

Physics 201F

Concepts of Physics

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Office hours: TBA (W3? W2?)

This course is intended for students who wish to learn about some of the remarkable discoveries of modern physics, the insights and surprises they offer into the nature of reality, determinism, space, and time, and the mysteries they have so far left unanswered. It assumes no scientific background and no mathematics, but it is expected that students will come to the class motivated to explore complicated concepts and discuss them critically. Evaluation will be based on a mix of exams and writing assignments.

WEB Page: [//www.physics.utoronto.ca/~aephraim/201](http://www.physics.utoronto.ca/~aephraim/201)

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Math is just a language

“Physics in translation”

I may slip into speaking math sometimes,
like poor Prof. Dupré.



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No math does not mean no work!

Math is a “substitute,” or shortcut, for logic.

It’s like following the Ikea cartoons instead of figuring out yourself how to make sure the bookcase doesn’t fall apart.

You have to make do without the cartoons.

READ -- THINK -- DISCUSS -- WRITE
(preferably in that order)

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Quick Test

- I claim: “All the blue-backed cards are Kings.”
- Which card(s) must you pick up to test this?



A



B



C



D

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Another puzzle

The drinking age is 19. Which of these 4 people must you check?



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What is Physics?

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Science is *not* (just) about memorizing facts and learning to follow rules

- Scientific method (applicable, I hope, to more than just science)
- A quest to *understand* the world we live in

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A pained analogy

- Literature helps us understand human behaviour
- But in itself it doesn't let us diagnose people (psychology / psychiatry)
- let alone control/manipulate them (preachers / politicians)

TECHNOLOGY \neq SCIENCE !!!

(and \$\$\$\$\$ \neq TECHNOLOGY, whatever the papers think)

Technology is like politics, to science's literature.

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Weighing evidence

There are different perspectives on scientific issues

Furthermore, all the good "popular" science books I found have a mix of accurate and less accurate descriptions, of incisive analogies and muddled speculation, et cetera.

Your job is to weigh different sources, discuss and share your information, and come to your own perspective and understanding.

Required text: Hobson's *PHYSICS: Concepts and Connections*, Pearson Education (2003).

In addition to the required textbook, you will be expected to do outside reading (there is a long list of recommended texts), and we will make extensive use of David Harrison's online notes (see for instance [Quantum Mechanics listings](#)), as well as of web-based sources I will provide sporadically. You will be left a fair degree of liberty (and responsibility) to seek out sources (online or otherwise) which help you develop a sufficient understanding of the material to contribute to discussions in class and tutorials and to demonstrate on exams and in essays your ability to synthesize and expand upon this information.

Our principal references are listed [at the bottom of this page](#), and I strongly encourage you to begin reading one of the popularizations in parallel with the text by Hobson.

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Grading

	Fraction of Grade
Homework (P/F)	10%
Short Essay (1-2 pages)	10%
Mid Term	20%
Term paper (c. 10 pages)	30%
Final Exam	30%

There will be 3 or 4 homework assignments over the course of the semester, intended as a guide to the material you should be learning and thinking about; they will be graded pass/fail, and you should see them as an opportunity to stay on top of the subject matter. The assignments are to be handed in at the tutorial sessions.

There will be a midterm and a final exam, including both short-answer and essay questions.

A large part of your grade will be based on writing.

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Turnitin.com

One of my responsibilities is to protect you from any classmates who may be tempted to submit work that is not their own.

Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism.

All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

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Syllabus

This course will be a dialogue, and the syllabus may evolve. I welcome comments, questions, and requests.

What is Science and What is Physics?

The scientific method, observation, and prediction
What is an explanation?
Energy: a discovery or an invention?
Popper, Kuhn, falsification, and paradigm shifts

The Riddle of Light

What is light?
• Action at a distance, fields & waves
• Electricity and magnetism

Bohr, Einstein, and those guys: The World of the Quantum (part 1)

What is reality?
Does God play dice with the universe?
Can we *know* whether he does?

More about Einstein: Relativity and the Spacetime Continuum

Is reality absolute, or is it in the eye of the beholder?
What is time? What is space?
What happens if you go faster than light?
If the universe is expanding, why is it still so hard to get a parking spot?

Time's Arrow

The "Second Law of Thermodynamics" and irreversibility
What distinguishes past from future?
Why is this so obvious to normal people but so confusing to physicists?

Quantum Weirdness (part 2)

Is the world really random?
Is there a limit to how much we can know about the world?
Is there "spooky action at a distance"?
Are there many parallel universes?
Does quantum mechanics have anything to do with consciousness?
Applications of quantum weirdness: quantum cryptography, quantum teleportation, quantum computers

Miscellaneous topics (to be chosen in consultation with the class)

Could include: Matter and antimatter
Elementary particles and string theory
Black holes
Can you tell whether you're looking at the real world or at a reflection in a mirror?

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Assignments

From time to time, I will post some additional assigned reading here.
For the first week of class, I recommend that in addition to starting on one of the books listed under "Readings," you glance over Tony Key's [one-page summary of Newton's Physics](#), and take a look at the first sections of his ["Magic of Physics" write-up](#).

Readings

Some excellent popularisations of modern physics (You are advised to choose your favorite from this first list of four, and begin reading it immediately):

Schrödinger's Kittens and the Search for Reality: Solving the Quantum Mysteries by John Gribbin
The Fabric of the Cosmos: Space, Time, and the Texture of Reality by Brian Greene
Quantum Reality Beyond the New Physics by Nick Herbert
How to Teach Physics to Your Dog by Chad Orzel

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Lecturer:

Aephraim M. Steinberg

(rm 1103, tel 978-0713, my last name at physics.utoronto.ca)

Office hours: TBA (tentative = W2 in MP 1103)

Teaching Assistants:

Ray Goerke
Dan Fine

Times and Venues

Lectures: Tu & Th 17-18 in MP137

Discussion sections: Tu & Th 18-19

There are two lecture hours per week plus one hour of discussion.
You are registered in either the Tuesday or the Thursday time slot for the discussion section.
Depending on your last name, you should go to one of the following rooms at your scheduled time:
A-Lee: MP125A (TA Dan Fine)
Lin-Z: MP125B (TA Ray Goerke)

FIRST TUTORIAL Tuesday 11 September 2012 --

.... any questions about course admin?

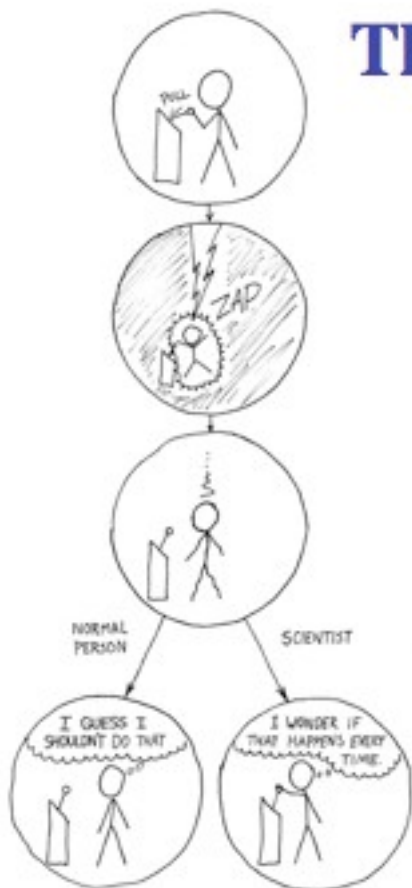
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The scientific method

QUESTION:

Has human activity contributed to a significant increase in global mean temperatures?

How do you know?



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Another question

Is there such a thing as action at a distance?



If you believe in
telekinesis
raise my hand



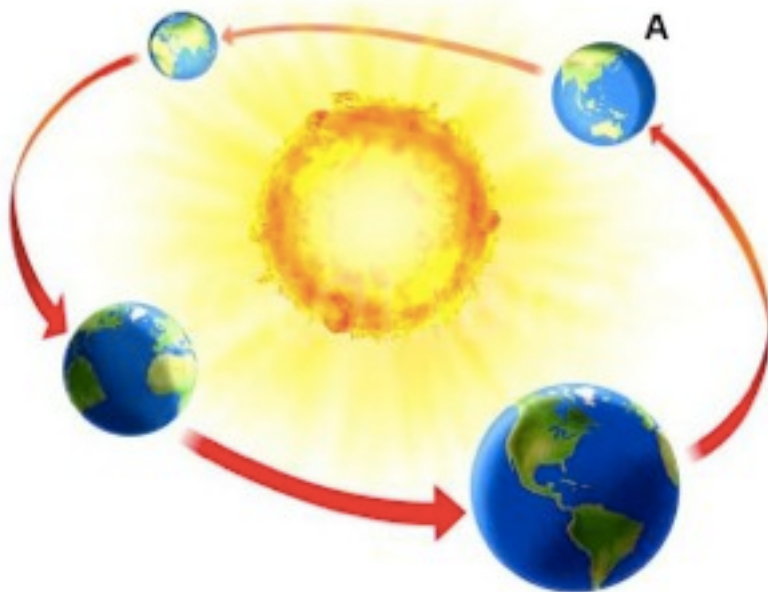
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What do you expect?

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What is an explanation?

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