Welcome to “The Physics of Life”! This is a rather long syllabus – it has a lot of detail on many components of the course that are constructed to help you learn and to make the term run smoothly and enjoyably. Don’t memorize it, but do read it and be aware of how it is organized.

**Instructors and Logistical Information**

| Class Time          | Tu 11:00 – 11:50 am, Willamette 110  
|                    | Th 10:00 – 11:50 am, Willamette 110  |
| Instructor         | Professor Tristan Ursell  
|                    | Office: 375 Willamette Hall  
|                    | Email: tsu@uoregon.edu  |
| Assistants         | This course has graduate student teaching fellows (GTFs)!  
|                    | • Julian Smith jhs@uoregon.edu  
|                    | • Savannah Logan slogan@uoregon.edu  
|                    | Julian is supported by UO’s Science Literacy Program (scilit.uoregon.edu), which aims to develop new & better general-education science courses.  
| Email              | We will try to respond to emails in a timely manner. Emails written in a disrespectful tone (e.g. starting with “Yo Prof Ursell”), with slang (e.g. “ur” instead of “your” or “you're”), or without full sentences will receive no response.  
| Office Hours       | Prof. Ursell: Weds. 11 – 11:50 am, Willamette 375  
|                    | Julian Smith: Weds. 12 – 12:50 pm, Willamette 73A  
|                    | Savannah Logan: Mon. 10 – 10:50 am, Willamette 354C  
|                    | 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.  
|                    | **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**

**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. 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:
- Understand how physical principles guide and constrain life.
- Understand how the molecules of the cell help give it Life.
- Assess and interpret graphs and quantitative data.
- Understand the process by which science generates knowledge.

**TOPICS**

<table>
<thead>
<tr>
<th>Introduction, Motivation, and Illustrations</th>
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<td>Scale and Powers of 10 – <em>In which we get a sense of the size and time scales of things.</em></td>
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**Molecular Narrative** – *In which we dissect how information is stored and read at the molecular scale, how that information builds the micromachines of the cell, and what is special about those micromachines.*

**Transport** – *In which we discuss how molecules in a cell get where they need to be when to be there.*

**Randomness and diffusion** – *In which we explore the perpetual motion of small things, both its unavoidable causes and its far-reaching consequences*

**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*

**On size and shape** – *In which we ponder how size and shape of can affect an organism's properties*

**DNA mechanics** – *In which we examine the physical properties of life's most important molecule, and why they matter*

**Soap films, cell membranes** – *In which we examine similarities between the two, and also look more generally at materials that assemble themselves.*
Evolution – *In which we explore Evolution as an algorithm that solves problems and explore the power of this algorithm through simulation.*

Life at Low Reynolds Number – *In which we ask: Why don’t bacteria swim like whales?*

Astrobiology – *In which we examine the physical aspects that make Earth a suitable habitat for life, and how that may relate to hospitable planets elsewhere.*

**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.
- Some assignments will involve working with data. You should be able to navigate the internet and make simple graphs (e.g. with Excel).
- You may find it useful to have a ruler and pencils.
- In general, lectures will not be posted online, you will need to attend class to take notes.

**Readings**
There is no textbook for the course. Articles and other documents will be distributed online, via the course website: http://physicalbiology.tumblr.com/phys171. Readings will largely be at the “Scientific American” level – i.e. having minimal mathematics. We’ll accompany readings from more technical sources with explanatory comments.

### Assignments and Assessments

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<th>Assignment Type</th>
<th>Description</th>
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<tr>
<td><strong>Reading Quizzes</strong></td>
<td>Reading assignments will <strong>precede</strong> most classes and will often be accompanied by in-class ‘reading quizzes’ administered via ‘clickers’.</td>
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<tr>
<td><strong>Article Commentaries</strong></td>
<td>Throughout the term, I will 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.</td>
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<tr>
<td><strong>Homework</strong></td>
<td>Homework assignments will cover topics discussed in class, and are intended to guide you in thinking further about the concepts we’re exploring. Your responses will typically be submitted via email to <a href="mailto:ursell.ou.courses@gmail.com">ursell.ou.courses@gmail.com</a> using your @uoregon.edu email address. You are encouraged to discuss homework assignments and readings with others, though your “final answers” should be your own – direct copying is not allowed, and evidence of such will result in a 0% score on the offending homework. Office hours are an excellent place to discuss homework!</td>
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<tr>
<td><strong>Clicker Q’s</strong></td>
<td>There will be in-class “clicker” questions related to the present topic, scored by participation only, not the accuracy of the response.</td>
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<tr>
<td><strong>Exams</strong></td>
<td>There will be one midterm exam, tentatively scheduled for Feb. 5th. We’ll discuss the format later in the term; in brief, it will have a combination of multiple-choice and short-answer questions. There will not be a final exam.</td>
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| **WRITING PROJECT** | During the first half of the course, we will read a number of high quality popular science articles (e.g. from Scientific American and Ars Technica). You and a partner of your choosing will write a 3 page popular science article. Your article can be on any topic in the biosciences realm, from molecular biology to ecology to human disease to astrobiology.

The goal of this project is three-fold: i) to get you thinking about how to digest and compose information into a coherent logical flow that can be understood by others, ii) to hone the skills of finding and vetting reliable sources of information in a digital age awash in questionable information, iii) to practice writing a clear and concise narrative that can be read and understood by others.

I will consider video projects, podcasts, or info-graphics with the same theme. If this interests you, please contact me privately.

The final draft will be due the Monday of Finals Week. |
| **MATH DIAGNOSTIC** | The mathematics in this course will be elementary, but it is important to be comfortable with basic numerical skills. Therefore there will be a diagnostic quiz to be taken on-line on basic mathematics (link on the class website). 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 weight toward the final grade are:

- **Clicker questions**: 5%
- **Homework assignments and article commentaries (~8)**: 55% (in total)
- **Midterm Exam**: 15%
- **Writing Project**: 25%

Prof. Ursell reserves the right to modify this grading scheme as necessary. |
| **SCALE** | The course grading scale: A=90-100%; B=80-89.9%; C=70-79.9%; D=60-69.9%; F<60%. |

**O T H E R  I N F O R M A T I O N**

| **ABSENCES** | I realize that students will 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%). Makeup post-class notes and iclicker questions will not be allowed – the point of this policy is to avoid the messes created by these sorts of ad-hoc arrangements. |
**Laptop and Cellphone Policy**

At no point are cell phones to be used in class, **put them on airplane mode before coming into class**. Students found using cell phones on exam days will receive an automatic 0% on the exam, no questions asked, and no exceptions.

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, Facebook, etc) 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. see Fried, C. B. *Computers & Education* 50, 906-914 (2008).) Plus, students in this class have complained about the environment created by their classmates’ laptop usage.

Incidentally, taking notes by hand is more effective at cementing concepts in your mind, than blithely following along on a screen.

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/](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/](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. If you are questioning the integrity of what you’re doing, it probably falls under the umbrella of academic dishonesty. If you have questions or concerns, come see me.

**Students with Disabilities**

If there are aspects of the instruction or course design that result in barriers to your inclusion, please notify Prof. Ursell as soon as possible. You are also welcome to contact Disability Services in 164 Oregon Hall, 541-346-1155.

**Policy on Missed Deadlines, Significant Absences, Incompletes, and Snow Days**

Only the following unforeseen and uncontrollable emergency situations are acceptable excuses for missed deadlines:

- Documented serious illness/injury;
- Documented death in the immediate 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

If a class is canceled due to external factors (e.g. inclement weather), we will have a makeup class at a suitable date and time.

| **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.

**Make use of resources.** If you have questions about lectures, assignments, readings, or other matters, please visit Prof. Ursell during office hours, or communicate by phone or email. Individual appointments can be arranged to accommodate schedule conflicts with the regular office hours.

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/](http://tlc.uoregon.edu/). |