

Philosophy 305 – Summer Pre-session 2005

Introduction to Philosophy of Science: Investigations in General Biology

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Course Description

This course will be an investigation into *General Biology*. Biology, the scientific discipline with which you are all familiar, studies life. But, what is life? Ask a biologist and she will point to the bacterial culture in the gelatin coated glass dish, or she will turn a rock and show you the multiple colors of algae that you have had always ignored, or she will take you to the botanical garden or the zoo and tell you fascinating stories about the critters there. Did she answer the question? At best, she gave you an answer to what life is *actually* like here on *Earth*. This was not the question, however. Could life have been different here on Earth? What would count as life if you were on Mars? Her answer does not address these questions. Now imagine, you ask the same question to a physicist. What will he say? Probably: “Go ask a biologist! I am a physicist.” Does he have the right to dismiss the question?

General Biology is an attempt the answer *the question* appropriately, and in a way that a physicist will not dismiss it. We will examine the first important question of General Biology: “What is life?” – “What makes a physical system, such as a bacterium, living?” But, and this is a big but, we want to answer the question without incorporating notions that make sense only for life here on Earth. We are not allowed to say that a system is living if it has DNA, simply because all examples of living forms have DNA. Part of the answer to the question “*What is Life?*”, must naturally address the question “How does life emerge and develop?” Biologists usually have a ready answer to this question – Theory of Evolution. But, “the strange thing about *theory of evolution* is that everybody thinks that they understand it.” Do they? The next question that we address is “What is missing from the theory of evolution to be a good foundation for Biology?” We will enter the world of self organization, dynamical criticality, and chaos. Finally, we will examine the second important question of General Biology: “How and why would life form in the universe?” Our goal will be to characterize the principles of development of Biospheres in a way that a Physicist would. We will attempt to formulate prospective natural *laws* for the formation of life.

In this course we well not engage in science. The proposals that we will investigate and discuss are not established and developed enough to be called science. We will engage in *proto-science*, in something that would, potentially, lead the way to a new science of biology – a science that can answer the questions: “What is life?” and “Why is there life in the universe?” satisfactorily. To do that, we must do some Philosophy. *Let’s ...*

Course Text:

Investigations, by Stuart Kauffman

This is a popular-science book that discusses important and controversial topics in Biology, Physics and their integration in the theory of natural organization. The book is philosophical and exploratory in character, but it assumes some general scientific background, or at least a strong fascination with science. Stuart Kauffman is a distinguished theoretical biologist and geneticist currently working at the Santa Fe Institute, a place where a lot of *new* science is being developed. The book is written at a level of difficulty equal to a *Scientific American* article. While I will not presuppose any university science classes, I will expect a full understanding of high school Biology, Physics and Mathematics. If you have forgotten your elementary molecular genetics or thermodynamics, I will advise you to review them. For those of you that have been impoverished by the low standards of some high school science programs, I will discuss all of these topics when they are needed, but I will expect maturity on your side to be able to seek and understand on your own anything that you think you are missing (this includes coming to office hours). Such topics are used as a tool for the presentation of the material; they are not the central topics. I will treat them as such. Our goal is to understand the brilliant innovative ideas that Kaufman is proposing, not to understand traditional biology or physics.

Course Administration

The class meets every week day from May 16 to June 4 (except May 30) from 1 – 3:50pm. The location of the class is: S Sci 311. **My office hours this session are 11:30 – 12:30 daily.**

This class will have a Desire2Learn web page where reading and assignments will be posted:

<http://help.d2l.arizona.edu>

Occasionally, copyrighted material will be available on the electronic reserves page for that course. The password for the course can be found in at the Desire2Lear site. The electronic reserves for the course can be found here:

<http://eres.library.arizona.edu/eres/coursepage.aspx?cid=4478>

Course Requirements

You are required to attend the classes, and you are required to do the assigned daily readings. I cannot emphasize enough how important that is. To assure that you, in fact, do the reading, a major portion of your grade will be based on you having done the assigned readings. *Investigations* has 10 chapters, thus we will cover approximately a chapter per day. You will be required to keep up with the pace. At the beginning of every day in which we begin a new chapter, you will have a short multiple choice quiz that is intended to test whether you have done the reading carefully enough. You will either pass

or fail the quiz, depending on whether I determine that you have done the readings. You can pass the quiz even if you have answered some of the questions incorrectly. If you pass a quiz, you will receive 1 point, if you fail the quiz, i.e. if you do not do the reading for a class on time, you will receive (-1) point. Ultimately, you will obtain between 0 to 10 points for the quizzes.

The grade partition of the class will be as follows:

1. **Ten Quizzes (40%):** **NOTE!** The way the quiz grades are assigned, if you do not do the reading for five or more of the classes on time, you will receive a total of 0 points for the quizzes and you will essentially fail the class. On the other hand, all you will need to do is do the readings on time and you will automatically receive 40% towards your grade. The readings for this class are **SACRED!**
2. **Final paper (25%)** ***Due Wednesday June 01:*** This will be a philosophical paper related to our discussions, the book, and possible external sources. I will provide topics allowing sufficient time for research and writing. (To the extent that this is possible in the pre-session.) You will have choice about the topics. This will be the main philosophical component of your assessment.
3. **Final Examination (25%)** ***On June 04 (last day of Classes):*** The final exam will consist of a collection of short answers related to the text, including some technical details. This will be the scientific component of the assessment.
4. **Class participation (10%):** In this class we will discuss topics that are scientifically very controversial – remember, we will be discussing proto-science. Therefore, discussion of the topics is more important than your actual learning of the details. For this reason, I expect you to participate vigorously in class, both in discussions and also as a means to understand the, sometimes quite difficult, material. Participation does not mean only comments and objections, it also includes clarificatory questions. In general, it measures your engagement in the class. I will take this grade very seriously; only listening and understanding in class will at most earn you a B as a final grade. **I WILL discriminate against shyness.** Fluency in English is also not an excuse. I was not fluent when I started as an undergraduate, but this did not stop me from asking questions.

Policies

Attendance: This is an upper division class, so I will assume maturity. Therefore, I will not keep attendance. However, considering the almost daily quizzes, there is an implicit penalty for absence. You will receive an automatic 0 for a missed quiz. There will not be a possibility for a makeup. The quizzes will take place around 10 min. after the beginning of the class to allow for some room for late arrival, but if you arrive too late, you will miss the quiz. Quizzes will be excused only for valid absences including: Documented medical reason, Family emergency, Holidays or special events observed by organized religions for those students who show affiliation with that particular religion, Absences pre-approved by the UA Dean of Students (or Dean's designee).

Class behaviour: I expect you to behave as mature students. You must respect your classmates and me. Please, avoid chatting on topics not related to the material. However, interruptions in the course of our discussion are welcome. Also, please turn off any cell phones during class.

The following is the University Policy on Threatening Behavior by Students

The University seeks to promote a safe environment where students and employees may participate in the educational process without compromising their health, safety or welfare. The Arizona Board of Regents' Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. Threatening behavior can harm and disrupt the University, its community and its families.

A. Prohibited Behavior Threatening Behavior is Prohibited.

"Threatening behavior" means any statement, communication, conduct or gesture, including those in written form, directed toward any member of the University community that causes a reasonable apprehension of physical harm to a person or property. A student can be guilty of threatening behavior even if the person who is the object of the threat does not observe or receive it, so long as a reasonable person would interpret the maker's statement, communication, conduct or gesture as a serious expression of intent to physically harm.

For a full description of the policy see:

<http://policy.web.arizona.edu/~policy/threaten.shtml>

Special Needs: Students registered with the S.A.L.T. Center or the Disability Resource Center must submit appropriate documentation to me if they are requesting special accommodations. Due to the nature of the quizzes, it would be impossible to take advantage of any special accommodations that requires you to take a quiz at another time. If you need any special accommodations, I will assist you during class.

Academic Integrity: Students should be familiar with and conform to the University of Arizona Code of Academic Integrity. Plagiarism will not be tolerated and students caught plagiarizing will be recommended for suspension.

Contested Grades: Students who wish to contest a grade on an assignment must submit their request in writing by email directly to me within three days of the date on which the assignment was returned to the class. The request must explain the specific points in dispute. Disputes will be resolved within seven days of being filed.

Content Disclaimer: In this class we will be talking about the natural origins and principles of life. One of the central aspects of our approach towards studying life will be that life is a natural, non-sacred phenomenon of physics. Such an approach towards life goes quite severely against most common religious and spirituals doctrines. Some people may find some of the discussions offensive. The course assumes explicitly a scientific, secular outlook to the subject. Non-secular considerations, while free to make, will not be given any academic merit. Students that may feel uncomfortable with the content of the course are advised not to take it.

Tentative Schedule

May 2005						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
15	16 First Day of Class 	17 Quiz 1 Chapter 1: Prolegomenon to a General Biology	18 Quiz 2 Chapter 2: The Origins of Life	19 Quiz 3 Chapter 3: Autonomous Agents	20 Quiz 4 Chapter 4: Propagating Organization	21
22	23 Quiz 5 1. Chapter 5: A Physics of Semantics? 2. Essay topics handed out 3. Writing tutorial	24 Quiz 6 Chapter 6: Emergence and Story: Beyond Newton, Einstein, and Bohr?	25 Quiz 7 Chapter 7: The Nonergodic Universe: The Possibility of New Laws	26 Quiz 8 Chapter 8: Candidate Laws for the Coconstruction of a Biosphere (Part 1)	27 Chapter 8: Candidate Laws for the Coconstruction of a Biosphere (Part 2)	28
29	30 Memorial Day Holiday No Class	31 Quiz 9 Chapter 8: Candidate Laws for the Coconstruction of a Biosphere (Part 3)	1 Quiz 10 Chapter 9: The Persistently Innovative Econosphere Paper Due	2 Chapter 10: (?) A Coconstructing Cosmos	3 Review/Catch up Session	4 Final Examination 

It is likely that some of the topics will take longer to cover. Chapter 10 (and even Chapter 9) may be skipped altogether. The quiz dates will follow the corresponding chapters, with the exception of Quizzes 8 and 9, for which I will give you special instructions.