| THE PHYSICS OF LIFE<br>(PHYSICS 171)<br>CRN: 14979<br><br>FALL 2016 | PROFESSOR RAGHUVEER PARTHASARATHY<br>(**Par**-tha-**sa**-ra-thē)<br><br>Office: 362 Willamette Hall<br>EMAIL: *raghu@uoregon.edu* |
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# SYLLABUS

*Welcome to "The Physics of Life" – my favorite course to teach! This is a rather long syllabus – it has a lot of detail on many components of the course that we've constructed to help you learn things, and to make the term run smoothly and enjoyably. Don't memorize it, but do* ***read it****. – Prof. Parthasarathy*

## *INSTRUCTORS AND LOGISTICAL INFORMATION*

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| **CLASS TIME** | TuTh 10:00-11:50 am, Willamette 110<br>*Note that there is a "clicker-based" participation grade as well as in-class quizzes – see the Grading and Quizzes sections, below.* |
| **INSTRUCTOR** | Professor Raghuveer Parthasarathy (**Par**-tha-**sa**-ra-thē)<br>Office: 362 Willamette Hall<br>Email: *raghu@uoregon.edu* |
| **ASSISTANTS** | This course has a graduate student teaching fellow (GTF) *and* an undergraduate assistant!<br>• Edouard (Teddy) Hay, edouardh@uoregon.edu<br>• Brianna Stamas (undergraduate), bstamas@uoregon.edu<br>Brianna is an undergraduate physics major supported by UO's Science Literacy Program (SLP) (scilit.uoregon.edu), which aims to develop new & better general-education science courses. |
| **EMAIL** | **Email:** You can certainly ask questions of me and of the teaching assistants by email. I usually respond within 24 hours; I rarely respond to emails that begin "Hey..." or are otherwise poorly constructed. |
| **OFFICE HOURS** | **Prof. Parthasarathy:** Tu. 1:00-1:50pm, Th. 12:00-12:50pm, Willamette 362<br>**Teddy Hay:** Tuesday 12:00-12:50pm, Friday 11:00-11:50am, Willamette 354C<br>**Brianna Stamas:** (TBA)<br>Please note that *office hour times may change*, both by request (if particular times are not good for many students) and due to scheduling conflicts that arise.<br>**Make use of office hours!** Even if you don't have specific questions, feel free to drop by and chat about course topics. |

## *COURSE DESCRIPTION AND MATERIALS*

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| **COURSE DESCRIPTION** | What are you made of? This simple question both puzzles and fascinates scientists. It is easy to make a list of your "components" – cells, bones, muscles, etc. – but this is neither interesting nor illuminating. What is it about your flesh that makes you "squishy?" How do you manage to pack a meter of DNA into a cell nucleus one-millionth of a meter wide? If you shrank a whale to the size of a bacterium, could it swim the same way? These questions, like many at the forefront of contemporary science, bring together concepts from a variety of disciplines, mixing together biology, chemistry, and physics.<br>This course will explore topics in biophysics. We will use readings, discussions, and hands-on exercises to study the physical aspects of biological materials and the constraints that physics places on living organisms. There are no scientific prerequisites, and mathematics will be at the level of basic algebra. |
| **LEARNING OUTCOMES** | Upon completing the course, students will have enhanced their abilities to:<br>• Understand how physical principles guide and constrain life.<br>• Assess and interpret graphs and quantitative data.<br>• Understand the process by which science generates knowledge. |
| **TOPICS** | • Introduction, Motivation, and Illustrations<br>• Scale and Powers of 10 – *In which we get a sense of the size of things*<br>• Surfaces and surface tension – *In which we explore the consequences of surface tension on the functioning of your lungs and ask: why can't you walk on water*<br>• On size and shape– *In which we ponder how size and shape of can affect an organism's properties*<br>• Randomness and diffusion – *In which we explore the perpetual motion of small things, both its unavoidable causes and its far-reaching consequences*<br>• DNA mechanics – *In which we examine the physical properties of life's most important molecule, and why they matter*<br>• Soap films, cell membranes – *In which we examine similarities between the two, and also look more generally at materials that assemble themselves.*<br>• Life at Low Reynolds Number – *In which we ask: Why don't bacteria swim like whales?*<br>• Microscopy – *In which we ask: How can we see small things?* |
| **MATERIALS** | • We'll use "iclickers," personal response systems that allow real-time polling and assessment in class. Each enrolled student needs one clicker. Clickers can be purchased at the bookstore. Borrowing the iclicker of someone *not* enrolled in this course and using it for this class *will* work fine.<br>• Some assignments will involve working with data. You should be able to navigate the internet and make simple graphs (e.g. with Excel).<br>• You may find it useful to have a ruler and pencils. |
| **READINGS** | There is no textbook for the course. I'll distribute **articles and other documents** online, via **Canvas**. Readings will largely be at the "Scientific American" level – i.e. having minimal mathematics. We'll accompany readings from more technical sources with explanatory commentaries. |
| **CANVAS** | We will be using Canvas in this course to distribute course materials, and also for online assignments. URL: https://canvas.uoregon.edu/ |

## *Assignments and Assessments*

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| **Reading Quizzes** | Reading assignments will **precede** many classes and will often have required "reading quizzes" associated with them. These will be answered in-class, usually via clickers. |
| **Quizzes** | There will be several short quizzes. (They won't be surprises; you'll get advance notice of at least one class.) We'll use these to assess understanding of key points as we progress without the heavy weight of a "real" exam. Each student's lowest quiz score will be dropped from the overall total. There won't be any make-up quizzes; if you miss one, this will be the quiz dropped from your overall grade calculation. |
| **Pop. Articles** | Throughout the term, I'll assign various "popular" science articles and ask you to analyze and comment on them. These assignments will be described further as the term progresses. |
| **Homework** | There will be homework assignments approximately every week. Feel free to discuss the questions with others, but of course, *the work you submit should be your own*. Assignments will mainly be submitted online, via Canvas. Solutions to all the problem sets will be posted – **study** these. No late homework will be accepted. Some assignments will involve finding and analyzing data. You should be able to navigate the internet and make simple graphs (e.g. with Excel).<br>*Homework grading:*<br>(1) Each student's lowest score will be dropped from the overall total.<br>(2) We will not comment in detail on your homework when grading it. It is especially important to study the problem set solutions. |
| **Clicker Q's** | There will be in-class "clicker" questions related to the present topic, scored by *participation only*, not the accuracy of the response. |
| **Clickers** | We'll use "iclickers," personal response systems that allow real-time polling and assessment in class. There is a participation grade associated with the clickers – i.e. clicker response is scored by *participation only*, not by the correctness of the answer. Each student needs one clicker, which looks like this:<br>  <br>Clickers can be purchased at the bookstore. Borrowing a clicker from someone *not* enrolled in this course will work fine.<br>**Clicker registration:** We'll do this through Canvas; **don't** use iclicker.com!<br>**Overall score.** Clicker points cannot be made up. However, I realize that absences are unavoidable, and so I will rescale the clicker scores so that 90% counts as 100%; i.e. you can miss 10% of the clicker |

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| **EXAMS** | There will be two midterm exams, tentatively scheduled for Nov. 3 (Week 6) and Nov. 29 (Week 10). We'll discuss the format later in the term; in brief, they will have a combination of multiple-choice and short-answer questions. There is no final exam. |
| **FINAL PROJECT** | There will be a final project, described in more detail later. The project, to be done in small groups, will consist of a brief (3 minute) summary presented to the class, and a short write-up or video. The summary is due in Week 10; the write-up by 11:00 am Thurs., Dec 8. |
| **MATH DIAGNOSTIC** | The mathematics in this course will be very elementary, as discussed in class, but it is important to be comfortable with these basic numerical skills. Therefore there will be a diagnostic "quiz" to be taken on-line on basic mathematics. Re-taking the quiz **is** allowed – you are encouraged to learn from your mistakes, and to see the GTFs and me for help. Scoring 75% or higher by the Thursday of Week 2 is **required** for continuing in the course. (A score of <75% will automatically result in a failing grade for the course.) |
| **GRADING** | The various grade components and their weights for the final grade are:<br>• *Reading quizzes: 5%*<br>• *Quizzes: 10%*<br>• *Clicker questions: 5%*<br>• *Homework Assignments: 20%*<br>• *Popular Science Article Assignments: 10%*<br>• *Midterm Exam #1, 20%; Midterm Exam #2: 15%*<br>• *Final Project: 15%* |
| **SCALE** | The course grading scale: A=87-100%; B=74-86.9%; C=60-73.9%; D=46-59.9%; F<45.9%. |

## *OTHER INFORMATION*

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| **ABSENCES** | I realize that it is unavoidable that people will have to miss a few classes (due to illness, for example). Therefore I will rescale the grades of the post-class notes, clicker questions, and reading quizzes such that 90% becomes 100%. (In other words, I will divide each student's percentage by 0.9, with a ceiling of 100%. If your original score were 75%, the rescaled score would be 83%.) I will not allow "makeup" quizzes, etc. – the point of this policy is to avoid the messes created by these sorts of ad-hoc arrangements. |
| **LAPTOPS IN CLASS** | The use of laptop computers in class is not allowed. Why? Several studies, plus past experience, show that students using laptops in class spend a great deal of time on non-class-related activities (surfing the web, playing games, ...) and that these distractions negatively impact both learning and grades. This alone isn't a reason to ban laptops – you're responsible for your own performance in class. *In addition*, however, studies have shown that non-class-related laptop use distracts and impacts the learning of *other students nearby*. (E.g. Fried, C. B. *Computers & Education* **50**, 906-914 (2008).) Plus, *students* have complained to me about the environment created by their classmates laptop use.<br>Taking notes by hand, by the way, is more effective in cementing concepts in your mind.<br>In summary, laptops are not allowed in class. The only exceptions will be for people with documented medical needs; please see me if this is the case. |
| **NECESSARY CAVEATS** | Students are expected to abide by university policies on academic honesty, avoiding plagiarism, fabrication, cheating, and academic misconduct. The Student Conduct Code (http://conduct.uoregon.edu/) provides definitions of these terms and explanations of the university policy on the subject. The UO Library also provides a guide to avoiding plagiarism (http://libweb.uoregon.edu/guides/plagiarism/students/). You are responsible for understanding these regulations and abiding by them. Students should be particularly careful to avoid plagiarism in out-of-class assignments, as well as projects and exams. Academic dishonesty will be dealt with severely, as it is disrespectful to your fellow students and your instructor, as well as being against both university regulations and state laws. |
| **STUDENTS WITH DISABILITIES** | If there are aspects of the instruction or course design that result in barriers to your inclusion, please notify Prof. Parthasarathy as soon as possible. You are also welcome to contact Disability Services in 164 Oregon Hall, 346-1155. |
| **POLICY ON MISSED DEADLINES, SIGNIFICANT ABSENCES & INCOMPLETES** | Only the following unforeseen and uncontrollable emergency situations are acceptable excuses for missed deadlines:<br>• Documented serious illness/injury;<br>• Documented death in the *immediate* family.<br>All of the following are **unacceptable** – note that they include "personal" as well as "technological" excuses:<br>• Special occasions (e.g. weddings, birthdays, anniversaries etc.) |

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| | • Work and school conflicts: "I had to work extra hours," "I have a huge midterm tomorrow in another class…"<br>• Couldn't get to campus (alarm didn't ring; missed the bus; etc.)<br>• Being generally "busy" or having "a lot going on right now…"<br>• Forgot or "mixed up" the assignment or due date<br>• No access to computer or printer; assignment completed on computer is "missing," was accidentally erased, or is inaccessible |
| **SUCCEEDING IN THIS COURSE** | **Plan ahead and start early!** The reading assignments are a vital part of this course, and it is important to start reading them early not only to understand the subject matter but also to be able to articulate what you *don't* understand – in class lectures and discussions will build on your reading experiences. Note that the reading assignments must be done **before** the days at which their topics are discussed in lecture. In general, it will be crucial to keep up with the course and not fall behind; later topics will build on earlier ones.<br><br>**Make use of resources.** If you have questions about lectures, assignments, readings, or other matters, come to Prof. Parthasarathy's or the GTFs' office hours with questions! Also, we encourage communication by phone or email, though we may often reply that it's more effective to chat in person, at office hours.<br><br>The University's Teaching and Learning Center (TLC) provides a variety of workshops, individual consultations, writing assistance labs, and more to assist UO students. For more information, see http://tlc.uoregon.edu/ .<br><br>*Another suggestion:* ***Sleep!*** *Numerous studies show that sleeping helps both memory and understanding.* |