

THE PHYSICS OF LIFE (PHYSICS 171) CRN: 35298 SPRING 2012	PROFESSOR RAGHUVeer PARTHASARATHY (Par-tha-sa-ra-thē) Office: 174 Willamette Hall EMAIL: raghu@uoregon.edu
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SYLLABUS – MODIFIED APR. 4, 2012

This is a rather long syllabus – it has a lot of detail on many aspects of the course, some familiar and some unusual, that are constructed to help you learn things, and to make the term run smoothly and enjoyably. Don’t memorize it, but do read it and be aware of how it’s organized – RP.

CLASS TIME	MWF 11:00-11:50am, Willamette 110 <i>Attendance is not required, but is strongly recommended. Note that there is a “clicker-based” participation grade as well as in-class quizzes – see the Grading and Quizzes sections, below</i>
INSTRUCTOR	Professor Raghuvēer Parthasarathy (Par-tha-sa-ra-thē) Office: 174 Willamette Hall (NOTE: This will change during the quarter.) Email: raghu@uoregon.edu
ASSISTANTS	This course has several people assisting it – make use of them! <u>Kendra Nyberg</u> – undergraduate “peer learning assistant.” Kendra worked with this course last year. nyberg@uoregon.edu <u>Ryan Baker</u> – graduate student. rbaker.rpb@gmail.com <u>Matt Jemielita</u> – graduate student*. matthewjemielita@gmail.com <u>Tristan Hormel</u> – graduate student*. hormel@uoregon.edu * Matt and Tristan are half-assistants who will alternate between topics.
EMAIL	Email: You can certainly ask questions of me and 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	Drop-in / office hours are posted as an “announcement” on the Blackboard site. (They may change during the term, and so I’m not writing them here.) <i>There are lots of office and drop-in hours – about 7 per week! You’re strongly encouraged to come to these, mine as well as the course assistants’, either with specific course-related questions, or just to chat about physics, science, and other general topics.</i> Note that there is no discussion section for the course.
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. This course will explore topics in biophysics and biomaterials. We will use readings, discussions, and hands-on exercises to study the physical properties of biological materials, as well as the constraints these properties place on living organisms. We'll also explore the behavior of "complex" soft materials – for example gels and foams – and their connections to biological materials. There are no scientific prerequisites, and mathematics in the course will be at the level of basic algebra. Beyond exploring exciting areas of contemporary science, our goals will be to improve critical reasoning abilities, especially with respect to quantitative data. We will also develop the "scientific literacy" necessary to understand biophysical topics of importance to contemporary society.
TOPICS	Introduction, Motivation, and Illustrations Scale and Powers of 10 – <i>In which we get a sense of the size of things</i> Surfaces and surface tension – <i>In which we explore the consequences of surface tension on the functioning of your lungs and ask: why can't you walk on water</i> On size and shape– <i>In which we ponder how size and shape of can affect an organism's properties</i> Randomness and diffusion – <i>In which we explore the perpetual motion of small things, both its unavoidable causes and its far-reaching consequences</i> Rubber bands and DNA – <i>In which we examine similarities between the two</i> Soap films, cell membranes – <i>In which we examine similarities between the two, and also look more generally at materials that assemble themselves.</i> Squishy materials – <i>In which we ask: Why are you soft? We'll examine structural similarities between biomolecules and the components of other "soft" materials</i> Life at Low Reynolds Number – <i>In which we ask: Why don't bacteria swim like whales?</i> Frontiers of Microscopy – <i>A look at how we know what we know, focusing on recent optical tools</i> "Common" Biomaterials – <i>In which we examine ways to characterize solids, and the properties of wood, bone, spider silk, and other biological materials</i>
MATERIALS	• We'll use "clickers," 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 clicker of someone <i>not</i> enrolled in this course and using it for this class <i>will</i> work fine. • Some assignments will involve working with data. You should be reasonably adept at navigating the internet and making simple graphs (e.g. with Excel). • You may find it useful to have a ruler and pencils.
READINGS	There is no textbook for the course. However there is a course reader available at the bookstore that has copies of a few book chapters we'll make use of. Articles and other documents will be distributed via Blackboard

	(https://blackboard.uoregon.edu/). Readings will largely be at the “Scientific American” level – i.e. having minimal mathematics. Readings from more technical sources will be accompanied by explanatory commentaries.
READING QUIZZES	Reading assignments will precede most classes and will have required “reading quizzes” associated with them. These will be answered in-class, via clickers. GROUP-BASED READING QUIZZES. You can have your reading quiz grades assigned individually, or as part of a group. • <i>Individual:</i> You’ll take the reading quiz and get a score, as usual. • <i>Group:</i> Group members can chat with each other about the readings for a few minutes before the quiz, and then each person will take the quiz individually. Each member will receive the average of the scores from his/her group. Groups of 4-5 people will be assigned randomly. You can decide whether you want the “individual” or “group” option at the end of Week 1. As an added bonus to those in groups: if at the end of the term the group’s score is greater than the average score of those who chose not to be in groups, I will add an extra 20% to the group’s reading quiz grade (even if this is over 100%).
POST-CLASS NOTES	Even briefly reviewing what one learned from a class session helps cement one’s understanding. Seeing what people think they learned or didn’t learn is also useful for the person teaching the class. Therefore: within 24 hours of the end of each class, submit a short (less than 150 word) summary of what the key points of that day’s class were. You can also state things that were unclear or need further explanation. This will be simply graded on clarity – it’s not an assessment of how well you understood things, but just on your reflection on what there was to understand. You can write your summary together with 1-2 other people, and all submit the same text. You’ll use homework.uoregon.edu to submit this – be sure to indicate each person’s name.
ARTICLE COMMENTARIES	Throughout the term, I’ll assign various “popular” science articles and ask you to analyze and comment on them. This can (and should) be done in small groups. These assignments will be described further as the term progresses.
HOMEWORK	Homework assignments will cover topics discussed in class, and will typically be submitted on-line, via Blackboard. (As noted, post-class notes will be submitted using a different system.) You are encouraged to discuss homework assignments and readings with others, though your “final answers” should be your own. Office hours are an excellent place to discuss homework!
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
GRADING	The various grade components and their weight toward the final grade are: • <i>Reading questions: 10%</i> • <i>Post-class notes: 4%</i> • <i>Clicker questions: 6%</i> • <i>Homework Assignments: 15%</i> • <i>Article commentaries: 10%</i> • <i>Midterm Exam: 25% (Monday May 7, unless otherwise noted)</i> • <i>Final Exam: 30%</i>

		<u>Alternate weight:</u> In general, vibrant class participation enhances all students' learning experiences – one of the motivations for “clicker” usage. Similar motivations are present for the other course components, like the reading quizzes. However, if you consider it overly paternalistic to require attendance, I can grade you using an alternate weighting: Homework 15%, Article Commentaries 10%, Midterm 35%, Final Exam 45%. You must meet with me to request this grading option. Based on past experience, I strongly advise <i>against</i> using it.
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 (via Blackboard) on basic mathematics. Re-taking the quiz is allowed – you are encouraged to learn from your mistakes, and to see the TAs and me for help. Scoring 75% or higher 75% by the Wednesday of Week 2 is required for continuing in the course. (A score of <75% will automatically result in a failing grade for the course.)
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		<u>The use of laptop computers in class is not allowed.</u> 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. <i>In addition</i>, however, studies have shown that non-class-related laptop use distracts and impacts the learning of <i>other students nearby</i>. (E.g. Fried, C. B. <i>Computers & Education</i> 50, 906-914 (2008).) Plus, <i>students</i> have complained to me about the environment created by their classmates laptop use. Taking notes by hand, by the way, is more effective in cementing concepts in your mind. 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: • Documented serious illness/injury; • Documented death in the <i>immediate</i> family. All of the following are unacceptable – note that they include “personal” as well as “technological” excuses: • Special occasions (e.g. weddings, birthdays, anniversaries etc.) • Work and school conflicts: “I had to work extra hours,” “I have a huge midterm tomorrow in another class...” • Couldn’t get to campus (alarm didn’t ring; missed the bus; etc.) • Being generally “busy” or having “a lot going on right now...” • Forgot or “mixed up” the assignment or due date • 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 to be able to articulate what you <i>don’t</i> 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. Make use of resources. If you have questions about lectures, assignments, readings, or other matters, please visit Prof. Parthasarathy during office hours, or communicate by phone or email. Individual appointments can certainly be arranged to accommodate schedule conflicts with the regular office hours. The University’s Academic Learning Services (ALS) center provides a variety of workshops, individual consultations, writing assistance labs, and more to assist UO students. For more information see als.uoregon.edu, or call (541) 346 3226. The University’s Teaching and Learning Center also provides workshops and courses – see http://tlc.uoregon.edu/index.html and http://tlc.uoregon.edu/learningservices/workshops.html .