

Astrobiology Final Project

You will write a roughly 10-page paper (normal margins, 11-point font, double-spaced) on a current topic in astrobiology. You should:

- Summarize the current state of the field
- Describe the controversy
- Identify what (in your opinion) are the next steps to be taken to move this work forward. Be specific — not just ‘more research should be done.’

Paper requirements

You’ll read at least 3-5 papers from the literature. Wikipedia and web pages don’t count. Doing the research and writing the paper will require a lot of actual work.

Your paper should be a well-written narrative, but also be quantitative. This is a physics class; do some calculations where appropriate. You can’t just philosophize and speculate; you must defend your ideas.

Subject

Pick a topic that is controversial, or at least where there is some debate, or multiple sides to the issue. This is not too hard — astrobiology is a young and growing field, and most issues are controversial. Unless you pick one of the topics below, you should run your idea by me first.

Journal articles

You’ll probably come across some journal articles that you need. UP has online access to some journals; I have access to more. arxiv.org has preprints for many articles, especially in astronomy. Articles > 1 year old in Astrophysical Journal (“ApJ”) and Astronomical Journal (“AJ”) are available for free online via the Astrophysical Data Service (adsabs.harvard.edu), as are abstracts for virtually all other relevant published articles.

Citations

All of your references should be cited (journal articles, plus any online sources where you cannot find an actual article). Things which are obvious to the typical physics student, like a derivation of Kepler’s laws, don’t need to be cited, nor do commonly agreed physical constants like the radius of Saturn.

Advice

I strongly recommend talking with me about your project as you are proceeding. It’s easy to get sidetracked onto tangents that won’t play out. I want you to do to a great job, and I’m here to help you work through ideas, find papers, and stay on track.

Due Date

Friday 6 Dec 2013

Sample Topics

- In 2011, a paper in Nature by Wolfe-Simon and colleagues claimed that they had identified bacteria that -- for the first time ever -- used arsenic instead of phosphorous. The paper was published to wide acclaim and criticism, and followup work does not support the original findings. What was the controversy, how was it handled, and what implications does this have for future work?
- In 1996, a paper in Science by McKay and colleagues claimed that a Martian meteorite held evidence for fossilized life on that planet, drawing widespread interest from both scientists and the public. Since then, no more evidence has been uncovered. What is the state of this debate, what were the controversies, and what work in this area remains to be done?
- Saturn's moon Titan, which has extensive photochemistry but no liquid water, has been claimed to be a potential habitat for life. What are the arguments for and against life (or habitability) on Titan? What future work should be done?
- Life on Earth is 'chiral' -- that is, amino acids and DNA spiral in one direction, but not in their chemically equivalent mirror image. What are the possible sources of this chirality on Earth?
- Titan, Enceladus, and Europa are three targets in the solar system of great interest to astrobiologists. Propose a mission to one of these destinations, building on current spacecraft capabilities, and justify why you pick one of these (e.g., why does it offer the best prospects for life?). Be specific in your science goals, and your instrumentation to achieve those goals.
- Much work has focused on the ability of life to be created on Earth. It has also been proposed that life was delivered here from another planet, or another solar system. What are the relevant arguments in this debate on 'panspermia'? Justify your position on the issue. What research could be done to address the controversy?
- Water beneath the Europa ice shell bears some similarity to Lake Vostok, beneath the Antarctic ice sheet. Recently, Russia has caused some controversy by drilling into this protected and pristine lake, raising the possibility that they might contaminate it. What are the issues of 'Planetary Protection' that affect sites on Europa and throughout the solar system? Do the world's space agencies do an adequate job of protecting the natural environments on distant planets, or are they at risk?
- The SKA will be Earth's largest radio telescope. What will it do for astrobiology? How do its capabilities compare to other ground-based telescopes? What are the most important projects it could undertake? Are there projects which will be controversial for some governments to be involved with?

Grading Criteria

Your project will be graded based on the following criteria, in roughly equal weighting.

Depth of Understanding

How well does the paper demonstrate the completeness of your knowledge of the subject.

Quality of Research

Did you find, read, and synthesize material from a variety of sources, including relevant published research papers in the literature? Are citations used properly?

Thoughtfulness and Creativity

Your paper should go beyond just a factual restatement of knowledge. How well do you balance your discussion of two competing ideas and/or controversies in the field? When discussing your plan for the future, how well thought-out is this, and do you adequately describe and justify it?

Quality of writing

Organization and clarity; grammar.