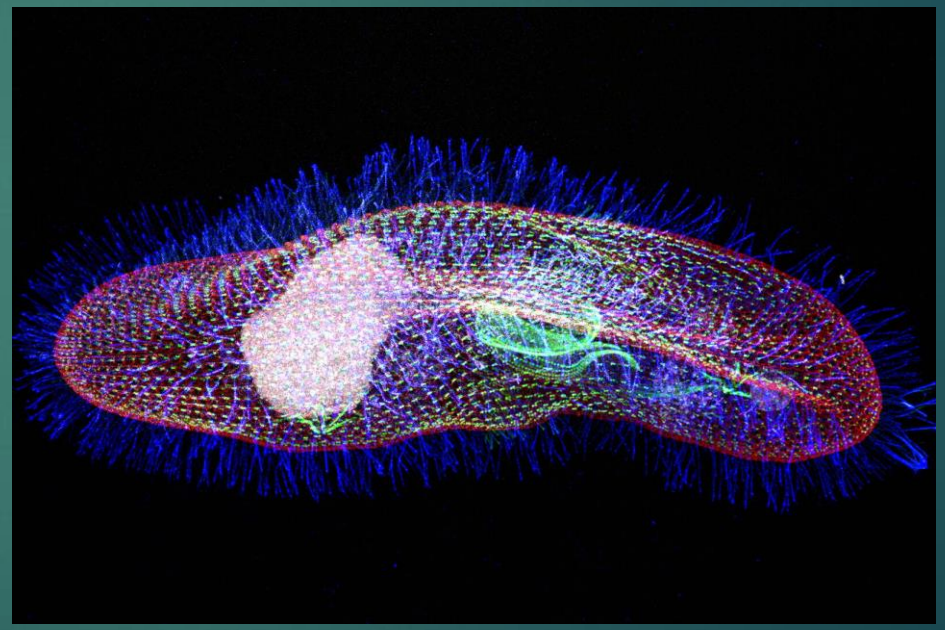
Autopoiesis

- In *Mind in Life* (2010), Evan Thompson argued that this provides the basis for understanding both mind and normativity
- An autopoietic system (ie. any living thing down to single-celled organisms) navigate their self-making in a goal directed way, the goal being continued existence
- This creates the simplest possible field of good and bad, simple normativity



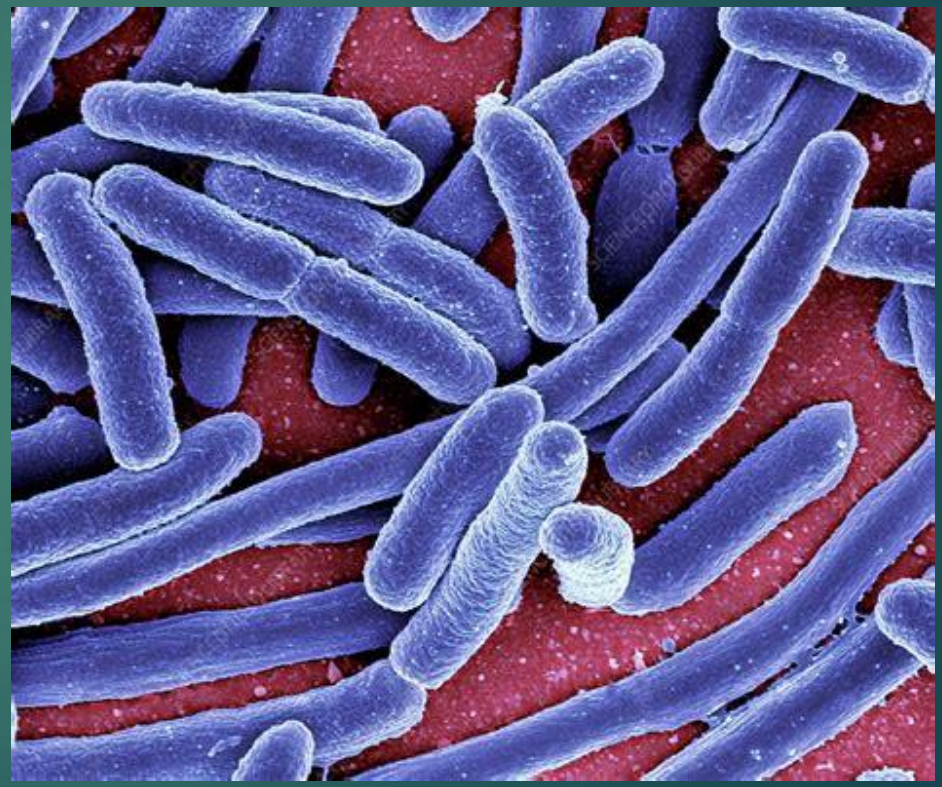
The Basis of Normativity

- The precarious nature of self-making is the root of any sense that things are good or bad
- If existence were guaranteed, nothing would be food or poison
- Living things generally try to stay alive, the simplest act of cognition



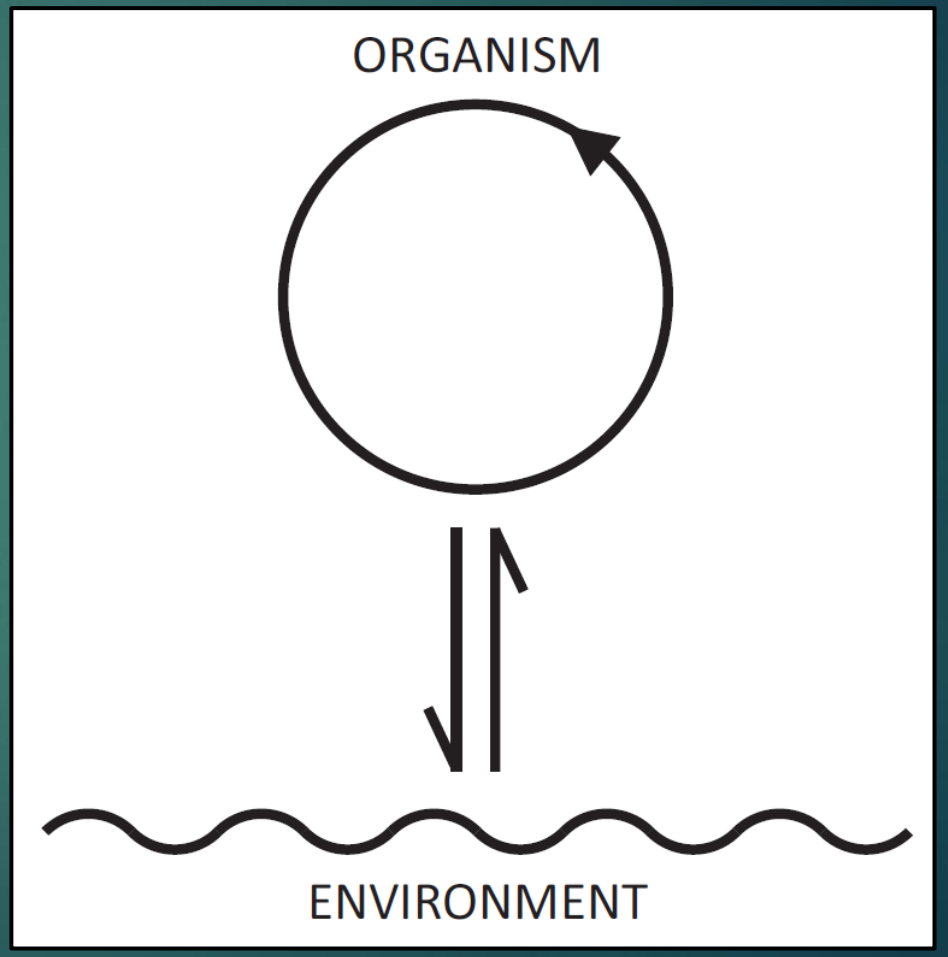
Regulated Cell Death

- It's perhaps worth noting that even single celled organisms seem to sacrifice themselves sometimes
- E. Coli have been found to contain a toxin/anti-toxin system, where they continuously produce a toxin and its antidote
- If the cell becomes dysregulated (say by being infected by a virus) the antidote stops being produced and the cell destroys itself



Autopoiesis

- So even at the single cell level, the minimum unit of life, we see a concern for living things beyond themselves
- It seems that life does not simply aim at preserving itself (as individuals) but preserving life more generally



Life is valuable in itself.

- Maybe the autopoietic perspective is helpful here
- Life isn't just good/bad, it is the condition for the possibility of anything being good or bad
- And it seems that life tries to keep life going even at expense of individuals interests

Life is valuable in itself.

- This is just a sketch of an argument
- But maybe it offers a way of thinking about the value of life that doesn't reduce to utilitarian arithmetic
- Life is precarious by definition
- But maybe it's overall worth preserving, because life is what makes anything worth anything in the first place

Thanks!