

Physics 15: The Nature of the Universe

Summer 2013

Course Syllabus



Instructor: Dr. Jack Singal (jsingal@stanford.edu)
Office: 216 Physics/Astrophysics building
Office hours: Tuesdays and Wednesdays, 1:30-2:30 PM

TAs: TBD
TBD

Lectures: Tuesdays and Thursdays, 10:00 to 11:50 AM, Room TBD

Discussion section: TBD

Textbook: "Discovering the Universe" by Comins & Kaufmann (recommended)
Course website: <http://coursework.stanford.edu/> (site Su13-PHYSICS-15-01)

About the course:

This course will focus on understanding the Universe through astronomy. Astronomy is one of the oldest and most fascinating areas of human inquiry. We are so fortunate to live in a time when we actually have answers to some of the most basic questions that have intrigued mankind for millennia when they looked up at the sky. In this course we will learn about those questions and answers, and also some of the questions that still need to be answered.

We'll start by learning the fundamentals of gazing at the sky, then about light and how we discover the cosmos. We'll discuss gravity, the laws of motion, and our solar system. Then the course will move on to stars, our galaxy, other galaxies, dark matter, dark energy, and the Universe as a whole. All throughout, we will explore special topics and the connections to other realms of inquiry.

Level: This is a college course. We will discuss the implications of this in the first lecture. The pedagogy relies primarily on the instructor's expertise as communicated in the lectures, rather than on the textbook, which is supplemental.

Conceptual and quantitative understanding: The homework problems will concentrate somewhat more on the quantitative aspects of the topics covered. However, the exams will test both conceptual and quantitative knowledge.

Math: This course will use math at the level of the SAT – algebra, trigonometry and so on. We will attempt to avoid having to memorize specific numbers or long formulas. The point is not to be able to regurgitate these things but rather to understand and use them.

Physics 15 Summer 2012 Requirements:

Attendance: Attendance at the lectures is mandatory. Attendance at the discussion sections is optional, and you may go to either discussion section in any given week, regardless of which one you are officially signed up for.

Class participation: Everyone gets more out of an experience if they are actually involved. In most lectures I will be presenting questions on the material for you to work out in groups, pairs, or alone. I will be calling on people to discuss their answers and their reasons. At this point it is more important to be engaged than to get the correct answer.

Homework: Homework is due at the beginning of lecture every Thursday. I will assign it the preceding Thursday. You are allowed to work together on homework, but everyone has to turn in their own. In addition, there will be one fun and easy stargazing assignment to look at the night sky and report what you see.

Exams: There will be one in-class midterm exam on 7/19/2012 during the normal class time and one two-hour final exam on 8/17/2012 starting at 8:30 AM. The exams will have both questions to test qualitative and conceptual understanding, and ones to test quantitative and mathematical understanding.

Observatory trip: We will be making one visit to the Stanford observatory, where we will use the telescope to look at astronomical objects. The first date is July 26 with August 2 as a backup in case of bad weather. You should keep both nights open.

Please don't be late to the lectures, and please put cell phones on vibrate.

Grading:

40% Final Exam
20% Midterm Exam
30% Homework
10% class participation

Physics 15 Summer 2012 Schedule:

Slides from the lectures will be posted to the class website after they are given

- 1 Class organization; Brief preview of the Universe; Astronomy as science
Tu 6/25/13

- 2 The sky - what we see and when; Phases of the moon, eclipses; Seasons
Th 6/27/13 Corresponding textbook section: Chapter 1

- 3 Gravitation and motion of the planets; Tides
Tu 7/2/13 Corresponding textbook section: Chapter 2

- 4 The key to astronomy: Light of all kinds
Th 7/4/13 Corresponding textbook section: Chapters 3.0-3.4 & 4
Homework set 1 due

- 5 The key to astronomy: Telescopes
Tu 7/9/13 Corresponding textbook section: Chapter 3.5-3.17

- 6 The solar system and the planets
Th 7/11/13 Corresponding textbook section: Chapters 6 thru 9
Homework set 2 due

- 7 Our sun and the stars; Exoplanets
Tu 7/16/13 Corresponding textbook section: Chapters 10 & 11

- 8 In-class Midterm Exam
Th 7/18/13 *Homework set 3 due*

- 9 The life cycle of stars; Different types of stars
Tu 7/23/13 Corresponding textbook section: Chapter 12

- 10 Supernovae, white dwarfs, neutron stars, and black holes
Th 7/25/13 Corresponding textbook section: Chapters 13 & 14.1-14.9
Homework set 4 due

- 11 Galaxies; Clusters
Tu 7/30/13 Corresponding textbook section: Chapters 15 & 16.1-16.10

- 12 Redshift and the expanding Universe
Th 8/1/13 Corresponding textbook section: Chapter 16.12-16.15
Homework set 5 due

- 13 Active Galaxies; Gamma Ray Bursts
Tu 8/6/13 Corresponding textbook section: Chapter 17, 14.10

- 14 Dark Matter and Dark Energy
Th 8/8/13 Corresponding textbook section: Chapter 16.11 & 18.13-18.15
Homework set 6 due

15	The early Universe
Tu 8/13/13	Corresponding textbook section: Chapter 18.1-18.12
16	Life in the Universe; Additional activities (time permitting)
Th 8/15/13	Corresponding textbook section: Chapter 19 <i>Homework set 7 due</i>
17	Final exam (two hours)
Sat 8/17/13	Starts at 8:30 AM

Some important characteristics of science:

- Seeks to explain aspects of nature and reality systematically
- Seeks *natural* descriptions of phenomena (and doesn't stop seeking)
- Aims for the correct descriptions, regardless of how it makes people feel
- Contains theories and laws which make definite predictions
- These predictions can be tested with experiments or observations
- If theories or ideas are shown to be wrong, they are modified to fit the data
- Takes contributions equally regardless of race, gender, religion, nationality, and so on