Course Description

PHYS 114: General Physics I for Students of the Life Sciences

Summer Session II, 2018

Instructor: Ben Levy

This course investigates the basic principles of physics including forces, energy, oscillations, diffusion, heat transfer and random processes, and focuses on how to apply these concepts to understand biological systems and processes. This course is intended to meet the needs of, but is not restricted to, students majoring in the life sciences. Students who have taken PHYS 104, PHYS 116 or PHYS 118 may not receive credit for PHYS 114.

Course prerequisite: None

Recommended Preparation (but not required): Math 231 or equivalent (Calculus of Functions of One Variable)

Syllabus changes: The instructor reserves the right to make changes to the syllabus, including due dates and test dates. These changes will be announced as early as possible.

Instructor Contact Information

Lecture/Studio Instructor: Ben Levy
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Office: 110 Phillips Hall
Office Hours: End of Studio – 12:30pm Weekdays, or by email-scheduled appointment

Studio TA: Britta Gorman
Email: brittabr@live.unc.edu
Office: 237 Phillips Hall (Physics Tutorial Center) h
Office Hours: 1:00pm – 3:00pm Wednesday, or by email-scheduled appointment

Course Meetings

Lecture: 9:00am - 9:50am Weekdays in 247 Phillips Hall
Studio: 10:00am - 11:50am Weekdays in 335 Phillips Hall
Exams: 8:00am - 8:50am Most Tuesdays in 247 Phillips Hall
Final Exam: 9:00am - 12:00pm, Tuesday 7/31, 247 Phillips Hall

A complete daily course schedule may be found here, or in the sidebar of the Sakai site.

Course Goals

1. To gain a fundamental understanding of matter and its interactions.
2. To be able to apply that fundamental understanding to analyze biological systems and processes.
3. To enhance skills in quantitative analysis of physical systems and phenomena.

Through this course you will have the opportunity to analyze the physical world around you and improve your critical thinking skills. The instruction for this course places significant emphasis on qualitative physical reasoning as an important foundation to quantitative problem solving.

Course Philosophy and Format

Philosophy

The instruction in this course focuses on student-centered learning and involves active participation from the students. The instructor will act more as a "coach" who facilitates student learning, as opposed to a pure "lecturer" who transmits knowledge without necessarily requiring thought or action on the part of the student. Since the instructional focus is on learning rather than teaching, students are expected to take more responsibility for their own learning than might be required in a more traditional lecture-only format. At the same time, frequent course assignments are designed to keep students "on track" through the learning process. To the extent possible, the instruction is aimed to meet a variety of learning styles. You are encouraged to spend a few minutes examining your own learning style using the on-line Index of Learning Styles survey. (It's fun! If you take the survey, here is an explanation of the results)

You will not be required to memorize lots of physics equations, but you will be required to comprehend and apply physics concepts to a variety of situations, especially (though not exclusively) those that arise in living systems. The reason that many students find physics difficult is that it goes beyond memorization by requiring higher-level thinking skills (levels 4 through 6 below). Learning physics is also like learning a foreign language since new words and symbols must be understood and applied correctly within the context of various physical situations.

Bloom's Taxonomy of the Cognitive Domain:

1. **Knowledge** - memorization of facts, words, and symbols
2. **Comprehension** - understanding the meaning of knowledge
3. **Application** - applying concepts to various situations
4. **Analysis** - breaking apart complex ideas
5. **Synthesis** - putting individual ideas together to form a complete explanation
6. **Evaluation** - judging the merits of individual ideas and making decisions

Physics Education Research has shown that students actively involved in their learning of the subject will gain a greater understanding of physics than those students who are passive. In this course you will engage in active learning with other students in small groups. Science is a group activity, carried out in collaboration in research groups. Working in groups will help you develop skills that will benefit you throughout life. In addition, group work will help you learn physics. By discussing the concepts and problems with others you will discover alternative ideas and solutions. You will also have the opportunity to teach others what you have learned (i.e. peer instruction). Nothing tests your understanding of an idea better than trying to explain it clearly to someone else. This also gives you practice using the language of the discipline (physics in this case).

Active learning is a general term which refers to the active involvement of students in the classroom rather than passive involvement. As mentioned above, instead of only listening to lectures and watching demonstrations, on any given day students might be answering questions, working in groups, performing activities, and/or discussing concepts. To this end, a variety of teaching techniques will be used throughout the semester. These may include (but are not limited to) the following.

- **Pseudo-Socratic dialog**: Student questions are not answered directly. Instead, the instructor asks students leading questions to assist them in answering the questions themselves.
- **Peer Instruction:** Lectures consist of short presentations on key points. Students are then asked a conceptual question related to the topic at hand. They are given time to think about it and then to discuss it with their neighbors. Answers are then given and discussed as a class.
- **Cooperative Group Problem Solving:** A supportive environment is fostered in which students can practice using problem-solving strategies in groups within the classroom setting.

Format

In line with the above findings, the course will be conducted in a "Lecture/Studio" format. The class meetings are grouped in ***modules***, each consisting of a 50-minute lecture and a 110-min. studio session on the same topic. The course material is divided into eight ***units*** (see the unit list at the end of this syllabus), each of which includes several ***topics*** (see bullet points within each unit in the unit list). A unit will typically span more than one module, and sometimes more than two modules. Many units will begin with a lecture introducing a biological "driving question" and the physics concepts relevant to the question. During class (both the lecture and the studio parts of each module) you will spend most of your time performing hands-on, minds-on activities including responding to conceptual questions, discussing ideas with your classmates, performing experiments, and working with computers and computer simulations. The basic aim of this format is to allow you to take charge of your own learning, with the curriculum materials and your instructor as guides.

All students are expected to engage in learning activities in all class meetings. In lectures students will respond to questions asked by the instructor, using an electronic personal response system; these responses may be followed by discussions with other students (peer instruction). In studio meetings activities will include laboratory exercises, simulation exercises, and cooperative problem-solving, all carried out in small groups. All activities will be aimed at enhancing your grasp of the physics concepts and how they can be applied to understand biological systems. Graded work

associated with the activities will include (but is not limited to) group worksheets, problem solutions and calculations, and individual or group mini-reports summarizing the findings of a laboratory or simulation exercise.

Required Course Materials

Textbook: *College Physics: A Strategic Approach, 3E*, Knight, Jones & Field

Online Homework System*: MasteringPhysics.* Homework and Warm-up assignments will be assigned in MasteringPhysics. Additional practice problems will also be available. The course access code is: **PHYS114S218**. Instructions on purchasing access to *MasteringPhysics,* and instructions on joining our course on the platform are available in the Resources section of Sakai, under "General Course Resources" folder. (MasteringPhysics_Information.pdf)

Classroom Response System (clickers): *iClicker.* If you already have an iClicker remote from another course, it should be compatible in this course. You can register a new or used clicker using the i>clicker tab on the left sidebar of the course Sakai site. Note iClicker+ and iClicker 2 are both compatible.

Approximate Prices for Required Materials:
Hardback copy of textbook and *MasteringPhysics*: ~$275
Access to *MasteringPhysics* only: ~$75
Access to *MasteringPhysics* with e-text: ~$130
iClicker+/iClicker 2: ~$45

Assignments

Warm-ups
Before the beginning of each module, students must complete a Warm-up assignment. These Warm-ups are typically due by midnight before the corresponding lecture. The assignment may include reading from the textbook, a video to view, or other preparation for the upcoming activities. Several related questions to test your understanding are posed. For quantitative questions, you will be given five attempts without penalty. For multiple-choice questions, you will be given five attempts, with a deduction of 15% for each incorrect attempt.
Typical Warm-up Schedule:
Release: Warm-ups will be made available on *MasteringPhysics* at 5am, two days before the corresponding module (not including Saturdays).
Due: Warm-ups will be due on *MasteringPhysics* at 8pm, on the day before the corresponding module.

Clicker Questions
We will use the iClcker response system in lectures. For more details on setting up your iClicker and compatibility, see *required course materials* (above). Clicker responses in class account for 5% of your overall grade. The number of clicker questions varies between classes, but is typically about 5-7 questions, and 1 point is assigned for each question. Note that points are only assigned for participation and not correctness. If your iClicker score at the end of the course is at least 90%, your score will be rounded to 100%. This allows for two class days to be missed without penalty (in case your clicker is not working or you missed the lecture). If your score is below 90%, it remains at that value and does not get scaled. Each student is entirely responsible for bringing their clicker to class and for the function of their clicker (we recommend bringing extra batteries to class).

Studio Assignments
Students will work in groups of 3 or 4 in studio to complete worksheets. Students will be graded as a group, and scores will account for 25% of your overall grade. These worksheets may involve laboratory exercises, simulation exercises, and cooperative problem-solving. Some studio activities may require the submission of excel spreadsheets, or other materials via Sakai. All group-members must participate fully in the completion of studio activities. Insufficient participation may result in loss of studio points at the instructor's discretion. Note that students are expected to complete all studio assignments within studio (unfinished worksheets may not be completed outside of class for credit).

Homework
Each module will have an associated set of exercises to be completed individually outside of class. We will use the *MasteringPhysics* online homework system for this purpose. You are encouraged to discuss the exercises with other students, but you must submit your own responses to the questions. For quantitative questions, you will be given five attempts without penalty. For multiple-choice questions, you will be given five attempts, with a deduction of 15% for each incorrect attempt. No points will be deducted for using the hints, but students who do not use the hints will receive bonus points (2%).
Typical Homework Schedule:

Release: Homework will be made available on *MasteringPhysics* at 12pm, on the day of the corresponding module.
Due: Homework will be due on *MasteringPhysics* at 11:59pm, two days after the corresponding module (not including Saturdays).

Examinations

There will be three exams during the course and a comprehensive final exam, all closed-book. The dates for the exams are posted below and on the schedule found in the General Course Information section under Resources. Exams will occur in the lecture room. The final exam will be *comprehensive* (with an emphasis on later modules), and will be administered in compliance with UNC final exam regulations.

Exam 1: Tuesday, 7/3/18, 8:00 am - 8:50am
Exam 2: Tuesday, 7/10/18, 8:00 am - 8:50am
Exam 3: Tuesday, 7/24/18, 8:00 am - 8:50am
Final Exam: Tuesday, 7/31/18, 9:00 am - 12:00pm

Missed Exam Policy
Please try to avoid missing exams if possible. If you do miss an exam, it will fall into one of the following categories:
***Excused* - If you miss an exam due to illness, UNC sanctioned events, or an emergency, please fill out an excused absence request form. If your request is approved, you will be given the option either to make up the missed exam later on the day of the exam at no penalty (be proactive in scheduling this with me), or to replace that exam's grade with your final exam grade at no penalty.**
***Unexcused* - If you miss an exam, and your absence is not excused you will be given the option either to make up the missed exam later on the day of the exam with a 20% point deduction (be proactive in scheduling this with me), or to replace that exam's grade with your final exam grade with a 20% point deduction.**
***Somewhat Excused* - If you miss an exam, and your absence is not excused, but you have been proactive in notifying me of the absence several days prior to the day of the exam, I *may* allow you to make up the exam at no penalty *if you can do so later on the day of the exam*. Otherwise, please see the "unexcused" category.**

Grading Policy

Warm-up assignments: 5%
iClicker responses in lecture: 5%
Homework exercises: 10%
Studio assignments: 25%
Midterm Exams (3): 10% each (30% total)
Final Exam: 25%

A: 93-100
A-: 90-92
B+: 87-89
B: 83-86
B-: 80-82
C+: 77-79
C: 73-76
C-: 70-72
D+: 67-69
D: 60-66
F: < 60

Note: All final course grades will be posted to ConnectCarolina within 72 hrs of the final exam. At that point, all grades are final and cannot be changed except for instances of clerical errors. ***I cannot raise individual scores through extra credit or by any other means - it would not be fair to the rest of the class.***

Attendance Policy

Students are expected to attend all class meetings and participate in all lecture and studio sessions. In cases of **illness**, **UNC sanctioned absences, or other emergencies**, students may request their absence be excused by completeing the online Excused Absence Request (EAR) form which can be accessed in the General Course Resources folder. Students must also provide documentation or other evidence for each absence to the instructor

who determines whether or not to grant the request. Documentation may be submitted via the EAR form, or in person to the instructor. Excused absences will not count against a student's grade, but missing an excessive number of classes may result in an Incomplete or other alternative action.

Late Assignment Policy

No credit will be awarded for homework and warm-up assignments submitted after the due date; however, extensions on *MasteringPhysics* assignments may be granted at the discretion of the instructor.

Honor Code Policy

The Honor code and the Campus Code, embodying the ideals of academic honesty, integrity and responsible citizenship, have for over 100 years governed the performance of all academic work and student conduct at the University. Acceptance by a student of enrollment in the University presupposes a commitment to the principles embodied in these codes and a respect for this significant University tradition. Your participation in this course is with the expectation that your work will be completed in full observance of the Honor Code.

Academic dishonesty in any form is unacceptable, because any breach in academic integrity, however small, strikes destructively at the University's life and work. If you have any questions about the Honor Code, please consult with someone in the Office of the Student Attorney General or the Office of the Dean of Students.

Students are expected to abide by the Honor Code in all classroom activities. Collaboration is explicitly allowed on assignments that are designated as group submissions. Discussion with other students prior to submitting an individual answer is also permitted on personal response activities in lecture and on homework exercises, as described above. All other graded assignments (warm-ups and exams) must be submitted without any aid not explicitly authorized by the instructors.

Detailed Course Content List

Below is a verbose course schedule. A more succinct, printable version may be found here.

Unit 1 Estimations and Scaling (Modules 1-3)

- Introduction to the course: The physical nature of life
- Scaling
  - Orders of magnitude & scientific notation
  - Dimension
  - Estimation
  - Scaling laws

Unit 2 Kinematics, Dynamics and Momentum (Modules 4-10)

- Displacement, Velocity, and Acceleration
- Vectors
- Rates of change
- Forces and Newton’s laws
- Momentum

Unit 3 Stress and Strain (Module 11)

- Hooke’s law
- Stress and strain
- Material stiffness
- Young’s modulus

Unit 4 Torque (Modules 12-13)

- Equilibrium
- Torque and vectors
- Locomotion and torque

Unit 5 Energy I (Modules 14-17)

- Work and the energy of motion
- Gravitational potential energy
- Exchange of kinetic and potential energy

Unit 6 Oscillations (Modules 18-19)

- Simple harmonic motion: mass on a linear spring
- Other types of oscillatory systems
- Energy in harmonic motion
- Damped harmonic motion

Unit 7 Energy II (Modules 20)

- Potential Energy Curves

Unit 8 Thermodynamics and Diffusion (Modules 21-23)

- Energy contained in a material: temperature and thermal energy
- Ideal gases
- 2^{nd} law of thermodynamics
- Probability and entropy
- Entropy and statistics
- Diffusion: random motion