WHY ELECTRICITY AND MAGNETISM?

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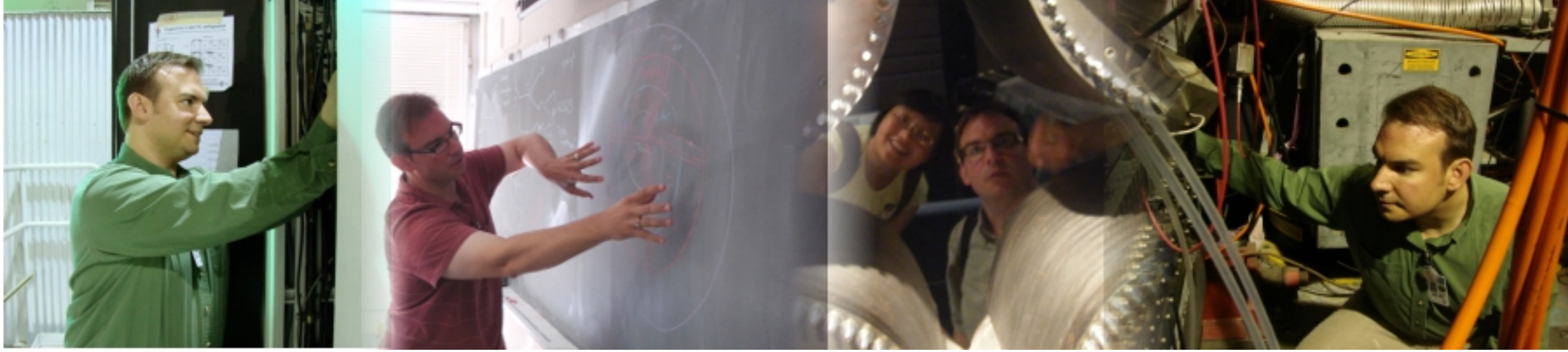
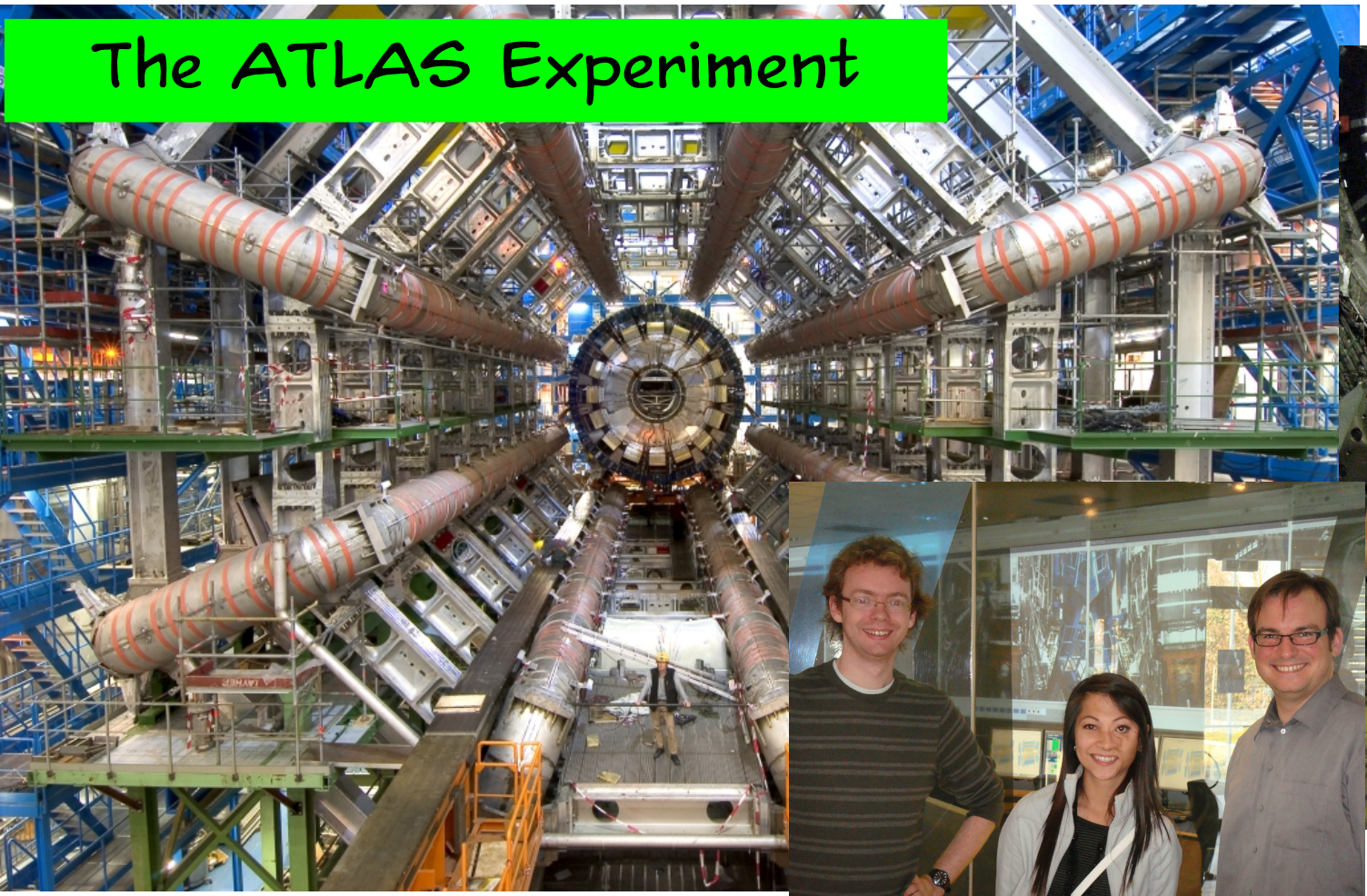
1/18/2011

Supplementary Material for PHY1308 (General Physics - Electricity and Magnetism)

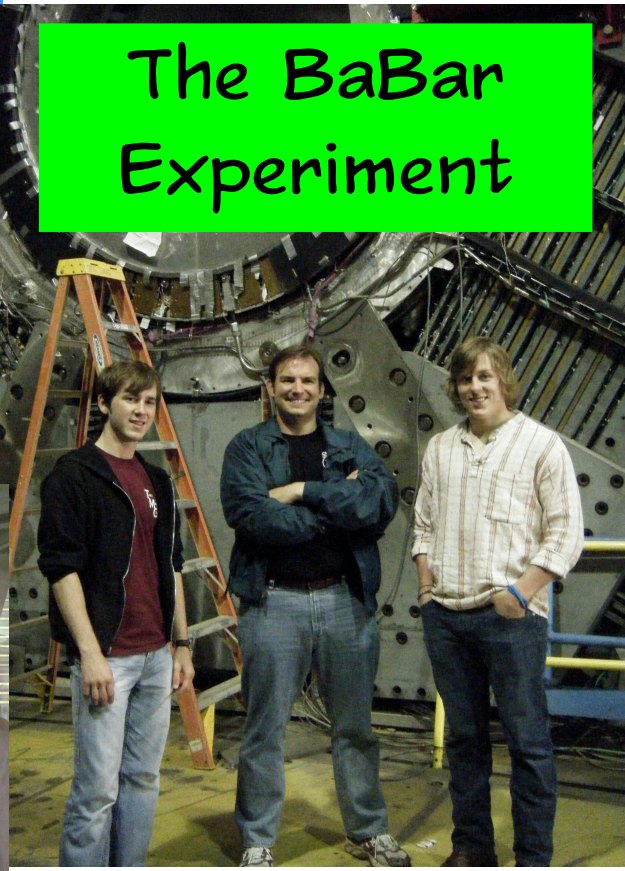
Who are you?



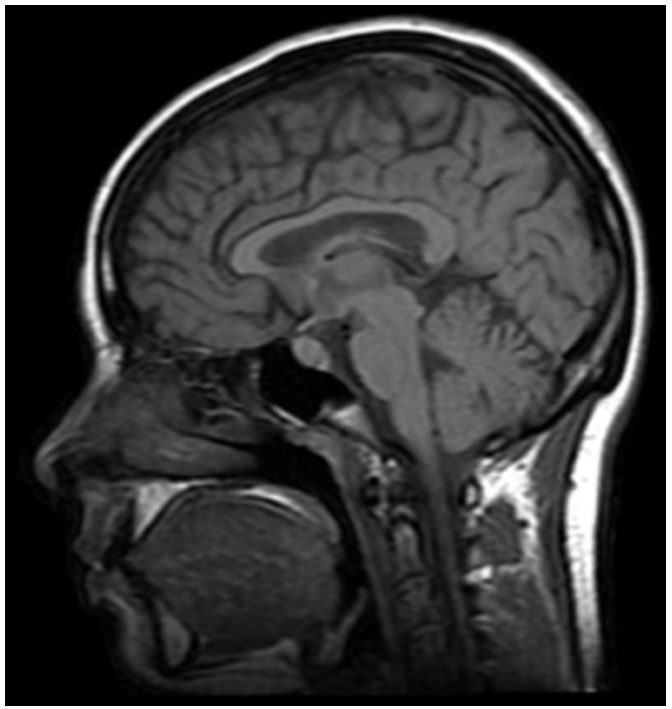
The ATLAS Experiment



The BaBar Experiment

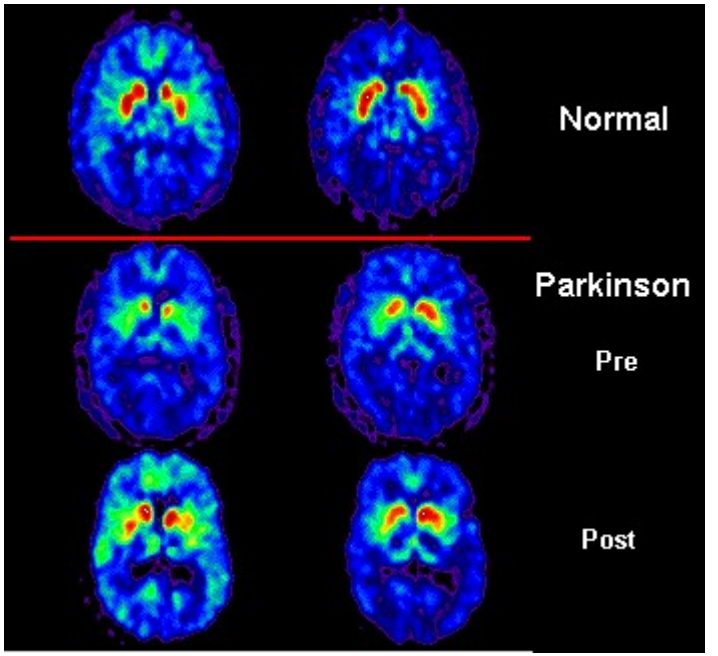


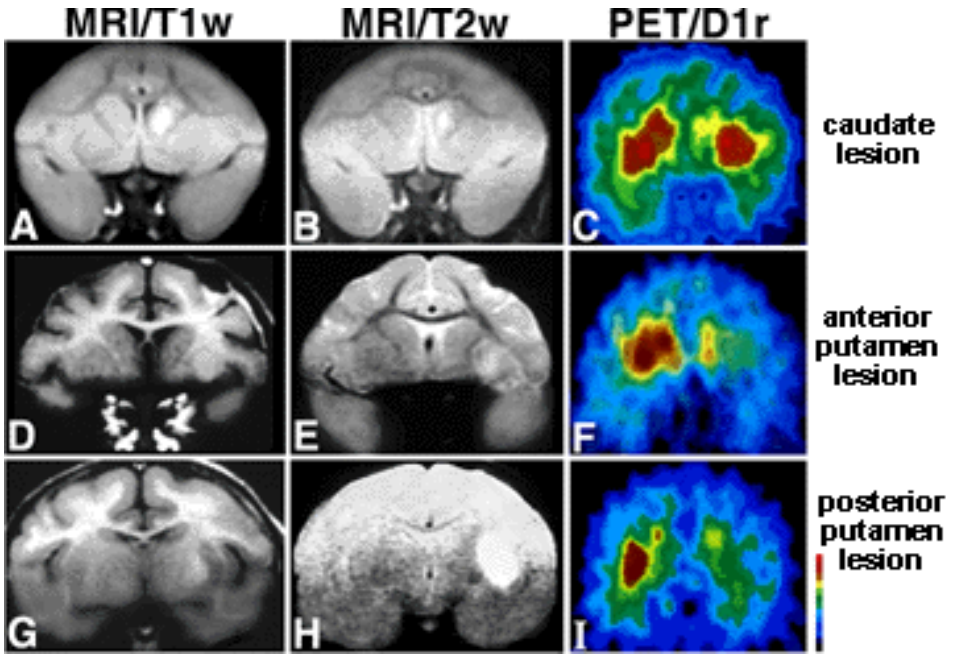
Why should I care about electricity and magnetism?



Magnetic Resonance Imaging (MRI)

PET Scans (Positron Emission Tomography)





Average MCAT Scores by Selected Majors, 2009.

	Physical Sciences	Biological Sciences	Verbal reasoning	Number of applicants
Biomedical Engineering	10.9	10.7	9.6	1,005
Physics	11.1	10.3	9.6	207
Electrical Engineering	10.9	10.5	9.4	195
Economics	10.4	10.5	9.7	566
Neuroscience	9.9	10.6	9.5	1,066
Mathematics	10.3	10.1	9.6	374
English	9.4	9.9	10.3	434
Biochemistry	9.9	10.3	9.1	2,594
Chemistry	9.8	9.9	9.0	2,091
Microbiology (or Bacteriology)	9.0	9.9	8.7	775
Psychology	8.8	9.4	9.1	2,421
Biology	8.7	9.5	8.7	12,705
Premedical	8.3	9.0	8.4	663
All Majors	9.2	9.8	9.0	41,487

While this data is for students and their majors, clearly an education in physics is a critical ingredient in success on the MCAT!

(similar data exists on the LSAT)

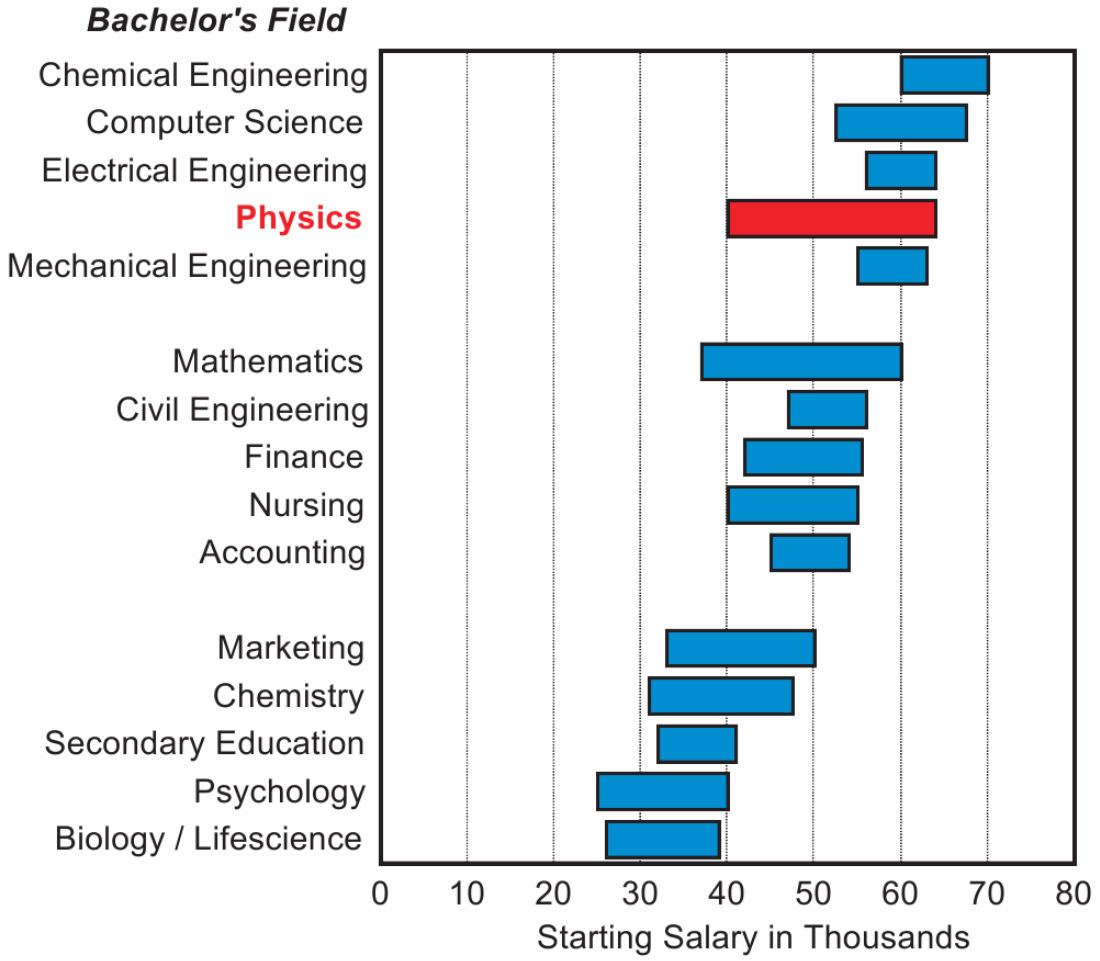
The Medical College Admissions Test (MCAT) has three sections of standardized multiple choice questions (total of 219 items) with an additional writing sample comprised of two essays. Scores of 9.5 to 11 in each section are considered competitive by most medical schools.

Source: Association of American Medical Colleges, Data Warehouse

http://www.aip.org/statistics

What's a Bachelor's Degree Worth?

Typical Salary Offers by Campus Recruiters, AY 2008-09

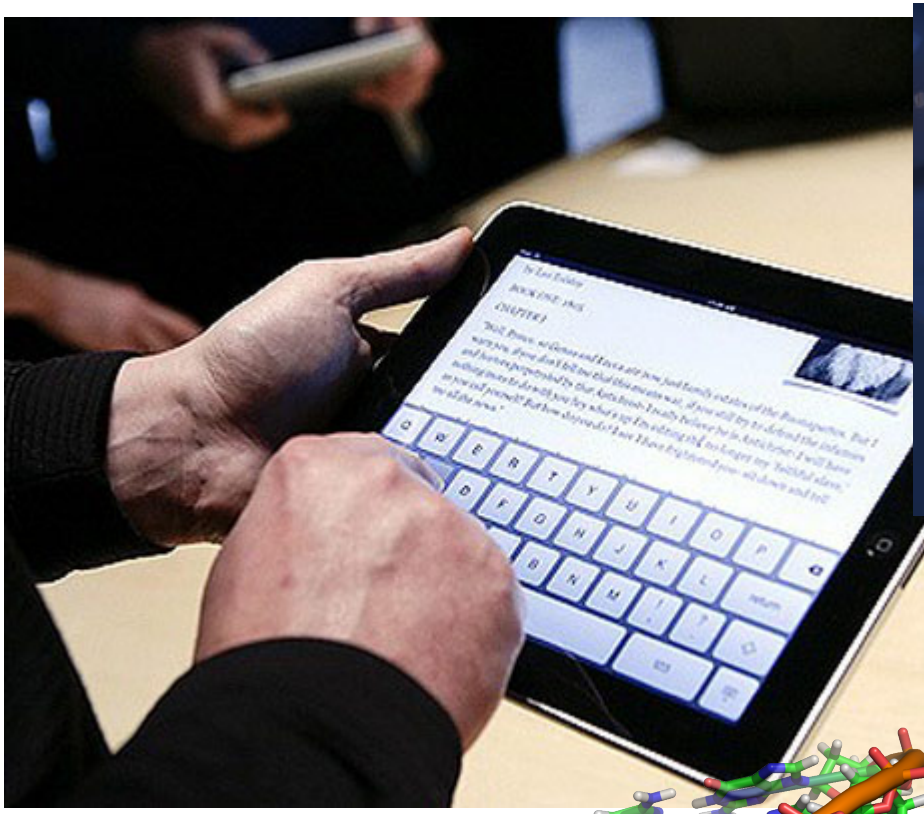


Typical salaries are the middle 50%, i.e.between the 25th and 75th percentiles.

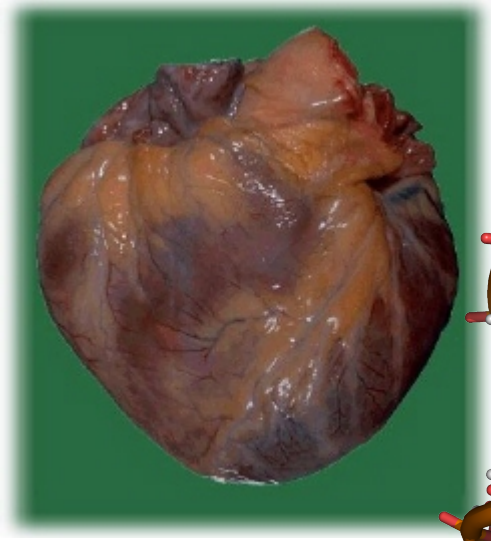
Reprinted from the Fall 2009 Salary Survey, with permission of the National Association of Colleges and Employers, copyright holder.

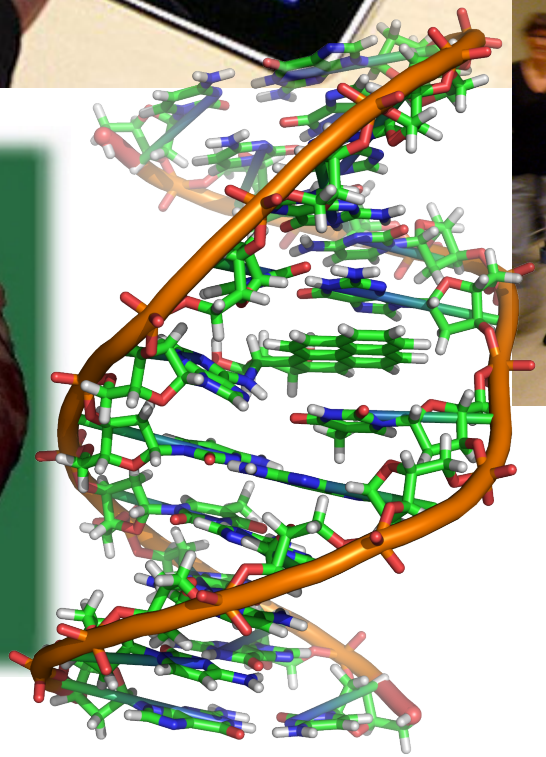
Fall 2009

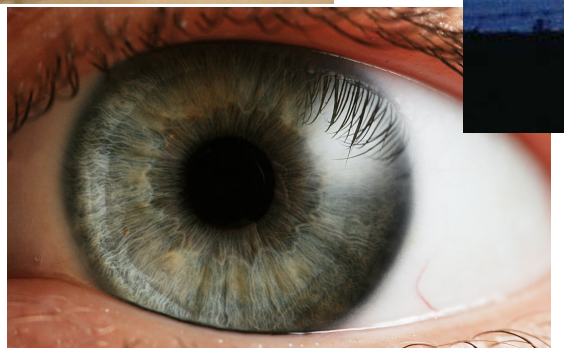
While this data is for students and their majors, the reason a physics major is valuable is because physics teaches you about problem solving in challenging environments, requiring innovative thinking.




Brooklyn Bridge-City Hall Station
Nassau St
Park Row
Church St
140
yards
0.25 M
1.30 min
10:11 am
10:12 am
31 mph
Broadway
tomtom







What are the goals (learning outcomes) of this course?

Upon successful completion of this course, students will be able to:

1. Explain the nature of electrical charge, force, potential, and fields and describe the behavior of electrical phenomena; explain the basic components of electrical circuitry, including conductors, batteries, resistors, and capacitors; explain the nature of magnetism and describe the behavior of magnetic phenomena; explain the nature of light and its connection to electricity and magnetism; explain the basic working of optical systems; explain how the study of electricity, magnetism, and light set the stage for a revolution in our understanding of the universe;

2. Apply their understanding of electricity, magnetism, light, and optics to areas other than physics, such as medicine, biology, chemistry, electronics, and everyday life.

3. Demonstrate the basic understanding of electricity, magnetism, light, and optics required to advance in the study of physics or topics which require a basic understanding of these phenomena.

What is the structure of this course?

STRUCTURE

- Lectures
  - Tue/Th; attendance is required (see syllabus for exceptions)
  - Expect "chalk talk", multimedia, demonstrations, and discussions
- Homework
  - about 1 per week - 10% of the grade
  - strict homework policy (see course website)
  - quality of homework policy applies to answers on quizzes and tests
- Quizzes
  - about 1 per week, in-class - 15% of the grade
  - two lowest quiz grades are automatically dropped
- Exams
  - 3 incremental in-class exams (see syllabus) worth 45% of the grade
  - Final exam (cumulative) - 30% of the grade

RESOURCES

- Me
  - Office hours: 2-4 on Monday and Wednesday
  - Additional discussions must be arranged in writing (e-mail)
- Teaching Assistant
  - We will setup 1 help session per week
- The Web
  - Course website: http://www.physics.smu.edu/sekula/phy1308
- Communication
  - I will make announcements over e-mail (please check at least once per week)
  - I'll push announcements out by Twitter and identi.ca and Facebook, as well as any useful factoids in the news about topics we are discussing.
    - find anything interesting or have a question? Tag it with #phy1308.

THE BIG PICTURE

- I encourage you to work together outside of class
  - cheating and plagiarism will NOT BE TOLERATED
  - Work handed in must be the unique product of your own effort, even if you collaborate with others
- Science has much in common with the humanities
  - there is a good story, and this class will aim to teach part of it
  - to seek a deeper understanding of the world around us and the larger cosmos, we will dig rigorously into many subjects
- Physics is exciting
  - physics is the study of energy, matter, space, and time
  - it is a quest, paid for with the blood of experimental labor and expressed in the language of mathematics, for the ultimate knowledge of the origin, composition, and fate of the universe.

REVIEW OF CORE PRINCIPLES

CORE PHYSICS PRINCIPLES 1

- Matter can execute motion
  - that motion can be described using place (coordinates: x, y, z ,etc.) and time (t), changes in place with respect to time (speed, v = Δx/Δt), and acceleration (changes in speed with respect to time)
- Forces alter the motion of matter
  - Newton's Laws
    - In the absense of forces, objects at rest tend to remain at rest, objects in motion tend to remain in motion ("inertia", or the tendency of matter to resist change)
    - Force alters motion, as ecapsulated by F=ma (or its more general form, F = Δp/Δt)
- Total Energy and momentum are always conserved

CORE PHYSIS PRINCIPLES 2

- Matter is made from atoms
  - all matter is composed of fundamental building blocks called "atoms"
- Atoms are composed of electrons, protons, and neutrons
  - electrons "orbit" a nucleus of protons and neutrons
- The macroscopic properties of matter are a result of the behavior of atoms

ALGEBRA

- You should already be able to . . .
  - express statements in symbolic form
    - example: "Write an equation that expresses the position of an object as proportional to time."
  - solve simple equations
    - 1st order equations: $2x - 1 = 3$
    - 2nd order (quadratic) equations: $3x^2-4x-1=5$

GEOMETRY/ TRIGONOMETRY

- You should already be able to . . .
  - know what a point, line, and plane are
  - know how to relate angles when lines bisect each other
  - explain the relationship between angles in a triangle
  - compute sines, cosines, and tangents

VECTORS

- You should already be able to . . .
  - know how to define a coordinate system
  - know that a "vector" is a way of expressing a direction in space using numbers along coodinate axes
  - know how to write a vector in either "unit vector" notation or in (x,y,z) notation
  - know how to add and multiply vectors

CALCULUS

- You should already be able to . . .
  - explain what a *derivative* is, and be able to calculate one.
  - explain what an *integral* is, and be able to calculate one.

RESOURCES

- Don't be afraid of math
  - if you haven't done this in a while, there are many ways to review
  - recommended by previous PHY1308 students:
    - Schaum's reference guides on calculus, trig, etc.
    - "Calculus for Dummies" or similar book - bad title, good solid and quick review
    - Tutoring at ALEC