LB 273, Fall 2015: Physics of the Life Sciences, I
Course Syllabus

Course Description

LB 273 is the first semester of the Lyman Briggs College calculus-based introductory physics sequence, and will be taught by Vashti Sawtelle, Leanne Doughty, Walt Benenson, and Alanna Pawlak. This course will focus on Newton's classical mechanics for the most part, and later on thermodynamics and statistical mechanics. All of these topics will be made relevant by using examples that show how the form and behavior of biological systems are constrained by the laws of physics.

The primary learning goals of this course are:

1. To develop a conceptual understanding of physics and the interconnectedness of physical phenomena, and how the laws of physics affect living organisms. For example, we will explore why bugs don't need lungs, but humans do and how Newton's Laws apply even at the cellular level.

2. To develop autonomous learning skills, particularly in relation to create a toolkit of representations for expressing and manipulating the laws of physics, which will help you to make quantitative predictions about the motion of falling objects, the behavior of cells, and the flow of blood through your arteries.

3. To learn to think clearly and simply about the physical world. We will work on increasing problem-solving and modeling skills. Specifically, we will focus identifying the important elements of a problem (in a physics context or otherwise), making appropriate simplifications, constructing a solution, and identifying the limitations of the solution. A few years after this course is over, it is likely that you will have forgotten the formula for the kinetic energy of an object that rolls without slipping - but you hopefully will have retained these modeling skills.

We will work toward the goals expressed above throughout the course, using research-tested active learning techniques such as think-pair-share and small-group problem solving. In lecture, we will use these methods, have discussions, and use physics demonstrations – **very little time will be used for lecturing!**

Readings and required course materials

Course reading materials are available in the required course pack, and are an essential part of learning the material covered in this course. A paper version of the course pack is available **ONLY** at the MSU bookstore, though we will also have PDF versions available online at http://msu.lon-capa.org if you don't want to purchase a paper copy. The material is organized by topics over the course of the semester. For each topic, there are three stages:

1) Read the material before the first day that it will be discussed in class and respond to a few free-response and quantitative questions online, prior to the first lecture where that chapter will be discussed.
2) Material will be worked on in lectures and hands-on sessions
3) Homework is due after the material has been discussed in class

The written course material establishes the expected learning outcomes for this course, and students are expected to read ALL of the material on a given subject before coming to class.

In addition to the course pack, you are **required** to purchase an iClicker 2. The course pack can only be found at the MSU bookstore at the International Center. The iClickers are available at the campus bookstore, among other places.

Course activities

In-lecture activities: The lecture component of this course will be used to clarify and elaborate upon the reading materials, rather than comprehensively cover all of the subjects discussed in the reading. To this end, we will engage in a range of activities, including think-pair-share (also known as "clicker questions"), lecture demonstrations, small group and individual problem solving, and conceptual tutorials.

Hands-on learning sessions: The hands-on component of this course will be used to enhance your conceptual understanding of the material and your problem-solving skills. To further these goals, you will participate in a variety of activities: physics tutorials, in-class guided problem solving, laboratory exercises, and occasionally some other activity that has intellectual utility for the course. These assignments will generally be worked on in groups of 2-4.

Homework: One of the most important things that you can do to train your brain to simplify the physical world is *to think through physics problems.* We will assign homework in two forms: the LON-CAPA online homework system, and occasional paper-based hand-in assignments.

LON-CAPA: We will regularly use the course's LON-CAPA website (at http://msu.lon-capa.org). The homework here will generally focus on one or two specific topics. The homework questions will consist of multiple-choice, essay, numerical response, and graph-oriented questions. LON-CAPA will also be used for the pre-class reading questions, which will be assigned separately.

Paper: Paper based homework questions can be found on the course website, and will be focused on a single topic. These assignments will usually be more involved problems, requiring the drawing of diagrams, writing of explanations, and complex computations. This paper-based homework will not be assigned every week, so students will need to pay attention to the course calendar. Students have the option to complete this homework in pairs and to turn in one copy of the assignment. We encourage students to use this option but submitting individual assignments is allowed.

Exams: One of the ways that we assess your learning will be by three midterm exams and a cumulative final examination. These will be composed primarily of free response questions. Exam questions will be taken from the reading materials, topics discussed during the lectures, the LON-CAPA homework, and from the work that you do during your hands-on sessions. The final exam will be held on two days in the week starting December 14th. One will be Friday December 18th and the alternative day will be decided later in the semester.

Grading Information

The course grade is determined by contributions from several sources: LON-CAPA reading questions, homework, assignments in the hands-on sessions, in-lecture "clicker questions," and exams. Each of these contributes to the final grade in the following percentages:

30% Midterm exams (3 exams, 10% each)
15% Final exam
10% Clicker questions
20% Homework (LON-CAPA and occasional paper-based)
5% LON-CAPA reading questions
20% Hands-on learning sessions

The course grading scale is as follows:

4.0 $\geq 92\%$
3.5 $\geq 84\%$
3.0 $\geq 76\%$
2.5 $\geq 68\%$
2.0 $\geq 60\%$
1.5 $\geq 52\%$
1.0 $\geq 44\%$
0.0 $< 44\%$

Please consult the LB 273 Grading Policies document (available on the course LON-CAPA page, at http://msu.lon-capa.org) for more detailed information about grading.

Other important information

Class Hours: The classroom component of this course meets three times a week, on Monday, Wednesday, and Friday in C-106 Holmes Hall. There is one lecture section, which is from 11:30 a.m. to 12:20 p.m. Please bring paper, pencil, a calculator, and your iClicker to class every day.

The hands-on sessions meet Monday through Thursday in the Lyman Briggs Physics Lab, which is E-26 Holmes Hall (in the basement of the East wing). You are expected to attend the section that you are enrolled in. If you need to change sections for a week you must contact Prof. Doughty in advance, and she will work with you to find a hands-on session that fits into your schedule. Please make sure to let the LA(s) running the session know that you are there temporarily!

Office hours: Office hours for Fall 2015 will be Wednesday mornings from 9-11 a.m. in Professor Sawtelle's Holmes Hall office (193-B East Holmes) and Professor Doughty's Holmes Hall office (C-1), and by appointment. You are also welcome to stop by their Holmes Hall office whenever the door is open (they are usually around Holmes Wednesday and Friday mornings). Note that there will be no office hours during the first partial week of class or the weeks of Thanksgiving and of final exams.

Help room: The help room is a place to get assistance with homework problems and exam preparation. It is located on the 5th floor of East Holmes Hall and is staffed by the course's undergraduate learning assistants. Help room hours will be announced during the first week of class in lecture and via email. **Help room hours start the week of September 15th**. The help room hours may change, depending on attendance patterns and TA/LA availability. These changes will be announced in lecture and via email.

LON-CAPA discussion boards: Each homework problem in LON-CAPA provides an attached discussion board. We encourage you to make extensive use of this resource. We request, however, that students do not simply post the answers to specific homework questions – while it is helpful in the short term, it is detrimental to overall learning.

What to do if you are having difficulty in this class: Physics can be a challenging subject to learn, and lots of people struggle to figure out how best to study. The primary reason for this is that, in physics, we take a small number of concepts and learn to apply them in a variety of ways - so, instead of having a great deal of information to retain, you must instead deeply understand a small amount of information. If you are having difficulties in this class, we have several suggestions:

- Work in a group with at least one other person, and make sure to explain the solutions to problems to each other - explaining the material helps to solidify it in your mind!
- Consult the "How to study physics" links located in the Supplementary Materials folder on our LON-CAPA page. There are lots of useful ideas in there.

- Purchase a copy of Schaum's 3000 Solved Problems in Physics, and judiciously choose practice problems from within this book. It's often very useful to look at a problem, attempt to solve it, and then look at the provided solution afterward - solving many problems helps you to see common methods of solution, and to solidify concepts!
- Consider using an alternate resource to the LB 273 textbook, such as the Khan Academy lectures on physics (http://www.khanacademy.org/), the Light and Matter textbook (http://www.lightandmatter.com/lm/), or one of the standard calculus-based physics texts. Many older editions of the latter are available used on Amazon.com for around $10!
- Hire a tutor. Many physics graduate students are interested in tutoring, and are willing to work either on a regular basis (e.g., weekly) or for an hour or two right before exams. Tutors typically cost around $15/hour for one person, with possible discounts for more than one person. It's particularly effective to email your tutor ahead of time with specific questions, etc. so they can be prepared.
- **Above all, if you feel like you're falling behind, please talk to Professor Sawtelle, Professor Doughty, or Alanna immediately!** They will be able to help you find resources, talk about your study habits, and generally offer moral support.

Honors Project Information: If you are interested in doing an Honors project, please contact Professor Sawtelle and Professor Doughty some time within the first two weeks of class. We have a wide range of equipment available for an honors project, including normal and high-speed video cameras, an infrared camera, and various Pasco sensors that are identical to the ones used in lab, but which plug into iPads and portable PASCO sensor platforms. We encourage people to do interesting projects, particularly in groups, and in collaboration with the graduate teaching assistant – see http://www.pa.msu.edu/~osheabr/honors_options.html for some ideas, and for a list of honors options done in previous semesters. Please email us if you have any questions!

Instructor Information

Professor Sawtelle and Professor Doughty are in charge of all aspects of the lecture of the course, including exams and the LON-CAPA site (at http://msu.lon-capa.org). They are also responsible for the help room. Professor Benenson is in charge of the hands-on components. Alanna Pawlak is responsible for many of the logistical aspects of the course, including the grading of hands-on session material and exams. Our contact information is:

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Contacting course staff: We can be reached at the e-mail addresses found above. **Please be sure to put "LB 273" and the nature of your query in the subject heading of the email** (for example: "LB 273: missed exam due to alien abduction, need to schedule retake"). We will respond within 48 hours. **The course staff does not ever check their LON-CAPA email.**